VILNIUS GEDIMINAS TECHNICAL UNIVERSITY

FACULTY OF CIVIL ENGINEERING

DEPARTMENT OF CONSTRUCTION TECHNOLOGY AND MANAGEMENT

Student: Adrian, Anula López

Supervisor: Jonas Saparauskas

Language – English

Statybos planavimas automobilių prekybos centre, Dariaus ir Girėno g. 15 Vilniuje. Construction plannin of the car shopping center at Darius and Girėnas str. 15 in Vilnius.

FINAL THESIS WORK

VILNIUS, 2014

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VILNIUS GEDIMINAS
TECHNICAL UNIVERSITY

Head of Department:

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Student: Adrian, Anula López

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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: *Adrian ANULA LOPEZ*

The title of final thesis: *Construction planning of a garage building at Darius and Girėnas str. 15 in Vilnius.*

Approved: *2014-04-04 by Dean's order No 149st*

The term of completion of the Thesis: *10 of June 2014.*

THE TASK OF FINAL THESIS

Initial information: architectural drawings.

Workbook
Architectural 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, assembling of frame and piles' foundation. Perform calculations of construction masterplan, compile schedule of whole construction process.
Economical Part. Perform calculations of costs for all three technological cards.

Drawings
Architectural part - 1 item; Technological cards - 3 items; Construction masterplan - 1 item; Construction schedule - 2 item.

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

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

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(name and surname)

2014-04-04
(date)

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

VILNIUS GEDIMINAS TECHNICAL UNIVERSITY

Adrian Anula Lopez, 20140033

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

Faculty of Civil Engineering

(Faculty)

Construction Technologies and Management, STVino-12

(Study programme, academic group no.)

DECLARATION OF AUTHORSHIP IN THE FINAL DEGREE PAPER

June 9, 2014

I declare that my Final Degree Paper entitled „Construction planning of a garage building at Darius and Girėnas str. 15 in Vilnius" is entirely my own work. The title was confirmed on April 4, 2014 by Faculty Dean's order No. 149st. 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 Paper is Assoc Prof Dr Jonas Šaparauskas.

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

(Signature)

Adrian Anula Lopez

(Given name, family name)

Vilniaus Gedimino technikos universitetas
Statybos fakultetas
Statybos technologijos ir vadybos katedra

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Pirmosios pakopos studijų **Statybos technologijų ir valdymo** programos bakalauro baigiamasis darbas 3

Pavadinimas **Automobilių serviso pastato Dariaus ir Girėno g. 15, Vilniuje statybos projektavimas**

Autorius **Adrian Anula Lopez**
Vadovas **doc. dr. Jonas Šaparauskas**

Kalba: anglų

Anotacija

Šio baigiamojo darbo tema "Statybos planavimas automobilių prekybos centre, Dariaus ir Girėno g. 15 Vilniuje (Lietuva).

Baigiamąjį darbą sudaro trys dalys:

1. Architektūrinė dalis susideda iš trumpo aprašymo pagal projektavimą ir brėžinius pastato, kuris parodo pagrindinį fasadą, dviejų vertikalių sekcijų ir vieno horizantalaus skyriaus.

2. Technologinė dalis. jis susideda iš trijų skirtingų technologinių kortelių:

-Pamatų statybos

-Rėmų montavimo

-Trijų fasadų diafragminės sienos įrengimas

3.Organizacinė dalis, sudaryti grafikus visiems darbams, darbuotojams ir mašinoms.

Baigiamasis darbas susideda iš:

-Aiškinamosios dalies: 70 puslapiai

-Grafinės dalies: 6 A1 brėžiniai

Prasminiai žodžiai: automobilių prekybos centras, stiprinimas betonu, žmogaus saugos, kokybės kontrolė, planavimas, pavojinga zona, darbo jėga, plieno konstrukcijos, krūva

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Faculty of Civil Engineering
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Bachelor Degree Studies **Construction Technologies and Management** study programme Bachelor Graduation Thesis 3

Title	**Construction planning of a garage building at Darius and Girėnas str. 15 in Vilnius**
Author	**Adrian Anula Lopez**
Academic supervisor	**Assoc Prof Dr Jonas Šaparauskas**

Thesis language: English

Annotation

The subject of this final work is "Construction plannin of the car shopping center at Darius and Girėnas str. 15 in Vilnius (Lithuania).

This final work consist of three parts:

1. The architectural part consist of a short description of the building under design and drawings, which shows the main facade, two vertical sections and one horitzontal section.

2. Tecnological part. it consist of three different technological cards:

-Foundation construction

-Assambling of frame

-Curtain wall installation in three facades

3.Organization part, consist in schedules of all works, workers and machinery.

The final thesis consist of:

-The explanatory handwriting: 70 pages

-The graphical part: 6 A1 drawings

Keywords: car shopping centre, reinforcement concrete, human safety, quality control, scheduling, dangerous zone, workforce, steel structure, piles

1. ARCHITECTURAL PART

1.1 DESCRIPTIVE MEMORY

1.1.1 INTRODUCTION

This final thesis work consist on the construction of a car shopping center at Darius and Girėnas str. 15, in Vilnius. It will have two floors. The building has two different spaces, one of them is made up of the sales of cars, with showroom, waiting room and repair services and the other one is for the offices.

This project building will be done according to Spanish standards.

The two spaces are separated by the staircase. In this way, we are avoiding inappropiate noise to disturb the sale of cars.

Surfaces:

-Building area: 1446.19 m^2

-Plot: 4300 m^2

1.1.2 LOCATION

The future building is located in Darius and Girėnas str. 15, in the city of Vilnius (figure 1.1). (Lithuania). Aerial view (figure 1.2-1.3). This situation is far from the city center.

Figure 1.1. Aerial view of Lithuania

Figure 1.2. Aerial view of construction site

Figure 1.3. Aerial view of construction site

1.1.3 FIELD

Our building area is 1446.19 m^2 with increasing slope from west to east. The shape is an irregular polygon. In the north of the field is Žirnių street, as we can see in our location plan. This street will be the main entrance for all the machinery, and when the construction finishes, there will be access for private cars.

1.1.4 DISTRIBUTION OF THE FLOORS

First of all, we must highlight that the future building will have a really special appearance and will be very original.

The first floor (figure 1.4) is bigger than the second one. The first floor consists on a big car showroom with a complementary garage-auto repair shop through which cars enter, and an office to assist customers. There are two staircases which connect the different floors, one is in the showroom and the other one is in the garage.

At the second floor you will find the car showroom executive direction offices and a meeting room.

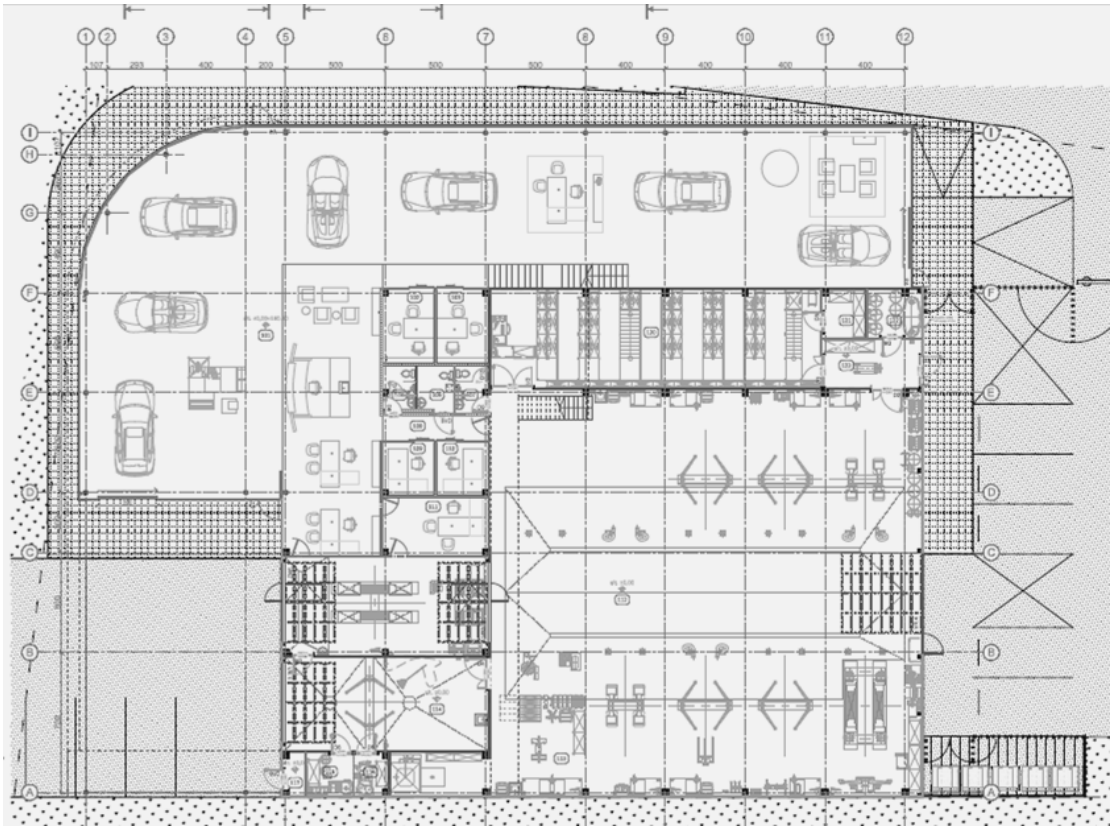


Figure 1.4. First floor section.

1.2. CONSTRUCTIVE MEMORY

1.2.1 FOUNDATION

After checking the quality of the land and considering it suitable for foundation (a mixture of plastic clay and loams), it should be considered to build deep foundation piles (figure 1.5) joined with bracing beams (figure 1.6), HA-25 reinforced concrete must also be used according to the EHE-08 normative.

The main features of concrete and iron are shown below:

Concrete type	HA-25
Characteristic resistance	f_{ck} =25 MPa
Coefficient deduction of concrete	γ_c = 1.5
Specific weight of reinforced concrete	γ_H = 2.5T/m^3= 24.5 KN/m^3
Coating	d´= 5cm
Type of iron in the armors	B500s
Characteristic resistance of iron	f_{ck} = 500 MPa

This kind of foundation is called surface foundation, because we reach a high depth.
The biggest width will be 50 cm.
The highest depth we are going to reach is 5m.
Iron will have different diameters, it should be B500s.
All the iron material in the foundations will be supported on plastic separators in order not to be in contact with the ground.

