MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN

Satbayev University

Institute of Architecture and civil engineering named after T. Basenov

Department of Civil engineering and building materials

Wali Ahmad Ahmadi

« Museum of contemporary art with translucent structures in Almaty »

To the diploma project
EXPLANATORY NOTE

Specialty 5B072900 – Civil Engineering

Almaty 2021

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ALLOWED TO PROTECT
Head of Department
Master of technical science,
lecturer
_________N.V. Kozyukova
«___»_______2021 yr.

EXPLANATORY NOTE
to the diploma project

On the theme of «Multifunctional administrative complex using solar energy in Kyzylorda»

5B072900 - "Civil Engeneering"

Prepared by Wali Ahmad Ahmadi

Scientific adviser Zh.T. Nashiraliyev
Candidate of technical science,
Associate professor
«_____»___2021 yr.

Almaty 2021

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Specialty 5B072900 – Civil Engineering

I APPROVE
Head of Department
________N.V. Kozyukova
Master of technical science, lecturer
«___»_______2021 yr.

ASSIGNMENT
Complete a diploma project

Student: Wali Ahmad Ahmadi
Topic: «Museum of contemporary art with translucent structures in Almaty»
Approved by the Order of the Rector of the University No. 2131-b dated November 24, 2020.
The deadline for the completed work is May 10, 2020.
Initial data for the diploma project: Almaty
Structural schemes of the building is a monolithic reinforced concrete frame with monolithic floors. pH outside walls - stained glass. The roof in the central parts is translucent domes.
List of questions to be developed:
a) Architectural and analytical part: basic initial data, space-planning solutions, heat engineering calculation of enclosing structures (outer wall), lighting calculation, calculation of the foundation option and depth of laying, justification of energy efficiency measures;
b) Calculation and design part: calculation and design of a column and rigel;
c) Organizational and technological part: development of technological maps, construction schedule and construction plan;
d) Economic part: local estimate, object estimate, summary estimate;
List of graphic material (with exact indication of required drawings):
1 Facade, standard floor plans, parts 1-1 and 2-2 - 4 sheets;
2 KZh columns, specifications - 1 sheet;
3 Technical maps of earthworks, calendar plan, construction site plan - 4 sheets.
11 slides of work presentation are provided.
Recommended main literature:

1 SP RK 2.04-01-2017 "Construction climatology";
2 SN RK 2.04-04-2013 "Construction heat engineering", SN RK 2.03-30-2017 "Construction in seismic zones".

SCHEDULE
preparation of thesis (project)

Part	30%	60%	90%	100%	Note
Architectural and analytical	11.01.2021г.-14.02.2021г.				
Calculation and design		15.02.2021г.-23.03.2021г.			
Organizational and technological			24.03.2021г.-01.05.2021г.		
Economic				01.05.2021г.-09.05.2021г.	
Pre-defense	10.05.2021г.-14.05.2021г.				
Anti-plagiarism, norm control	17.05.2021г.-31.05.2021г				
Quality control	26.05.2021г.-31.05.2021г.				
Defense	01.06.2021г.-11.06.2021г.				

Signatures
consultants and the normative controller for the completed diploma work (project) with an indication of the parts of work (project) related to them

Name parts	Consultants, I.O.F. (academic degree, rank)	the date signing	Signature
Architectural and analytical	Nashiraliyev Zh.T., Candidate of technical science, associate professor		
Calculation and design	Nashiraliyev Zh.T., Candidate of technical science, associate professor		
Organizational and technological	Kashkinbayev I.Z., Doctor of technical science, associate professor		
Economic	Nashiraliyev Zh.T., Candidate of technical science, associate professor		
Norm controller	Bek A.A., Master of technical science, assistant		
Quality control	Kozyukova N.V., Master of technical science, lecturer		

Scientific adviser ___________ Nashiraliyev Zh.T.

The task was accepted
for execution student ___________ Wali Ahmad Ahmadi

Date "__" ________ 2021 y.

АҢДАТПА

Осы дипломдық жобаның тақырыбы "Алматы қаласындағы мөлдір құрылымдарды қолдана отырып , заманауи өнер мұражайы" болып табылады. Жобада сәулет – құрылыс, есептеу – конструктивтік, технология және құрылыс процесін ұйымдастыру және экономикалық бөлімдер ұсынылған. Әрбір бөлім ғимараттардың параметрлері мен сипаттамалары, сондай-ақ жобаның өзінің құны көрсетілетін және есептелетін тармақтарға бөлінген. Жобалау кезінде бағдарламалар қолданылды

- Autodesk AutoCAD 2021- ғимараттарды жоспарлау;
- Revit - ғимарат моделін құру;

– Etabs 2018-ғимараттың статистикалық есебі.

АННОТАЦИЯ

Темой данного дипломного проекта является «Музей современного искусства с применением светопрозрачных конструкций в городеАлматы». В проекте представлены такие разделы как архитектурно – строительный, расчетно – конструктивный, технология и организация строительного процесса и экономический. Каждый раздел поделен на пункты, в которых указываются и рассчитываются параметры и характеристики зданий, а также стоимость самого проекта. При проектировании были использованы программы:

- Autodesk AutoCAD 2021 – планировка зданий;
- Revit – модели здания;
- Etabs – статический расчет здания.

ANNOTATION

The theme of this diploma project is "Museum of contemporary Art with Transulcennt Structure in Almaty". The project includes such sections as architectural and construction, design and cnstruction, technology and organization of the construction process, and economic. Each section is divided into items that specify and calculate the parameters and characteristics of buildings, as well as the cost of the project itself. Programs were used in the design process:

-Autodesk AutoCAD 2021-building constractive layout;
- Revit-building model;
- Etabs 2018-static calculation of the building.

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INTRODUCTION

To maintain sustainable development in a particular city, it is necessary to equip it with social and cultural centers for various purposes. Analyzing all the current problems in Almaty, I decided to develop the direction of the Museum of Contemporary Arts.

Public museum contemporary arts has a number of advantages over the younger generation: the formation of cultural life, artistic education and thinking, creative and intellectual development of young citizens, etc. All these factors influenced my choice of this topic. In this thesis, I would like to convey thought about how important it is to support and contribute to the development of the city, society and education.

Younger generation any society is very unstable and requires careful attention. That is why they sometimes need to get distracted from brain and work activity and just relax in a particular society. For this reason, the project I am designing has a leisure and creative direction. The purpose of my research is to attract young people to a creative image and perception of life. Since a person is a social