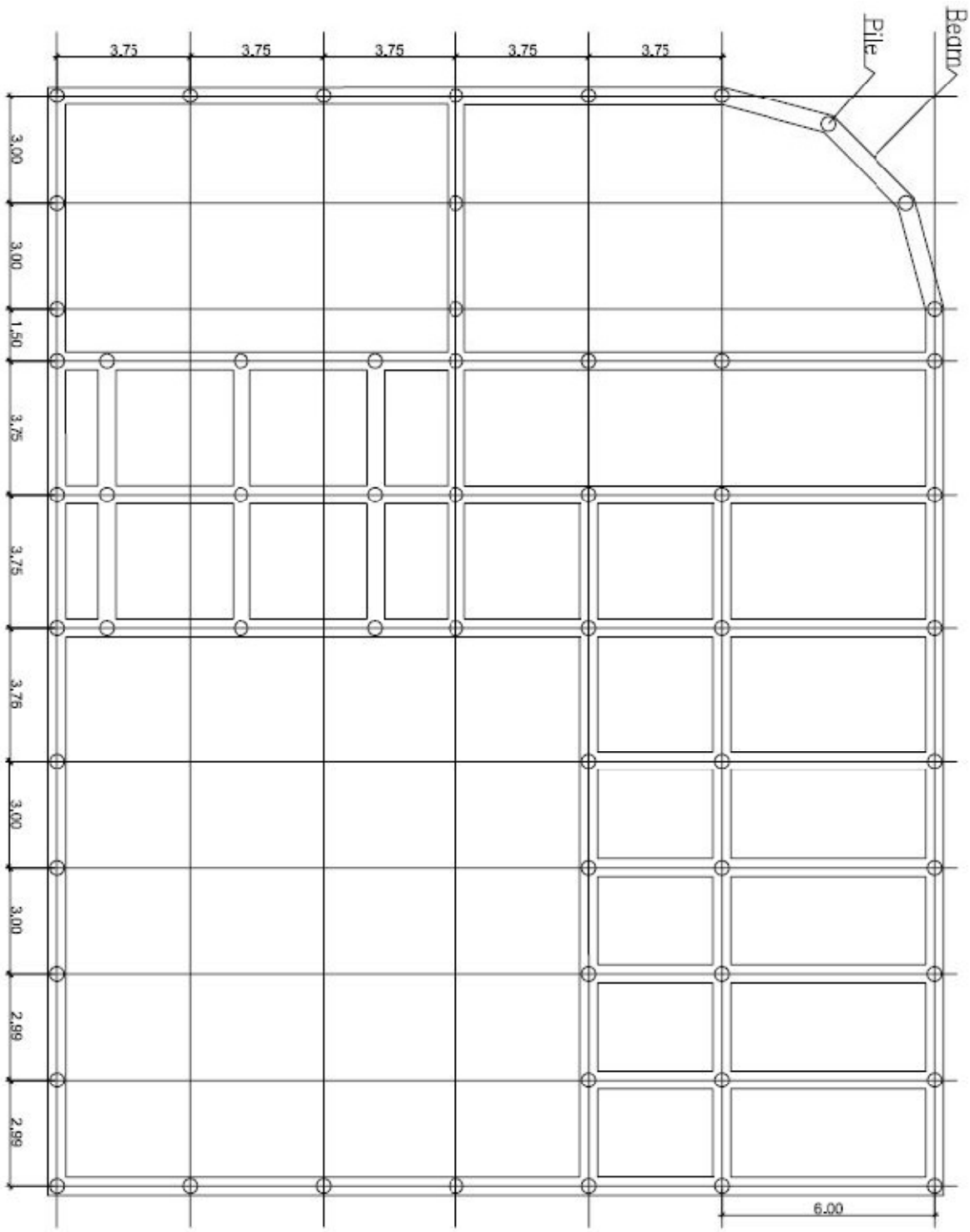


Figure 1.5. Footing foundation

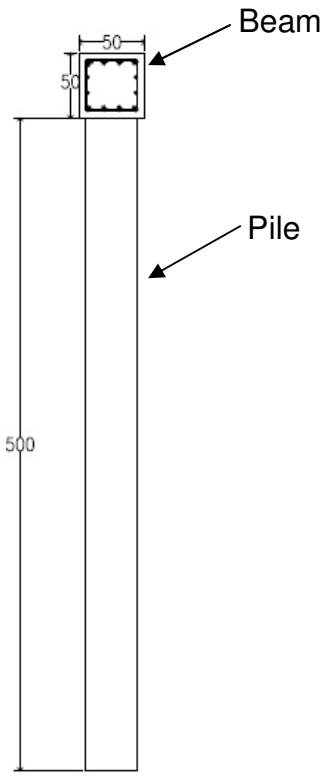


Figure 1.6. Brace beam and pile

1.2.2 COLUMNS

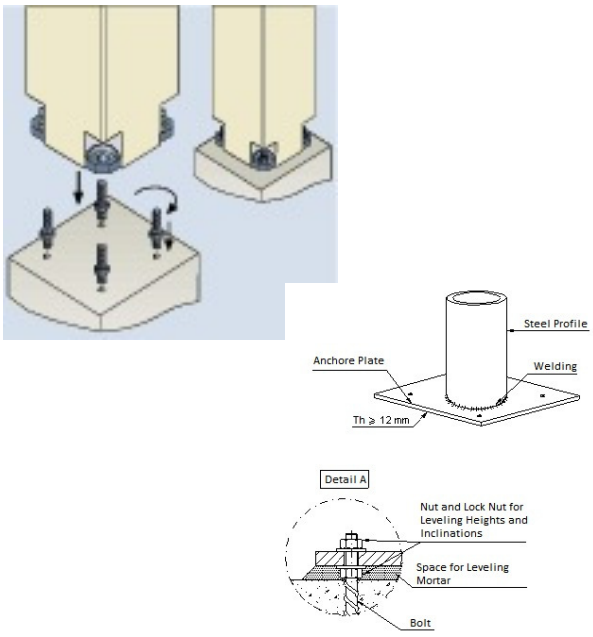
Monolithic columns of the round section are reinforced concrete on-site columns, and square cross-section columns are prefabricated concrete.

The concrete that we are going to use will be HA-25.

The iron for our columns will be B500SD.

The iron for connections with truss will be S275JR.

There will be columns of 30x30 cm of cross section for square columns, and 25 cm of diameter for round section columns (figure 1.7).



We can find square columns on the axes A, B, C, D, E and F which meet the axes 5, 6, 7, 8, 9, 10, 11 and 12 on the first and second floor.

We can find round columns on the axe 1 which meets the axes A, B, C, D, E and F. Axe I meets the axes 4, 5, 6, 7, 8, 9, 10, 11 and 12. Axe D meets the axes 1, 4, and 5. Axe H meets axe 3. Axe G meets axe 2. Axe A meets axe 4 on the first and second floor.

Figure 1.7. Square and round column example

1.2.3 WALLS

Interior walls are made of sandwich panel, gypsum and office partitions.

Exterior walls are made of sandwich panels with corrugated tin and tin cartridges finished with sandwich panel and curtain wall.

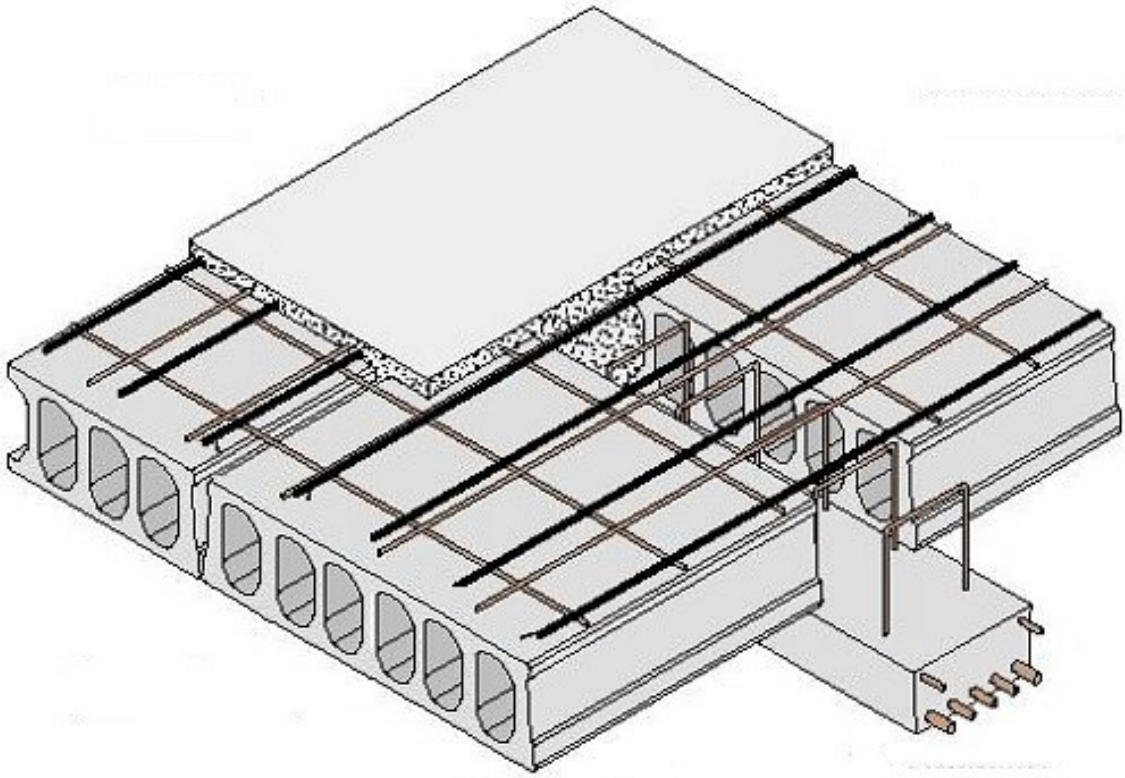
1.2.4 ROOF

The roof of the building has got an external rainwater drainage. We have a light roof structure (steel plates with thermal insulation). Roof flashings made of one-layer adhesive roller bituminous pavement. It has been used polystyrene foam as the main layer of rock wool insulation of the upper roof.

1.2.5 SLABS

Building slabs are prestressed prefabricated floor slab and prefabricated beams (figure 1.8), is a kind of one-way slab. Slabs will contain:

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



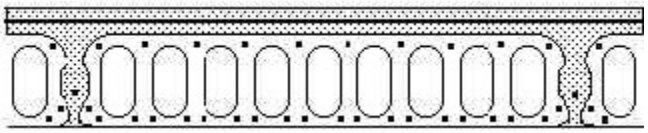


Figure 1.8. Floor slabs panels and beams

Floor finished:

-Tile: Automobile exhibition, washing-car and auto repair shops.
-Carpet: Showroom, management room and Direction.
-Concrete: Stock.

All the areas of the building (Table 1.1-1.2) are shown below:

Below is shown all the areas of the building

Table 1.1. First floor areas

Number	Name	Area m^2
101	Automobile exhibition	489.55
102	Showroom	9.64
103	Showroom	9.64
105	Adapted bathroom	4.16
106	Bathroom	3.73
107	Bathroom	3.87
108	Corridor	6.76
109	Showroom	7.04
110	Showroom	7.04
111	Workshop room	15.37
112	Workshop	499.01
113	Maintenance area	-
114	Washing-workshop	48.07
115	Maintenance	3.55
116	Technical room	4.32
117	Technical room	2.26
118	Workshop information	9.04
120	Stock parts	80.58
121	Stock guarantees	5.14
122	Stock cars oils and fluids	6.34
123	Stock	11.62
	Total	**1226.73**

Table 1.2. Second floor areas

Number	Name	Area m^2
201	Stock parts	24.08
202	Stock tires	23.92
203	Management room	10.05
204	Direction	10.05
205	Meeting room	43.10
206	Management room	10.84
207	Room	9.05
208	WC	1.45
209	WC	1.76
210	Kitchenette	10.51
211	Training room	13.38
212	Kitchenette	14.26
213	Gangway	7.07
214	Locker room	12.62
215	Toilet	2.53
216	Shower bath	2.56
217	WC	1.25
218	Technical room compressor	6.83
219	Technical space heating equipment	14.15
	Total	**219.46**

1.2.6 INTERNAL WALLS AND PARTITIONS

The internal walls will be modulated partitions: sandwich panel, gypsum and office partitions, depending on the rooms which it separates.

- Office partitions: Showroom, management room, direction and training room.
- Gypsum partitions: WC, bathroom and kitchenette.
- Sandwich panel fire resistant: Stocks and garage perimeter.
- Sandwich panel: Stocks partitions.

Wall decoration depends on the room and its function.

- Low Profile Sheets: Automobile exhibition part of garage's wall.
- Protective cement board: Garage.
- Wall tiles: Bathrooms.
- Plaster painted white: Kitchenette.
- Trim facade Cassettes: Inside of the trim facade panels.

1.2.7 STAIRS

The interior space stairs are designed by prefabricated concrete on metal beams.

1.2.8 FACADE

Facades will be made up with curtain wall and sandwich panel wall.

The surface of the facade corresponding to the sandwich panel is 717.40 m^2. This is located at the south facade and on the whole second floor of the building. That enhances the part on the first floor with curtain wall, making the customer focuses on the showroom. This system is obeying all requirements of safety, noise and thermal. The curtain wall and the sandwich panel combination makes the building looks modern.

1.2.9 INSTALATIONS

Design water and wastewater network STR 2.07.01:2003. Connecting sewer codes and branch joints elbows should not be steeper than 45º angle and it is installed with the minimum number of bends.

Domestic wastewater finds 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 too.

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.

Electric power

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.

1.2.10 FIRE SAFETY

The building will meet the criteria of all the requirements of CTE-SI (technical construction code-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 the criteria hygiene standards according to the CTE-HS (technical construction code-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 issues.

1.2.13 DISABILITY NEEDS

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

2. TECHNOLOGICAL CARDS

2.1 TECHNOLOGICAL CARD OF FOUNDATION

2.1.1 GENERAL DESCRIPTION

This technological card consists on the construction of deep foundation. The depth of piles is 5 m and the diameter is 40 cm. We are going to made reinforced concrete on-site piles.

I choose this type of execution because is cheaper and we can control the whole process.

2.1.2 DESCRIPTION OF TECNOLOGY AND SEQUENCE OF WORKS

The basics components of our foundation are:

-Concrete HA-25
-Iron armors B500s

CONSTRUCTION SEQUENCE (Figure 2.1):

1. Drilling (Figure 2.2).
2. Withdrawal and concreting.
3. Steel cage installation.
4. Headed pile.
5. Beam formwork.
6. Beam steel cage.
7. Beam concrete.

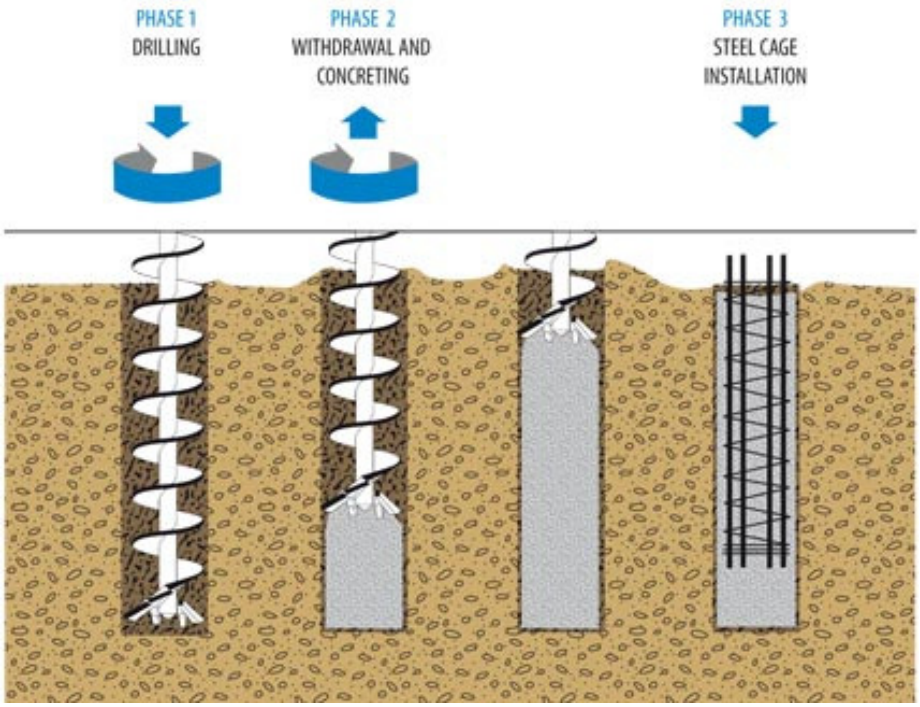


Figure 2.1. Piles construction sequence

Works order:

1. Piles staking (Figure 2.3)

Each pile has to be correctly positioned in plane or “line”. The drilling must also be plumbed. We will work from centre lines: the lines will be marked on the ground. We will have a main line of piles, and then any line parallel to this one at a knowning distance can be used.

2. Connecting piles with beams.

Each pile must be headed to release iron armor and so to connect the beams to the piles. After removing excess piles’ concrete armors must be unfolded for proper placement in beams.

3. Leave Columns starts.

When we connect piles’ steel cage with beams, we have to put also columns starting in their right position.

Figure 2.2. Pile drilling

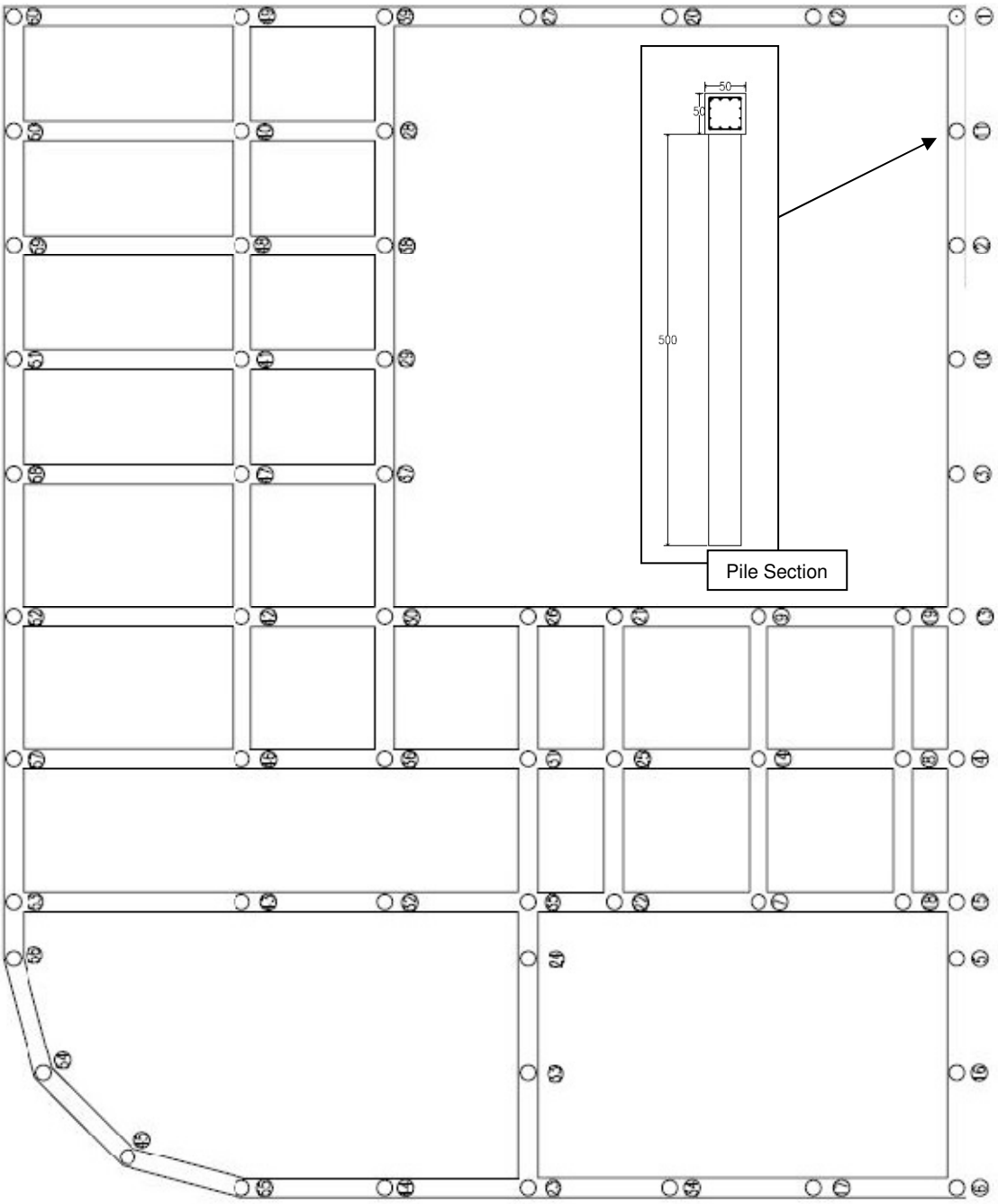


Figure 2.3. Piles staking

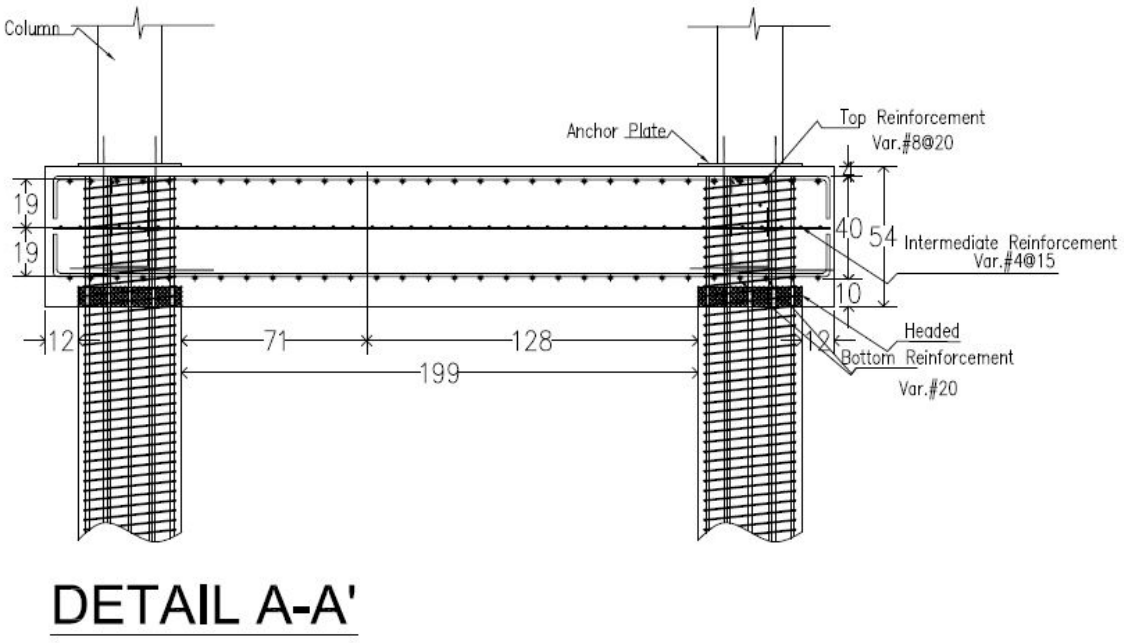


Figure 2.4. Pile Detail

2.1.3 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 and gloves)
3. Unnecessary collection of materials and debris from the workplace.
4. Should be grounded electrical equipment.
5. All electrical devices must be absolutely cleaned.
6. All cables must be in perfect condition.

2.1.4 MATERIAL-TECHNICAL RESOURCES

A table with the tools, mechanism and materials needed is shown below Table 2.1.

Table 2.1. Tools, mechanism and materials for build foundations.

Number	Name	Quantity
1	TOOLS	
1.1	Metal roulette 2PK	2
1.2	Levels Topcon AT-B4	1
1.3	Crowbar LM-24	3
1.4	Theodolite Prexiso T.O.2	1
1.5	Guying weight 13.3 Kg	3
1.6	Visor welding	2
1.7	Helmet	6
1.8	Security belts	3
1.9	Metal brushes	3
1.10	Chemical cleaning detail and found	3
2	MECHANISMS	
2.1	Electric welding machine for Tc-500 Q=1.2kW	1
2.2	Crane 130 EC-B6	1
2.3	Traverse TS-12, 5 weight 242 Kg	1
2.4	Compressor hammer	3
2.5	Continuous flight auger	1
2.4	Hook and versatile sling	4
3	Structures and materials bored piles installed	
	Construction	
3.1	Metal cage	60

2.1.5 QUALITY CONTROL

The piles are constructed according to the following ranges of tolerances:

a) The eccentricity of the axis of the pile relative to the set position, should be less than 10 cm, for piles with a diameter up to one meter (Ø ≤ 1.0 m) and tenth (1/10) of the diameter otherwise, but always less than 15 cm.
b) For vertical slope inclination error piles should not exceed two percent 2% of the value of the slope.

1. Soil behavior will be observed during drilling just checking that the conditions assumed are presented in the Geotechnical Report included in the Annual Report.
2. If obstacles during drilling are found, these will be removed by mechanical means. Explosives are not permitted within the bore. Is not allowed either the washing operation. Piercings will not be used, should be filled with concrete.

Concreting

1. After performing the drilling casing, it will be reviewed and approved by the Construction manager before pouring the concrete. The concreting of the piles, the utmost care will ensure that the pile remains in full length with your section completed without voids, air pockets or water, voids, cuts or bottlenecks. It will also seek to minimize washout by segregation of aggregates.
2. Concreted heads up higher than the theoretical 0.5 D Project in height (if below the water table 1.5 D), where D is the diameter of the pile, which was demolished later. The Contractor should receive no compensation for this excess concrete or his subsequent demolition.
3. If at the time of demolition it is observed that the headless was not enough to remove all faded and shoddy concrete, demolition will continue replacing the demolished concrete with new concrete well bonded to the previous. All such operations should be borne by the Contractor.
4. Concreting of a pile will be, in any case, without any interruption, so that between the introductions of two successive masses enough to pass the initiation of curing time. If for any breakdown or accident this requirement is not met, the Construction manager will decide whether the work completed and the pile can be considered valid or not. The pile that has been rejected for the reason stated should be filled, however, in all its length in the open ground without the Construction Company to receive any payment for it.
5. The filler portion after the rejected pile can run with lean concrete, but its implementation will be done with the same care as if it were a pile which would be subjected to charges.

Tolerance

1. The position of the piles, at the ground, after being built, must not differ from more than 10 cm as indicated on the Drawings. That is, the error will not be greater than 2% of the pile length indicated on the drawings.

Cleaning and background treatments

1. The excavation will proceed to the extraction of cuttings that have been stored in the bottom of the cavity. In piles of large a diameter, drying descent of an operator is suitable for checking such cleaning.

2. When they cannot guarantee the removal of detritus devices it should be provided to inject the pile tip, once completed, it possibly prior to pressure washing.

2.1.6 LABOR SAFETY

Risk	Chance	Consequences	Rated
- Falls of staff at the same level.	Medium	Slightly harmful	Tolerable
.			
- Falls of persons within the pile	Low	Extremely harmful	Important
- Stepping on objects	Low	High harmful	Tolerable
- Run over people	Low	Extremely harmful	Moderate
- Dump, shock and incorrect operation of excavation equipment	Medium	Extremely harmful	Important
- Cuts with sharp edges of the armor	Medium	Slightly harmful	Tolerable
- Interference with underground pipes.	Low	High harmful	Tolerable
- Distortion of normal traffic flows.	Medium	Slightly harmful	Tolerable
- Overexertion in awkward positions	Medium	High harmful	Moderate

PREVENTIVE MEASURES

During unloading and storage of materials and equipment:

- The material will be gathered in one place preset in advance.
- This location is conveniently signaled and facing the movement of vehicles on site.
- Collecting items to be arranged neatly and in groups.
- If the stored elements were able to move, as in the case of tubes, they will be propped in order to avoid undesired movement of materials.
- When these materials were stored points or sharp elements will be previously removed, such as planks.
- If the ground is soft, it will place rigid base materials to make the role of burden-sharing, and not sink into the ground.
- Own training and information measures relating to cargo handling, discussed in previous sections will be taken.
- Helmet, boots and gloves: the personal protective equipment provided should be used.
- When necessary to get on the truck, the worker will be properly secured with a seat belt.
- When working in proximity of a slope, you need conveniently signaled by appropriate markings, besides protecting the risk of falling through a resistive element; as railings, fences, etc.
- The material is discharged at the place storing default in the project work.
- Lifting equipment of adequate capacity should be used, with some over sizing on the load to be lifted.
- Suspended loads should be steered by ropes that will hold two separate operators led by the foreman.
- Guide loads with bare hands or body are prohibited. The horizontal transport or changing location using rollers made using only the necessary staff, who always push the load from one side, to avoid the risk of falling and blowing by rollers and used.
- It is prohibited to use the straps as handles cargo.
- A work surface up by solid railings and signage banners is to its dimension.
- Step of suspended loads over personnel will be avoided.
- Keep the area clean and tidy.
- Slings are used in good submit discarding broken wires or permanent deformation of consideration.
- The hook should be provided with safety latch.
- Nearby is signaled to avoid bumps and crashes with vehicles.
- The work area will be prepared to receive the trucks, patching and compacting the torches in rollover and entrapment avoidance.
- Notwithstanding the foregoing, the appropriate personal protective equipment will be used. Helmets, gloves, boots, overalls, etc, equipped with the appropriate certification.

During placement of armor:

- Armed reinforcement for vertical suspension for an introduction in the pile will be made by guide ropes attached to the free end. Never with bare hands.
- Similarly, the personal protective equipment for hands, feet and head should be used.
- Employees will be trained and informed in the proper handling of loads, as the diverse nature of the teams. When the dimensions of the load, or the weight of the same warrant, handling charges are held by personnel.
- Also, all entries made in relation to the handling and placement of reinforcement for working are taken into account.
- Special emphasis will be given in this chapter at the manipulation of metallic elements dominated by the length over width, such as tubes, steel bars, etc. So that they can contact overhead power lines.
- It is advisable to collect waste and scrap reinforcement, storing them in an appropriate place for further transporting to landfill.

During filling of piles:

- All nominations made to the tasks of "foundation" will be considered, with special attention and caring to all those scrupulous use of PPE required.
- Dug wells waiting to be concreted or armored shall be protected by guardrail with a safety distance from not less than 1.5 m.
- When a concrete pile cannot be ready before the end of the day, it will be placed on the wellhead a metal grille to prevent accidental falling into the well at night or during periods of rest.
- Whenever workers over 1.5m closer to the well, they should wear anti fall system anchored to a strong point.
- At all times, the work area should be kept with proper housekeeping.
- Operators responsible for managing and assisting the drilling equipment will be familiar with the following preventive rules:
    - Note that this machine is dangerous and can cause accidents. Be careful in handling. Adhere to these preventive measures and avoid the possibility of accidents.
    - Before starting work check the tires or chains. Warn of possible damage. A tire blowout in service could prove a serious accident.
    - Do not allow access to machine controls to unauthorized or untrained, because they can cause accidents or damage to other operators.
    - Check the condition of the bit. Consider that rupture can cause serious accidents.
    - Never operate this machine in situation of damage or semi breakdown. Have it repaired first and then resume work.

- After stoping the work and before putting the machine back in service, check that all pressure cuffs are right. A sleeve breakage can lead to accidents
- The engineer is the only person authorized to manage the machine on each shift. You will be trained and informed.
- When the machine is running, the driver will not be allowed to leave.
- The maneuvering area rig will be cleared of equipment and drilling outsiders.
- The driver and helpers on the coordination will be trained and informed of movements between them. Also, observe maneuvers loosening tool employing key supported on the mast.
- Personal hands protective equipment should be used be.
- Periodically, before starting the activity, a procedure must be established to monitor the status of the essential pieces that have to do with the safety of the drilling.
- Extraction of land and the load on the truck will not run simultaneously on the same pile. The burden of land from the excavation will take place where piles have already been concreted, thus avoiding interference between man and machine.
- All machines will have flashing light (flashing and rotating light) and audible (beeping horn and reverse).
- Workers involved in the pilot, waste land excavation or any other task in work areas where there is a presence of vehicles or mobile machinery, should wear high visibility clothing.

PROTECTION GROUP AND INDIVIDUAL.

Mesh tape and markings.
Certificated safety helmet.
Protective gloves (leather, latex, neoprene, etc).
Hearing protectors.
Safety boots with toe protection and security staff.
Safety boots with high rubber (with muddy terrain), with template and toe.

2.1.7 BUDGET

CPI080	m	Drilling and concreting pile for core tube auger.

Pilote reinforced concrete core drilling and concreting for drill pipe, diameter 40 cm, made of concrete HA-25 manufactured in Central and poured from a stationary pump truck, and steel

Decomposed	Ud	Decomposition	Yield	Unit Price	Price
mt07aco020m	Ud	Approved separator for piles.	3,000	0,09	0,27
mt07aco010c	kg	Corrugated steel B 500 S	5,600	1,00	5,60
mt10haf010naa	m³	Central concrete HA-25	0,200	82,88	16,58
mq03pii108a	h	Hidráulic digger wheels 84 CV	0,090	174,72	15,72
mq06bhe020	h	Stationary pump for pumping concrete.	0,055	55,91	3,08
mo041	h	Steel worker	0,619	18,10	11,20
mo084	h	Steel helper	0,619	16,94	10,49
	%	Auxiliary works	2,000	62,94	1,26
	%	Indirect costs	3,000	64,20	1,93
Ten-year maintenance cost: € 1.32 in the first 10 years.				Total:	66,13

TECHNICAL-ECONOMICS INDICATORS

1. Quantity of works: 5 m x 60 Piles = 300 m.
2. Installation cost: 66.13€/m x 300 = 19,839€ or 68,444.55 Litas.
3. Works duration: 5 Days.
4. Wage:
   Specialist Steel: 300 x 11.20€/m = 3360€ or 11,592 Litas.
   Continuous flight auger: 300 meter x 15.72€/m = 4,716€ or 16,270.20 Litas.

CPI200	m	Headed pile

Headed pile of concrete, 40 cm diameter, with compressor with jackhammer and mechanical load on truck or

Decomposed	Ud	Decomposition	Yield	Unit Price	Price
mq05pdm010c	h	Port.compre.diesel m.p. 2 m3/min 7 bar	0,266	12,23	3,25
mq05mai030	h	Jackhammer.	0,531	4,07	2,16
mq01exn010i	h	Hidráulic digger wheels 84 CV	0,006	45,59	0,27
mo104	h	Construction helper	0,644	16,25	10,47
	%	Auxiliary works	2,000	16,15	0,32
	%	Indirect costs	3,000	16,47	0,49
				Total:	16,96
				Total:	33,92

TECHNICAL-ECONOMICS INDICATORS

1. Quantity of works: 0.5 m x 60 Piles = 30 m.
2. Installation cost: 33.92€/m x 30 = 1,017.60€ or 3,510.72 Litas.
3. Works duration: 2 Days.

4. Wage:

Construction helper: 30 x 10.47€/m = 314.10€ or 1,083.65 Litas.

CAV020 **m²** **Beam formwork system**

Mounting of recoverable formwork wood beam foundation tied.

Decomposed	Ud	Decomposition	Yield	Unit Price	Price
mt08ema050	m³	Pine plank 2,50/4,00x205x55	0,020	255,00	5,10
mt08var050	kg	Wire 1,30 mm.	0,100	1,33	0,13
mt08var060	kg	Studs 20x100	0,050	7,00	0,35
mo041	h	Steel worker	0,374	18,10	6,77
mo084	h	Steel helper	0,374	16,94	6,34
	%	Auxiliary works	2,000	18,69	0,37
	%	Indirect costs	3,000	19,06	0,57
				Total:	19,63

TECHNICAL-ECONOMICS INDICATORS

1. Quantity of works: 288 m^2
2. Installation cost: 19.63€/m^2 x 288 = 5,653.44€ or 19,504.37 Litas.
3. Works duration: 8 Days.
4. Wage:

Steel worker: 288 x 6.77€/m^2 = 1,949.76€ or 6,726.67 Litas.

Steel helper: 288 x 6.34€/m^2 = 1,825.92€ or 6,299.42 Litas.

CAV010 **m³** **Concrete for beams**

Beam tied reinforced concrete on concrete HA-25 manufactured in Central and discharge from truck and steel.

Decomposed	Ud	Decomposition	Yield	Unit Price	Price
mt07aco020a	Ud	Approved separator for piles.	10,000	0,13	1,30
mt07aco010c	kg	Corrugated steel B 500 S	60,000	1,00	60,00
mt10haf010nea	m³	Central concrete HA-25	1,050	76,88	80,72
mo041	h	Steel worker	0,061	18,10	1,10
mo084	h	Steel helper	0,061	16,94	1,03
	%	Auxiliary works	2,000	144,15	2,88
	%	Indirect costs	3,000	147,03	4,41
Ten-year maintenance cost: € 1.32 in the first 10 years.				Total:	151,44

TECHNICAL-ECONOMICS INDICATORS

1. Quantity of works: 72 m^3
2. Installation cost: 151.44€/m^3 x 72 = 10,903.68€ or 37,617.70 Litas.
3. Works duration: 1 Days.
4. Wage:

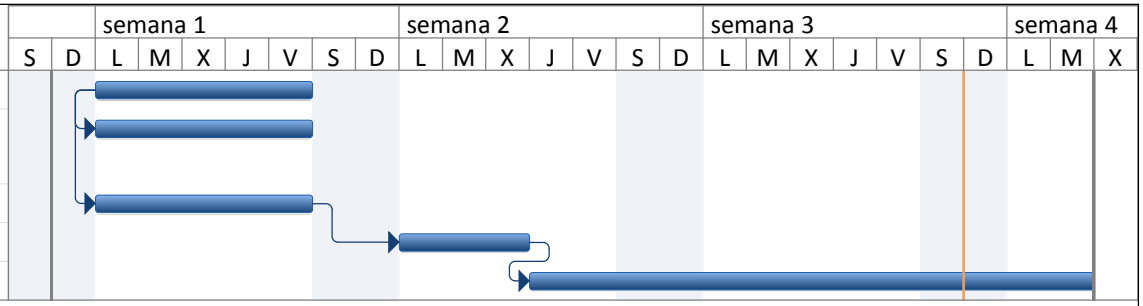
Steel worker: 72 x 1.10€/m^2 = 79.20€ or 273.24 Litas.

Steel helper: 72 x 1.03€/m^2 = 74.16€ or 255.85 Litas.

TOTAL

19,829+1,017.60+5,653.44+10,903.68 = 37,403.72€ or 129,042.83 Litas

Id	Modo de tarea	Nombre de tarea	Duración	Comienzo
1		DRILLING	5 días	lun 19/05/14
2		WITHDRAWAL AND CONCRETING	5 días	lun 19/05/14
3		STEEL CAGE	5 días	lun 19/05/14
4		HEADED PILE	3 días	lun 26/05/14
5		BEAM	9 días	jue 29/05/14



Proyecto: foundation
Fecha: dom 08/06/14

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

2.2 TECHNOLOGICAL CARD OF ASSEMBLING OF FRAME

2.2.1 GENERAL DESCRIPTION

This technological card consists in the construction of concrete frame, and steel frame and roof. The building length is 31.25 m and width is 25.25 m. We are going to use reinforced concrete columns 30x30cm for the columns and CHS ∅25 cm for metal columns with concrete filler, and inverted warren type truss for roof and metal sections type IPE 200 for beams.

The truss and metal beams are only a direction and upon it rests the roof.

The roof drains water only one side with a slope of 3%.

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

2.2.2 DESCRIPTION OF TECNOLOGY AND SEQUENCE OF WORKS

The basics components of our frame are:

-Prefabricated reinforced concrete columns 30X30 cm
-CHS 244.5x6 mm filled with concrete
-IPE 200
-UPN 100x50 mm
-L profile 60x40x5 mm

The truss (Figure 2.4)measured is 14.9, 13.4 and 11.2 m. Truss come already assembled and is composed of:

-RHS 100x100x5 mm
-RHS 80x80x5 mm
-RHS 60x60x5 mm

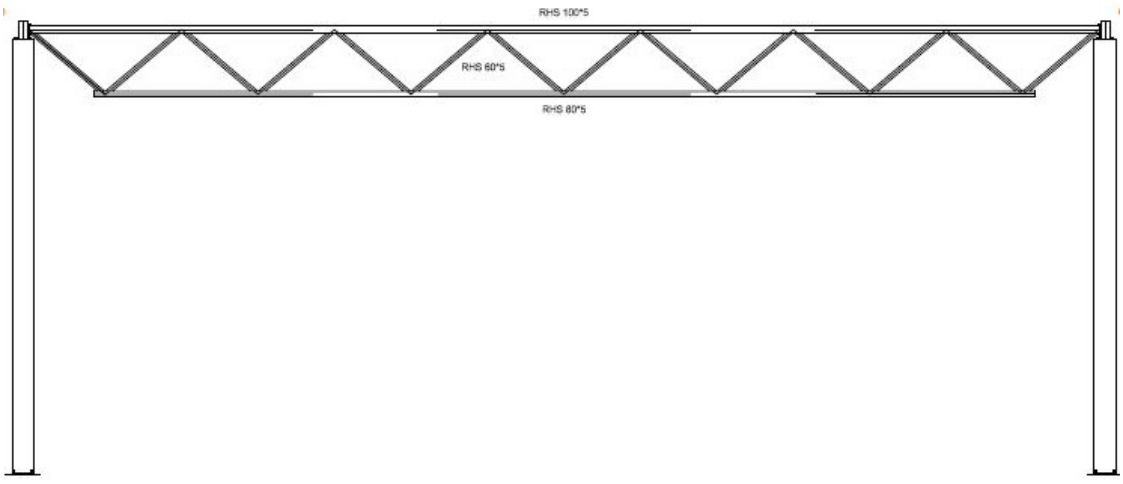


Figure 2.5. Truss

Roof will be mounted on works and is composed of:

- Profiled sheets with heat insulation
- Adhesive roller bituminous pavement
- Insulation polystyrene foam
- Rock wool insulation

CONSTRUCTION SEQUENCE:

1. Pillars staking.
2. Connect columns with foundations.
3. Connect columns with beam and trusses (Figure 2.5).
4. Raise trusses and beams that need assembling with crane.
5. Assembly work uploaded to a scaffold.
6. Connect the trusses with diagonal stabilizing.
7. Leave holes in the roof for skylights.
8. Put the different layers of the roof.

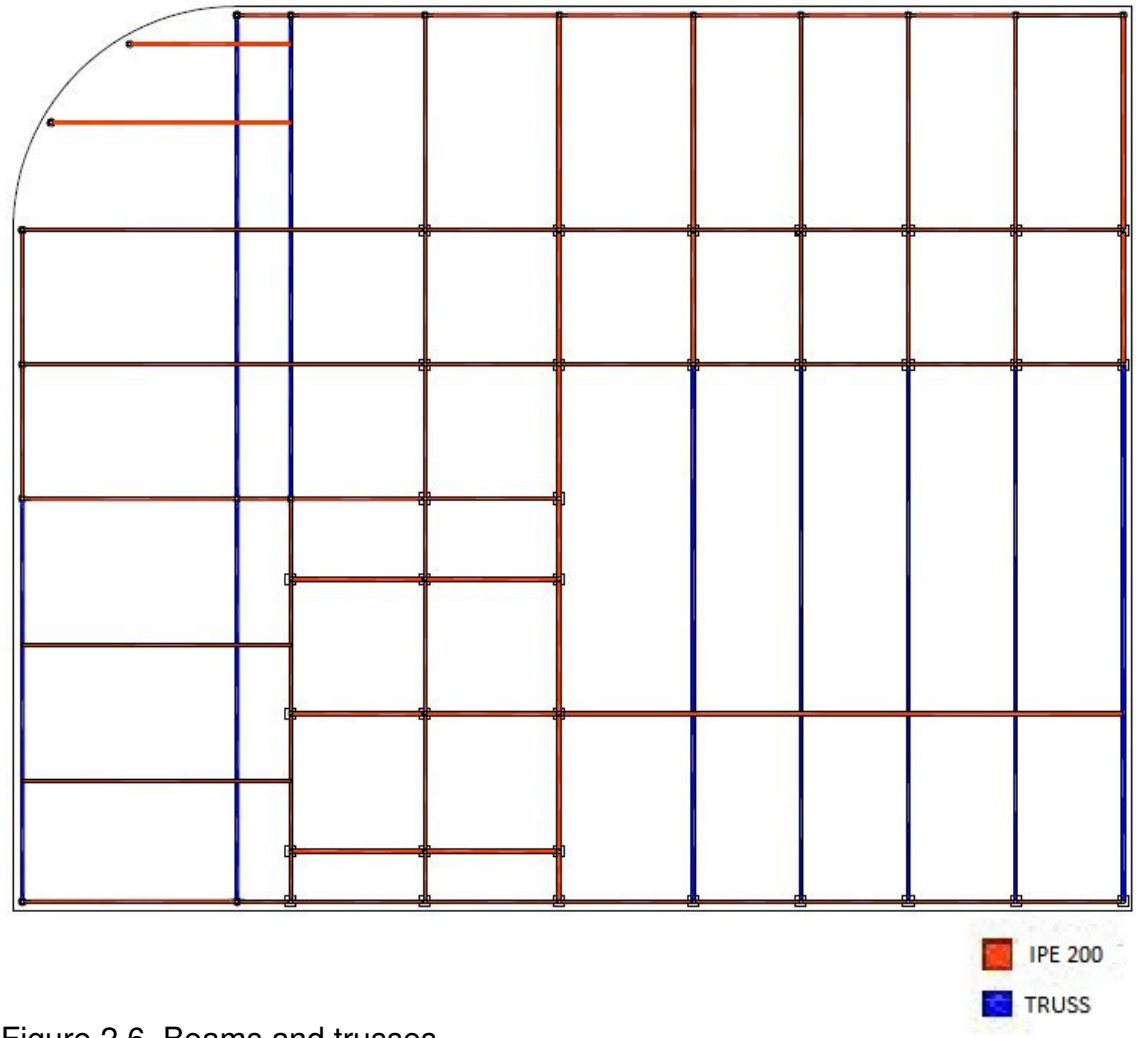


Figure 2.6. Beams and trusses.

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, to be erected will need guying if the holding-down bolt group is not sufficiently strong.

2. Connect columns with foundations

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 leveled before erection of columns.

- **Prefabricated reinforced concrete column**

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

- **Metal columns with concrete filler**

  Level nuts and washers lower. Take one benchmark. Put the motherboard and screw the upper nuts. Fill the joint with mortar Grout. Fill the column with concrete.

3. Connect columns with beam and trusses

Connect the beams and trusses threading screws and nuts. Raise trusses and beams that need assembling with the crane. Make assembly work uploaded to a scaffold.

4. Raise trusses and beams that need assembling with crane
5. Assembly work uploaded to a scaffold
6. Connect the trusses with diagonal stabilizing
7. Leave holes in the roof for skylights
8. Put the different layers of the roof

2.2.3 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 and gloves)
3. Unnecessary collection of materials and debris from the workplace.
4. Should be grounded electrical equipment.
5. Must be all electrical devices absolutely clean.
6. All cables must be in perfect condition.

2.2.4 MATERIAL-TECHNICAL RESOURCES

Below could be seen a table with the tools, mechanism and materials needed (Table 2.2).

(Table 2.2).Tools, mechanism and materials for assembling of frame.

Number	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	Electrodes 42A	2
1.5	Levels Topcon AT-B4	1
1.6	Crowbar LM-24	2
1.7	Building level 700mm	2
1.10	Theodolite Prexiso T.O.2	1
1.11	Guying weight 13.3 Kg	2
1.12	Visor welding	2
1.13	Helmet	12
1.14	Security belts	2
1.15	Metal brushes	2
1.16	Chemical cleaning detail and found	2
1.17	Chalk axes marked	2
1.18	Wrench	2
2	MECHANISMS	
2.1	Electric welding machine for Tc-500 Q=1.2kW	1
2.2	Crane 130 EC-B6	1
2.3	Traverse TS-12, 5 weight 242 Kg	1
2.4	Hook and versatile sling	4
3	Structures and materials bored piles installed	
	Construction	
3.1	Trusses	9
	Material	
3.2	Anchor bolts	362

2.2.5 QUALITY CONTROL

1. Control of material should be checked before and during installation each piece of 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, for 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 drawings. 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 summit 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. The construction manager has to confirm all inspections. 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 determining whether weld finishing beyond the contract terms is required.

12. Construction manager and EOR to monitor removal of false-work 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 member is within allowable tolerances.

2.2.6 LABOR SAFETY

Risk	Chance	Consequences	Rated
- Falls of staff at the same level.	Medium	Slightly harmful	Tolerable
.			
- Falls of persons at different levels	High	High harmful	Important
- Stepping on objects	Low	High harmful	Tolerable
- Run over people	Low	Extremely harmful	Moderate
- Dump, shock and incorrect operation of elevation equipment	Medium	Extremely harmful	Important
- Cuts with sharp edges of the metal profiles	Medium	Slightly harmful	Tolerable

PREVENTIVE MEASURES.

During unloading and storage of materials and equipment:

- The material will be gathered in one place preset in advance.
- This location is conveniently signaled and facing the movement of vehicles on site.
- Collecting items to be arranged neatly and in groups.
- If the stored elements were able to move, as in the case of tubes will be propped, to avoid undesired movement of materials.
- When these materials were stored points or sharp elements previously removed, such as planks.

- If the ground is soft, it will place rigid base materials to make the role of burden-sharing, and not sink into the ground.
- Own training and information measures relating to cargo handling, discussed in previous sections will be taken.
- Helmet, boots and gloves: the personal protective equipment provided shall be used.
- When will be necessary to get on the truck, the worker is properly secured with a seat belt.
- If working in proximity of a slope, you need conveniently signaled by appropriate markings, besides protecting the risk of falling through a resistive element; as railings, fences, etc.
- The material is discharged at the place storing default in the project work.
- Lifting equipment of adequate capacity shall be used, with some over sizing on the load to be lifted.
- Suspended loads shall be steered by ropes that will hold two separate operators led by the foreman.
- Are prohibited guide loads with bare hands or body. The horizontal transport or changing location using rollers made using only the necessary staff, who always push the load from the side, to avoid the risk of falls and blows by rollers and used.
- It is prohibited to use the straps as handles cargo.
- A work surface up by solid railings and signage banners is to dimension.
- Step of suspended loads over personnel be avoided.
- Keep the area clean and tidy.
- Slings are used in good submit discarding broken wires or permanent deformation of consideration.
- The hook shall be provided with safety latch.
- Nearby is signaled to avoid bumps and crashes with vehicles.
- The work area will be prepared to receive the trucks, patching and compacting the torches in rollover and entrapment avoidance.
- Notwithstanding the foregoing, the appropriate personal protective equipment will be used. Helmets, gloves, boots, overalls, etc, equipped with the appropriate certification.

<u>During placement of beams, trusses and columns:</u>

- Prefabricated columns for vertical suspension for an introduction in the anchor plate, will go by guide ropes attached to the free end. Never with bare hands.
- Similarly, the personal protective equipment of the hands, feet and head are used.
- Will form and inform employees in the proper handling of loads, as the diverse nature of the teams. When the dimensions of the load, or the weight of the same warrant, handling charges are held between personnel.
- Whenever workers, they should wear anti fall system anchored to a strong point.
-
- Also, all entries made in relation to the handling and placement of profiles and columns for work is taken into account.

- Special emphasis will be given in this chapter, in the manipulation of metallic elements, dominated by the length over width, such as tubes, steel bars, etc. So that they can contact overhead power lines.
- It is advisable to collect waste and scrap reinforcement, storing them in an appropriate place for further transport to landfill.

During filling of columns:

- All nominations made to the tasks of "structure" will be considered, with special attention and care to all those scrupulous use of PPE required.
- When a concrete column cannot be before the end of the day.
- Whenever workers, they should wear anti fall system anchored to a strong point.
- At all times, the work area shall be kept with proper housekeeping.

PROTECTION GROUP AND INDIVIDUAL.

Mesh tape and markings.
Certificated safety helmet.
Protective gloves (leather, latex, neoprene, etc).
Safety harness.
Safety glasses antiprojections
Safety boots with toe protection and security staff.
Safety boots with high rubber (with muddy terrain), with template and toe.

2.2.7 BUDGET

EAM020 m² **Truss**

Metal truss structure made of rolled S275JR steel, with a steel ratio of 2.81 kg / m²

Decomposed	Ud	Decomposition	Yield	Unit Price	Price
mt07ala010n	kg	Laminated steel A-42b	2,810	1,85	5,20
mt27pfi010	l	Quick Dry Primer, formulated with modified alkyd resins and zinc phosphate.	0,027	4,80	0,13
mo043	h	Steel worker	0,283	18,10	5,12
mo086	h	Steel helper	0,283	16,94	4,79
	%	Auxiliary works	2,000	15,24	0,30
	%	Indirect costs	3,000	15,54	0,47
Ten-year maintenance cost: € 0,54 in the first 10 years.				Total:	16,01

TECHNICAL-ECONOMICS INDICATORS

1. Quantity of works: 1,037.29 m^2
2. Installation cost: 16.01€/m^2 x 1,037.29 = 16,607.01€ or 57,294.19 Litas.
3. Works duration: 4 Days.
4. Wage:
   Steel worker: 1,037.29 x 5.12€/m^2 = 5,310.92€ or 18,322.69 Litas.
   Steel helper: 1,037.29 x 4.79€/m^2 = 4,968.62€ or 17,141.74 Litas.

EAV010 **kg** **Metal beams IPE 200**

S275JR steel beams with simple pieces of hot rolled sections of the IPE 200 with welded joints.

Decomposed	Ud	Decomposition	Yield	Unit Price	Price
mt07ala010h	kg	Laminated steel A-42b	1,050	0,99	1,04
mt27pfi010	l	Quick Dry Primer, formulated with modified alkyd resins and zinc phosphate.	0,050	4,80	0,24
mo043	h	Steel worker	0,020	18,10	0,36
mo086	h	Steel helper	0,020	16,94	0,34
	%	Auxiliary works	2,000	1,98	0,04
	%	Indirect costs	3,000	2,02	0,06
Ten-year maintenance cost: € 0,06 in the first 10 years.				Total:	2,08

TECHNICAL-ECONOMICS INDICATORS

1. Quantity of works: 6,842.53 Kg
2. Installation cost: 2.08€/KG x 6,842.53 = 14,232.46€ or 49,101.99Litas.
3. Works duration: 12 Days.
4. Wage:
   - Steel worker: 6,842.53 x 0.36€/m^2 = 2,463.31€ or 8,498.42 Litas.
   - Steel helper: 6,842.53 x 0.34€/m^2 = 2,326.46€ or 8,026.29Litas.

EPS010 **Ud** **Prefabricated reinforced concrete pillar.**

Pilar precast reinforced concrete section 30x30 cm, 5,5 m high, seen finishing concrete.

Decomposed	Ud	Decomposition	Yield	Unit Price	Price
mt07pha010bhg	Ud	Prefabricated reinforced concrete columns 30x30cm.h<6,00m	1,000	339,01	339,01
mo042	h	Construction worker	0,380	18,10	6,88
mo085	h	Construction helper	0,760	16,94	12,87
	%	Auxiliary works	2,000	358,76	7,18
	%	Indirect costs	3,000	365,94	10,98
Ten-year maintenance cost: € 28,24 in the first 10 years.				Total:	376,92

TECHNICAL-ECONOMICS INDICATORS

1. Quantity of works: 33 U
2. Installation cost: 376.92€/U x 33 = 12,438.36€ or 42,912.34 Litas.
3. Works duration: 2 Days.
4. Wage:
   - Construction worker: 33 x 6.88€/U = 227.04€ or 783.29 Litas.
   - Construction helper: 33 x 12.87€/U = 424.71€ or 1,465.25 Litas.

EAS006 **Ud Anchor plate with bolts screwed with washers, nut and locknut.**

Anchor Plate S275JR steel flat profile, 300x300 mm and thickness 12 mm, with 4 bolts corrugated steel 16 mm of diameter and 50 cm in length, bolted with washers, nut and locknut .

Decomposed	Ud	Decomposition	Yield	Unit Price	Price
mt07ala011d	kg	Steel plate 15 mm. For structural uses	8,478	1,34	11,36
mt07aco010c	kg	Corrugated steel B 400 S	3,155	1,00	3,16
mt07www040b	Ud	Set of washers, nut and lock nut for bolt 16 mm diameter.	4,000	1,32	5,28
mt09moa015	kg	Expansive mortar leveling, two component, cement-based enhanced with synthetic resins.	5,400	0,95	5,13
mt27pfi010	l	Quick Dry Primer, formulated with modified alkyd resins and zinc phosphate.	0,424	4,80	2,04
mo043	h	Steel worker	0,382	18,10	6,91
mo086	h	Steel helper	0,382	16,94	6,47
	%	Auxiliary works	2,000	40,35	0,81
	%	Indirect costs	3,000	41,16	1,23
Ten-year maintenance cost: € 1,27 in the first 10 years.				Total:	42,39

TECHNICAL-ECONOMICS INDICATORS

1. Quantity of works: 102 U
2. Installation cost: 42.39€/U x 102 = 4,323.78€ or 14,917.04Litas.
3. Works duration: 4 Days.
4. Wage:
   Steel worker: 102 x 6.91€/m^2 = 704.82€ or 2,431.63Litas.
   Steel helper: 102 x 6.47€/m^2 = 659.94€ or 2,276.79 Litas.

EAS010 **kg Round columns**

Perforated column Tub.S275JR RHS 250x6, HA-25

Decomposed	Ud	Decomposition	Yield	Unit Price	Price
mt07ala010h	kg	Laminated steel A-42b	1,050	0,99	1,04
mt27pfi010	l	Quick Dry Primer, formulated with modified alkyd resins and zinc phosphate.	0,050	4,80	0,24
mt10haf010naa	m^3	Central concrete HA-25	0,200	82,88	16,58
mo043	h	Steel worker	0,020	18,10	0,36
mo086	h	Steel helper	0,020	16,94	0,34
	%	Auxiliary works	2,000	18,56	0,37
	%	Indirect costs	3,000	18,93	0,57
Ten-year maintenance cost: € 0,06 in the first 10 years.				Total:	19,50

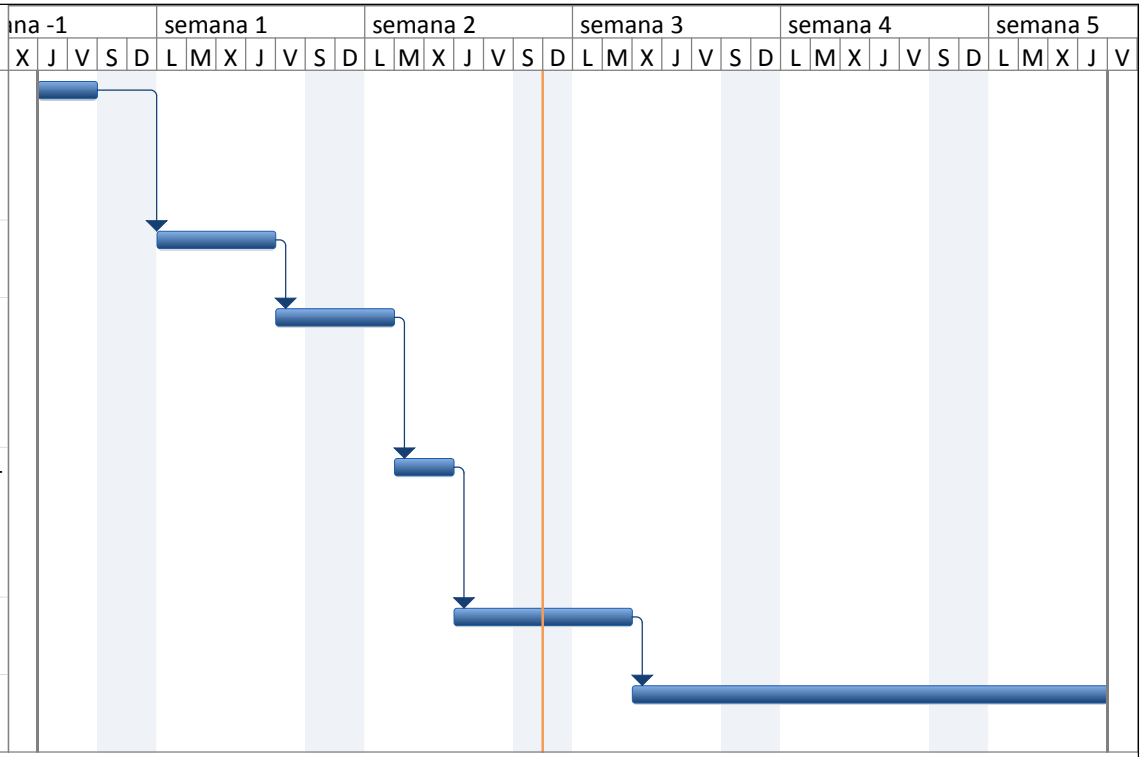
TECHNICAL-ECONOMICS INDICATORS

1. Quantity of works: 45Kgx18U = 810 Kg
2. Installation cost: 19.50€/Kg x 810 = 15795€ or 54,492.75 Litas.
3. Works duration: 4 Days.
4. Wage:
   Steel worker: 810 x 0.36€/m^2 = 291.60€ or 1,006.02 Litas.
   Steel helper: 810 x 0.34€/m^2 = 275.40€ or 950.13 Litas.

TOTAL

16,607.01+14,232.46+12,438.36+4,323.78+15,795= 63,396€ or 218,718.3 Litas

Id	Modo de tarea	Nombre de tarea	Duración	Comienzo
1		COLUMNS ANCHORAGE PLATE	2 días	jue 22/05/14
2		ROUND COLUMN	4 días	lun 26/05/14
3		PREFABRICATED REINFORCED COLUMNS	2 días	vie 30/05/14
4		ROOF ANCHORAGE PLATE	2 días	mar 03/06/14
5		TRUSSES	4 días	jue 05/06/14
6		STEEL BEAMS	12 días	mié 11/06/14



Proyecto: structure
Fecha: dom 08/06/14

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

2.3 TECHNOLOGICAL CARD OF CURTAIN WALL

2.3.1 GENERAL DESCRIPTION

In this technological card we will focus on analyzing the installation of the curtain wall. The surface of the facade corresponding to the curtain wall is 254.02 m^2. This is the North and west facades. This system is meeting all the criteria requirements of safety, noise and thermal. There are more modern solutions. The curtain wall makes the building looks sophisticated and modern. And it is a perfect combination with the other types of facades.

2.3.2 DESCRIPTION OF TECNOLOGY AND SEQUENCE OF WORKS

Curtain wall is a highly developed type of façade over the last years in Lithuania because it protects the facade in reformation cases.

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 frozen and unfrozen periods.

The brand of our curtain wall supplier will be “TECHNAL”.

This curtain wall consists in an auxiliary frame where put glass modules (Figure 2.6).

The dimensions of our curtain wall modules are principally two: 1000x2400x14 and 1100x2500x14 mm.

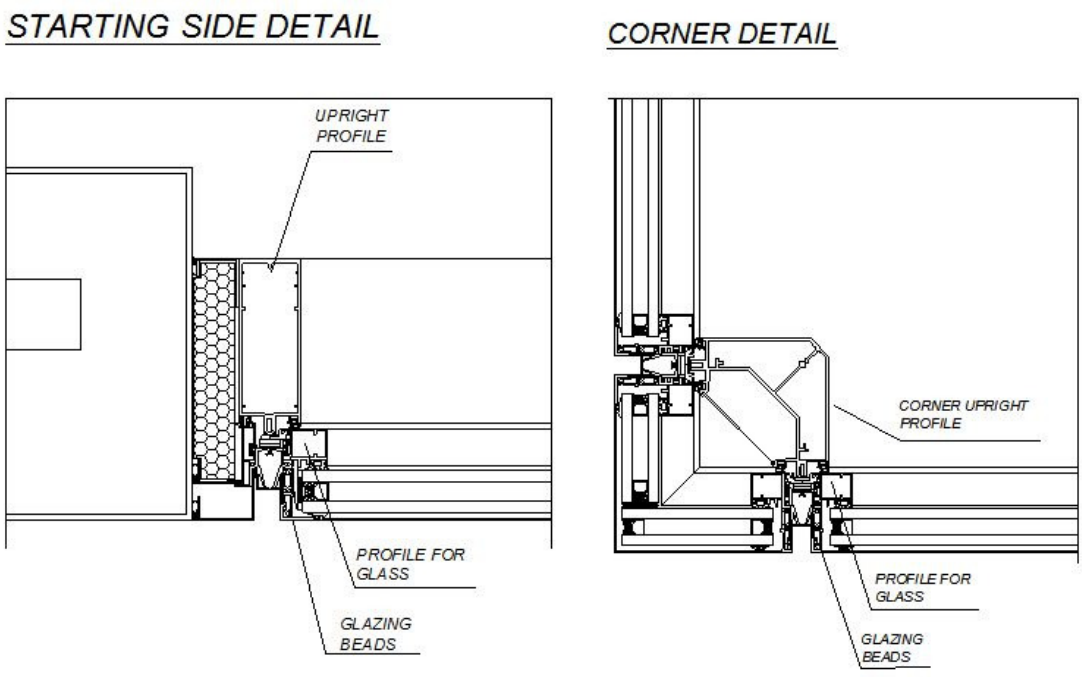


Figure 2.7. Curtain wall details

CONSTRUCTION SEQUENCE:

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

Works order:

1. Transportation, storage and handling

We have to check the materials: auxiliary frame and modules, and leave them where we have planned.

2. Anchorage and connection provision

Before using the concrete on the first floor we have to do a study of the connection of the auxiliary frame with the main frame.

3. Connections' stakeout

Before using the concrete on the first floor we have to mark where the connectors and the correct place of auxiliary frame will be placed.

4. Installation arrangement

Before starting with the installation we have to check and put the stanchions order to see if everything is right and ready to get the curtain wall just as we had planned.

5. Placement of the stanchions with the help of a crane

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

6. Glazing of the auxiliary structure with the help of the crane

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.

2.3.3 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 and gloves)
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.

2.3.4 MATERIAL-TECHNICAL RESOURCES

Below could be seen a table with the tools, mechanism and materials needed (Table 2.3).

Table 2.3.Tools, mechanism and materials for assembling of curtain wall

Number	Name	Quantity
1	TOOLS	
1.1	Metal roulette 2PK	2
1.5	Levels Topcon AT-B4	1
1.10	Theodolite Prexiso T.O.2	1
1.11	Guying weight 13.3 Kg	2
1.12	Visor welding	2
1.13	Helmet	6
1.14	Security belts	4
1.15	Metal brushes	4
1.16	Chemical cleaning detail and found	4
2	MECHANISMS	
2.2	Crane 130 EC-B6	1
2.3	Traverse TS-12, 5 weight 242 Kg	1
2.4	Hook and versatile sling	4

2.3.5 QUALITY CONTROL

1. Design Data

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 going to be located.

2. Factory Test Reports

Test reports: provide certified test reports, for each of following listed test, 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 test:

1) Deflection and structural test.
2) Water penetration test.
3) Air infiltration test.
4) Delaminating test.
5) Thermal conductance test.
6) Sound transmission.
7) Submit factory 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 may be submitted in lieu of listed testing.

3. Manufacturer's Certificates:

Submit Certificates of Compliance, with specification requirements for:

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:

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

INSTALLATION

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

2. 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. Any mistake or discrepancy should be discovered in location of marks, stop erection work in that area until discrepancies have been solved.

3. Ensure that drainage system operates rightly.

4. Do not proceed with structural silicone work when temperature is below 0ºC degrees.

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

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

7. Install an entire system so that fasteners are not visible.

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

9. Door:
    1) Install door in accordance with details indicated and approve shop drawing details.
    2) Seal exterior metal joints among members of doors, frames, mullions and mullion covers in accordance. Remove excess of sealant.
    3) After installing and glazing the doors, adjust the ventilators and hardware for operating smoothly and to be weather-tight when ventilators are closed and locked. Lubricate the hardware and moving parts.
    4) Install to make weather-tight contact with frames when ventilators are closed and locked. Do not cause binding of sash or prevent ventilator closing and locking.
    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.

10. Joint Sealants:
    - Surfaces to be primed and sealed should be clean, dried when touching, 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 should conform to approve detail drawings with a tolerance of plus 3 mm. do not apply compound unless ambient temperature is between 5 and 35 ºC degrees. Clean out loose particles and mortar just before sealing. Remove protective coatings or covering from surfaces in contact with sealants before applying sealants or tapes. Solvents used to remove coatings should be typed as those which leaves no residue on metals.
    - Match approved sample. Force compound into grooves with pressure enough 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 drying. Do not trim edges of sealing material after joints are tooled. Mix only amounts of multi-component sealant which can be installed within four hours, but at no time shall this amount exceeds 19 liters.
    - 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.
    - 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.
    - 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.

- 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 cleaning neat condition.

11. Glass
    - Install in accordance with manufacturer's recommendations as modified herein.
    - 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.
    - 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.
    - 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 surfaces 19 mm in height. Glazing rebate surfaces must be sloped to shed water.
    - 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.

2.3.6 LABOR SAFETY

Risk	Chance	Consequences	Rated
- Falls of staff at the same level.	Medium	Slightly harmful	Tolerable
- Falls of persons at different levels	High	Extremely harmful	Important
- Stepping on objects	Low	Slightly harmful	Tolerable
- Run over people	Low	Extremely harmful	Moderate
- Dump, shock and incorrect operation of elevation equipment	Medium	Extremely harmful	Important
- Cuts with sharp edges of the structure	Medium	Slightly harmful	Tolerable
- Entrapments	Low	High harmful	Moderate

PREVENTIVE MEASURES.

During unloading and storage of materials and equipment:

- The material will be gathered in one place preset in advance.
- This location is conveniently signaled and facing the movement of vehicles on site.
- Collecting items to be arranged neatly and in groups.
- If the stored elements were able to move, as in the case of tubes, they will be propped to avoid undesired movement of materials.
- When these materials were stored points or sharp elements previously removed, such as planks.
- If the ground is soft, it will place rigid base materials to make the role of burden-sharing, and not sink into the ground.
- Own training and information measures relating to cargo handling, discussed in previous sections will be taken.
- Helmet, boots and gloves: the personal protective equipment provided should be used.

- When getting on the truck is necessary, the worker is properly secured with a seat belt.
- If staff is working in proximity of a slope, they will need conveniently signaled by appropriate markings, besides protecting the risk of falling through a resistive element; as railings, fences, etc.
- The material is discharged at the place storing default in the project work.
- Lifting equipment of adequate capacity should be used, with some over sizing on the load to be lifted.
- Suspended loads shall be steered by ropes that will hold two separate operators led by the foreman.
- Guide loads with bare hands or body are prohibited. The horizontal transport or changing location using rollers made using only the necessary staff, who always push the load from the side in order to avoid the risk of falls and blows by rollers and use.
- Using the straps as handles cargo is prohibited.
- A work surface made up by solid railings and signage banners to its dimension.
- Step of suspended loads over personnel should be avoided.
- Keep the area clean and tidy.
- Slings are used in good submit discarding broken wires or permanent deformation of consideration.
- The hook shall be provided with safety latch.
- Nearby is signaled in order to avoid bumps and crashes with vehicles.
- The work area will be prepared to receive the trucks, patching and compacting the torches in rollover and entrapment avoidance.
- Notwithstanding the foregoing, the appropriate personal protective equipment will be used. Helmets, gloves, boots, overalls, etc, equipped with the appropriate certification.

<u>During wall system erection:</u>

- Wall system for vertical suspension for his right placement will go by guide ropes attached to the free end, never with bare hands.
- Similarly, the personal protective equipment of the hands, feet and head must be used.
- Employees will be formed and informed in the proper handling of loads, as the diverse nature of the teams. When the dimensions of the load, or the weight of the same warrant, handling charges are held by personnel.
- Also, all entries made in relation to the handling and placement of reinforcement for working is taken into account.
- Special emphasis will be given in this chapter, in the manipulation of metallic elements, dominated by the length over width, such as tubes, steel bars, etc. So this way they can contact overhead power lines.
- It is advisable to collect waste and scrap wall system, storing them in an appropriate place for further transport to landfill.

PROTECTION GROUP AND INDIVIDUAL.

Mesh tape and markings.
Certificated safety helmet.
Protective gloves (leather, latex, neoprene, etc).
Safety harness.
Safety glasses antiprojections
Safety boots with toe protection and security staff.
Safety boots with high rubber (with muddy terrain), with template and toe.

2.3.7 BUDGET

FMY030 **m² Curtain wall "TECHNAL" system.**

Aluminum curtain wall system performed using the structural glass (VEE) with thermal break of "Technal" with supporting structure calculated for maximum overload due to the wind of 60 kg / m², composed of a grid with a spacing stakeout 110 cm and a wheelbase of the floor or anchor points 250 cm; enclosure consisting of a 10% opaque surface and 90% fixed surface transparent tempered double glazed solar control + security (laminar), 6/6/3 +3.

Decomposed	Ud	Decomposition	Yield	Unit Price	Price
mt25mct010oac	m	Aluminium stanchions, "TECHNAL", 240x52 mm (Ix= 1698,80 cm4),matte silver anodized finish, with EWAA-EURAS seal that guarantees the thickness and quality of the anodizing process, whether the central seal.	0,667	54,05	36,05
mt25mct020hac	m	Aluminium crossbar, "TECHNAL", 120x52 mm (Iy= 38,37 cm4), matte silver anodized finish, with EWAA-EURAS seal that guarantees the thickness and quality of the anodizing process, whether the central seal.	1,200	35,54	42,65
mt25mct045ac	m	Profile aluminum frame for structural bonding of glass with silicone, with structural sealant "Technal" system.	2,933	5,96	17,48
mt25mct100b	Ud	Impact, m², accessories for curtain walls "Technal" system, and locking clamp and finials to work.	1,000	16,50	16,50
mt21veg055yaa	m²	Double tempered glazed solar control + security (laminar), assembly formed by outer tempered glass, solar control, 6mm blue, dehydrated air chamber separating aluminum and double perimeter sealing of 6 mm, and inner glass colorless laminar 3 +3 mm thick composed of two panes of glass sheet 3 mm, connected by a colorless polyvinyl butyral sheet.	0,905	124,60	112,76
mt25mco045a	m²	Panel sheet aluminum, 9mm total thickness, white lacquered finish, consisting of aluminum foil and 0.7 mm extruded polystyrene insulating core (density 35 kg / m³).	0,101	21,73	2,19
mt21vtt020b	m²	Tempered glass colored, gray, 10mm thick, even w / w mounting hardware.	0,101	47,69	4,82
mt21sik020a	Ud	Cartridge synthetic colorless silicone 310 ml (approximate performance seals 2m per cartridge).	1,485	2,67	3,96
mt21sik020b	Ud	Cartridge synthetic color silicone 310 ml (approximate performance seals 2m per cartridge).	0,165	2,67	0,44
mt21sik030	Ud	Impact per m² of structural sealant silicone-based bicomponent.	0,945	21,00	19,85
mt21vva021	Ud	Auxiliary material for placing glasses.	1,000	1,26	1,26
mo017	h	Construction worker	0,707	17,52	12,39
mo054	h	construction helper	1,111	16,19	17,99
mo045	h	Locksmith worker	1,414	17,82	25,20
mo088	h	Locksmith helper	2,019	16,13	32,57
	%	Auxiliary works	2,000	346,11	6,92
	%	Indirect costs	3,000	353,03	10,59
Ten-year maintenance cost: € 65,45 in the first 10 years.				Total:	363,62

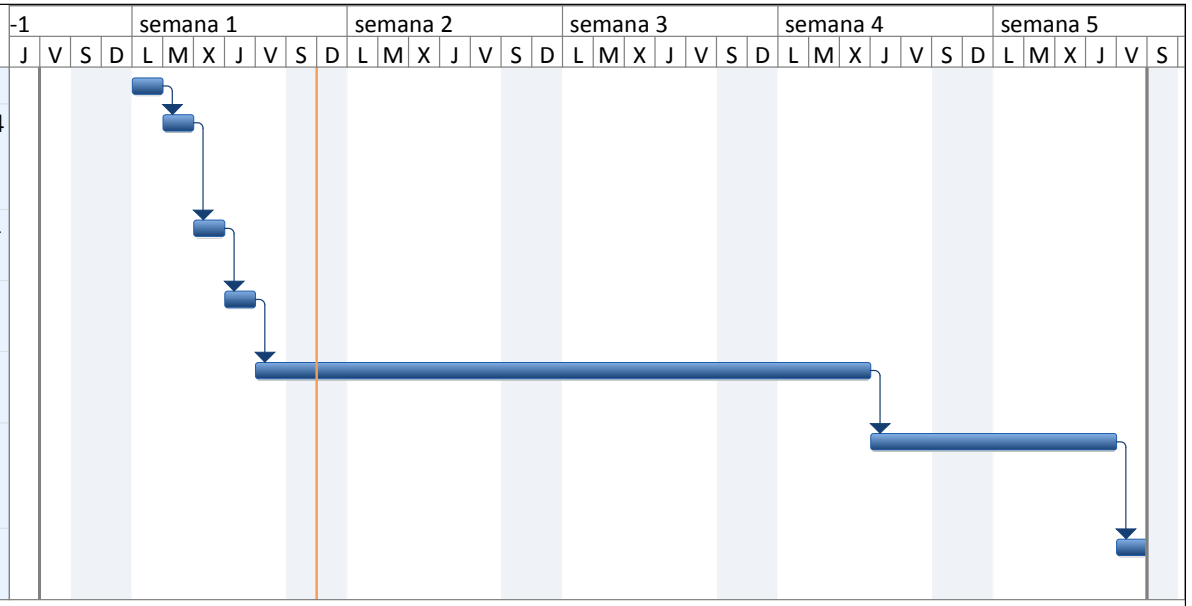
TECHNICAL-ECONOMICS INDICATORS

1. Quantity of works:254.02 m^2
2. Installation cost: 363.62€/ m^2 x 254.02 = 92,366.75€ or 318,665.30 Litas.
3. Works duration: 20 Days.
4. Wage:
   - Construction worker: 254.02 x 12.39€/m^2 = 3,147.31€ or 10,858.21 Litas.
   - Construction helper: 254.02 x 17.99€/m^2 = 4,569.82€ or 15,765.88 Litas.
   - Locksmith worker: 254.02 x 25.20€/m^2 = 6,401.30€ or 22,084.50 Litas.
   - Locksmith helper: 254.02 x 32.57€/m^2 = 8273.43€ or 28,543.34 Litas.

TOTAL

92,366.75€ or 318,665.30 Litas.

Id		Modo de tarea	Nombre de tarea	Duración	Comienzo
1			TRANSPORTATION, STORA	1 día	lun 02/06/14
2			ANCHORAGE AND CONNECTION PROVISION	1 día	mar 03/06/14
3			CONNECTIONS STAKEOUT	1 día	mié 04/06/14
4			INSTALATION ARRANGEMENT	1 día	jue 05/06/14
5			UPRIGHTS PLACEMENT WITH CRANE HELP	14 días	vie 06/06/14
6			AUXILIARY STRUCTURE GLAZING WITH CRANE HELP	6 días	jue 26/06/14
7			FINAL FIXING AND INSPECTION	1 día	vie 04/07/14



Proyecto: Curtain Wall
Fecha: dom 08/06/14

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

3. ORGANIZATION PART

3.1 DESCRIPTION OF THE TERRITORY

The function of building will be a car shopping center at Darius ir Girėnas str. 15, in Vilnius. The work plan includes the following works:

- Access and space for the working machines (trucks, concrete pumps, etc.) 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 to 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 to 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.
- 0 cm of soil must be removed and the ground must be prepared to 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 field with one signal panel of mandatory protective measures.
- We must pay attention to areas of crane installation and safety distances.
- Before starting we must prepare a big entrance for the supplied trucks and machinery.
- We must prepare the storage sites for the material.

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 power. 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.

3.2 SELECTION OF TOWER CRANE

In this part it is explained why we choose our tower crane LIEBBHERR 130 EC-B6.

Tower crane are selecting by two ways:

- According to technical parameters.
- According to economical parameters

In this task we are going to use the first way, we are going to select our crane according to technical parameters. This way is dividided into two steps:

1. Tower crane selection when the underground and over-ground works are fulfilling.
2. Tower crane selection when only the over-ground works are fulfilling.

Calculation of technological parameter of tower crane.

First of all we have to know the following parameters:

1. Building dimensions and location (underground and over-ground parts).
2. Weights, dimensions and location of installing constructions.
3. Work conditions (building site particularities, soil characteristics and underground structures peculiarities).

We must check if crane technical characteristics match the inequalities:

$Qk > Qr$

$Hk > Hr$

$Lk > Lr$

Qk- ascension power of selected crane ,t.

Qr- required ascension power, t.

Hk- reach of selected crane boom, m.

Hr- required reach of crane boom, m.

Lk-lifting height of selected crane hook, m.

Lr- required lifting height of hook, m.

The technological parameters of crane are calculated according to the building characteristics. The required crane is selected according to crane technical characteristics table.

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

First of all we are going to determinate height requires of hook lifting:

Hr= Building height + 3m= 7.2+3=10.2m

Then the ascension power of crane:

Qr= P + Pstr = 2.5+0.15= 2.65t

P-weight of heaviest lifting construction, t (in our case concrete for columns)

Pstr- weight of hitching equipment, t

When the values of Lr, Hr and Qr are calculated, the crane could be selected. Whereas for determining the reach of crane boom Lr, will be needed to know the under crane width of supports and dimensions of platform turn. These values are found 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, in the south-west corner, because in this corner we haven't facade, so the crane doesn't disturb us in the constructive process and it can minimize the tower arm length.

Lr = 35 m.

When we know the values of Lr, Hr and Qr, the crane could be selected using the diagrams of the tower crane.

The diagrams show that the crane we can use is LIEBBHERR 130 EC-B6.

Qk>Qr 3t>2.65t

Hk>Hr 17.2m>10.2m.

Lk>Lr 35m>32.5m

As we can see, the crane we have selected is capable of performing the required works.

3.3 SETTING OF DANGEROUS ZONE

During the installment works in some parts of the construction site, bars, workplaces and crossings the dangerous areas are appearing. During the construction such areas are known as dangerous zones. At 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.

- Dangerous zones in which dangerous and/or hazardous factors constantly affect the processes, are:
  - Near the electrical equipment with non-insulated parts electric current
  - Fenceless zones at a height when height difference is 1.3 m higher
  - Place where hazardous wastes and/or the concentration of harmful substances in workplace air may exceed the limit values.

(Table 3.1) Limiting the dangerous zones from the fenceless un-insulated parts of the electrical equipment

Voltage, kW	Distances, limiting the dangerous zones from the fenceless un-insulated 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

The limits of dangerous zones where the risk factors of harmful substances exceeding appears should be determined by measurement.

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

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

The determination of crane dangerous zones

The limits of dangerous zones where there is a transfer of elements performed by crane are determined by calculations, the sum of horizontal projection of lifted element, the maximum length of biggest elements and its possible fall distance.

Due to the conditions surrounding our lot we have to consider our danger zone should not override existing buildings. Then, let 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 to reduce the area of danger zone.
- The projection of the arm of crane will not be performed on existing buildings.

The next risk will be considered:

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

The prevention measures are established on the basis of the following legal text:

-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.

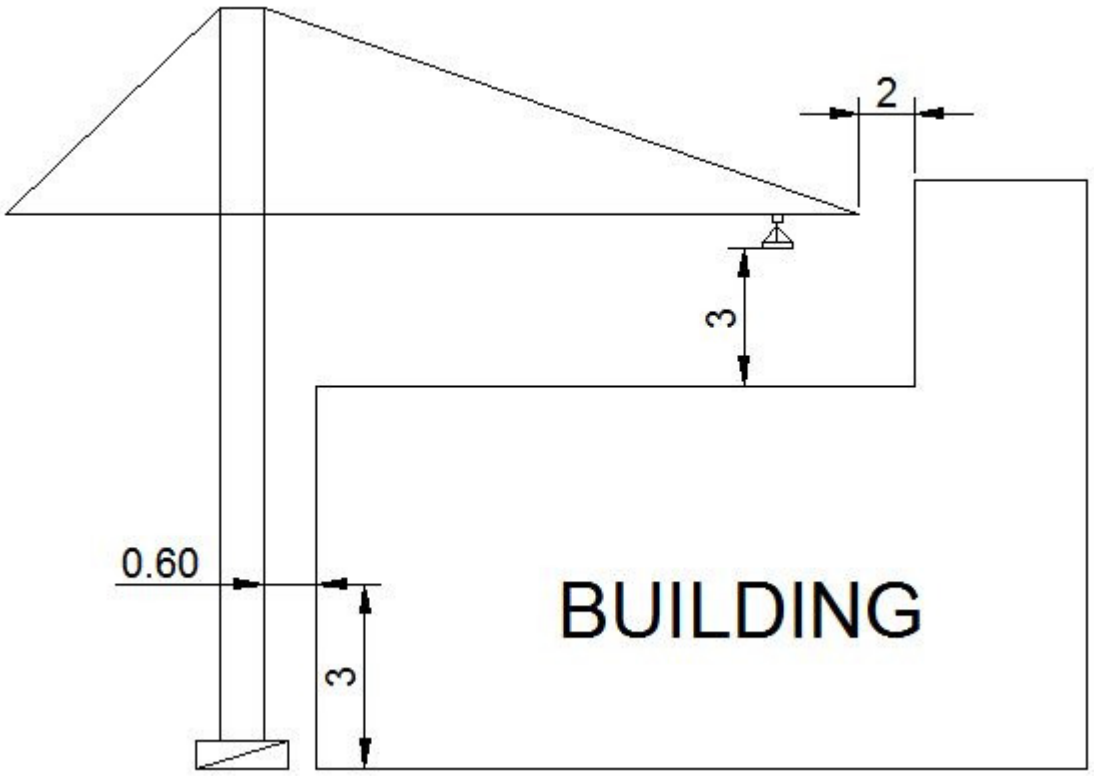
-Royal Decree 1215/1997 of 18 July, laying down minimum safety and health for use by workers in teams.

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 minimum 3 meters. If the load or empty hook passes within 3 meters of the area (Figure 3.1), will be necessary placed on it enough to prevent the indicators of his approach.”

This means that when the crane weathervane turn must respect the distances. And the area, which inevitably we must consider the burden.

We are not inclined to use signaling and also taking into account the flexibility of these structures, 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 meters wide and 2.50 meters high. In case of failure application of this condition will prohibit the access of staff to this area dangerous”. We have considered a minimum distance between the tip of the arrow and the nearest obstacle of 2 meters(Figure 3.1).



(Figure 3.1). Diagram of tower crane safety distances.

3.4 TEMPORARY ROADS TO THE BUILDING PLACE

Temporary roads are built to bring construction materials.

Temporary roads are built combining existing roads to reach warehouses, work places, machines, etc. outside the building place.

There are two different ways of temporary roads. The wide of the road has to be at least 6 meters, and the smallest distance from the road to the storage place is 1 meter. These roads are built to ensure easy driving to the building place and fast work.

3.5 TEMPORARY STORAGE BUILDINGS AND SITES

The construction site will contain two storage buildings model C20-P on the east side of the field (6x2.44x2.60 m) to store all tools; also we will need one on covered site (according the length of truss) on west side of the construction plot.

3.6 TEMPORARY BUILDINGS FOR WORKERS AND MANAGING

All the staff will have their own temporary buildings to satisfy all their needs. We calculate all the necessary temporary buildings knowing the workers volume.

According on "Royal Decree 486/1997, of 14 of April laying down general provisions minimum safety and health in the workplace" approaching the changing surface of 2 m^2 per worker.

The maximum number of workers that we will have working at same time will be 33. So we calculate 66 m^2 of surface for temporary changing building.

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

S= 33x2 m^2 = 66 m^2.
Chosen Buildings:

- 1 Toilet Model M 65 (6.00x2.44m) = 14.64 m^2.
- 1 Model M 6C (6.00x2.44m) = 14.64 m^2.
- 1 Model M 6 (6.00x2.44m) = 43.92 m^2.

The workers will use a temporary buildings Model M 6 as place for rest, eat…; and the Model M 65 as toilet and shower.
The managing staff will have one temporary building Model M 6C, where will be situated the office.

3.7 TEMPORARY ELECTRICITY SUPPLY

A temporary supply will be needed in order to make mostly all the works. A general electricity counter will be needed in the building fence connected to the electrical rush supply connected to the general electrical city system placed close the road, will be made an individual 4x16mm^2 derivation.

3.8 CONSRUCTION SITE LIGHTNING

To calculate the number of luminaries necessary for the correct work illumination (Formula 3.1):

$$N=\frac{ExA}{\emptyset_n x F_{UxF_M}} \quad \text{(Formula 3.1)}$$

Where:

N: Luminaries number are required

E: Average luminance in lux

A: Local area m^2

$\emptyset_n$: flow lamp rate in lumens

F_U: Factor of use

F_M: Maintenance factor

The surface of the work area is 4300 m^2, 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: 91.60 m

Width: 33.85 m

Height: 4.50 m

Index $K=\frac{lxb}{h(l+b)}=\frac{4300}{4.50(91.60+33.85)}=$ 7.61

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

This the lamps number required will be:

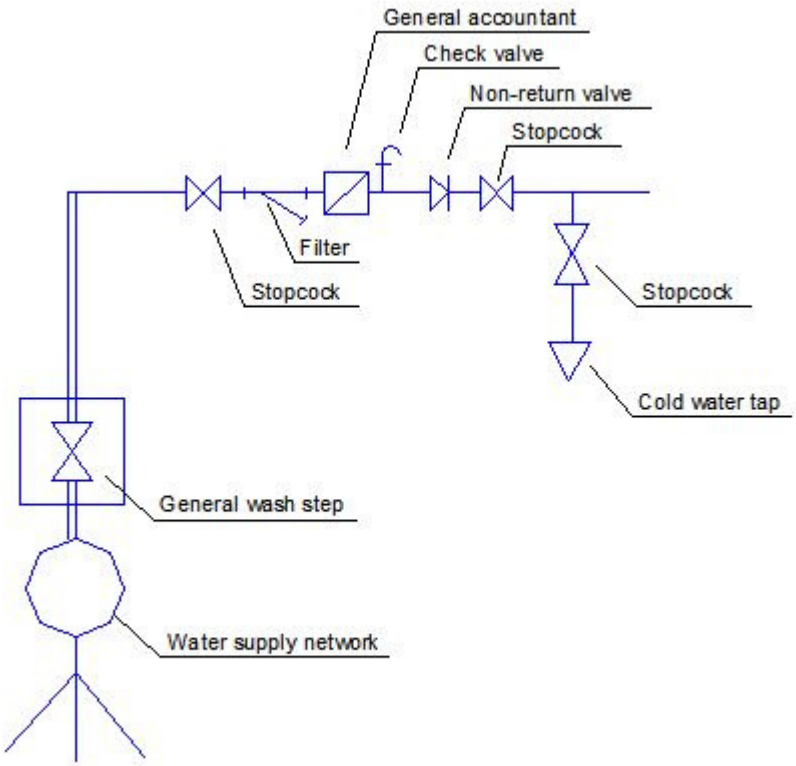
$$N=\frac{ExA}{\emptyset_n x F_{UxF_M}}=\frac{15x4300}{13000x1x0.95}\approx 6$$

By calculation we have obtained that we need a minimum of 6 lamps.

3.9 TEMPORARY WATER SUPPLY

We will need a temporary water supply (Figure 3.2). A general accountant will be installed in the building fence connected to the city water supply rush placed close to the road.

The temporary water supply line will require an accountant, stopcock general, pipe tube 32 mm, wash step and tap.



(Figure 3.2).Temporary water supply.

3.10 TEMPORARY SEWERAGE

The sewer construction will consist on removing water from rain and the elimination of waste water as a shower, basins and toilets.

Drainage is connected to the network of urban wastewater.

The drainage plan consist on connecting our network to existing networks of the city. The sewerage system will have a diameter of 200 mm.

3.11 FENCE OF CONSTRUCTION FIELD

The construction fence will protect the parcel's perimeter. The maximum width of the strip of public or private space to be occupied by work of fenced will be of 2 meters. The minimum step width should cover the separation or boundary between pedestrian and traffic.

Formal conditions:

- The fence will be forced to have a minimum height of 2 meters measured at any point on the outer fence face.
- The crown height is uniformed and horizontal projection admitting only to suit the terrain slopes, subject to compliance with the minimum height indicated in the previous section.
- Is expressly forbidden ridges and sharp objects, which can be incorporated into the fence, both temporarily and permanently.
- The outer fence face 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.
- It Is not allowed to over the space of public or private road bounded by the fencing work. It will be mandatory the placement of lights signaling pathway hedges occupying public or private.
- We will need 232.57 meters for the entire perimeter.
- The fence will be opaque, perfect for construction by the rapid assembly and disassemble.

3.12 TEMPORARY COMUNICATIONS

Temporary communications will consist on cell phones and USB modem internet for laptops (three of them) in managing temporary building.

3.13 GENERAL REQUIREMENTS OF LABOR SAFETY

Here we will evaluate the general hazards and choose the individual protective measures which must be available for workers protection.

List of hazardous jobs:

- Excavation works
- Working crane
- Reinforcement and concrete works
- Formworks installation
- Welding
- Height work
- Roof and facade installation
- Installation works
- Work with hand tools and power machinery

Individual protective elements:

- The safety helmet is expected per worker every six month.
- The safety helmet with viewfinder, just one every ten workers is expected, because their use is more specific than normal helmets.
- Helmet with ear protectors: Is provided to one every five workers.
- Safety glasses: Are expected every three workers.
- Hearing protection (foam earplugs): Some ones per worker every two month for works around loud noises.
- Fine dust filter mask: One per worker every two month.
- Gloves: Some gloves per worker every six month.
- High resistance to cutting and abrasion gloves: One every five workers every six month.
- Welder gloves: A pairs of gloves for welder every ten workers every nine month.
- Dielectric gloves: Two pairs, their use is limited for electrical work.
- PVC Boots: A pair of boots every five workers every nine months for work duration.
- PVC water boots: A pair of shoes per worker every nine months of work duration.
- Dielectric boots: Two pairs for all the work, their use is limited for electrical works.
-
- Seat belt lifeline: One every ten workers and twelve months of work, for working at height together with safety lines.
- Safety belt: One every three workers and six months.
- Device fall arrest safety belt: One every three workers and six months.
- Fall arrest system: One every three workers and six months.

- Strip back injury protection: One worker for nine months of working duration.
- Coverall: One per worker every six months.

Collective protective elements:

- Safety net: under first structural floor, only wherethere are more than 1 floor.
- Safety harness: One per worker.
- Perimeter railings: One on each working floor.
- Walkways and ramps at the same or different level.
- Working platforms: for height works.

3.14 ENVIRONMENTAL PROTECTION REQUIREMNTS

We must have planned the management of wastes generated during the works.

There must be a previous study for wastes, classified according their nature and dangerousness, and the will be checked which can be recycle and which cannot.

With this plan of construction wastes, when construction works are finished, wastes must not stay in our field.

During works execution we will have different containers for separate wastes.

We must appoint one person who will control the management of wastes.

3.15 FIRE PROTECTION REQUIREMENTS

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

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

In the construction site will have a visible and accessible place where there 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

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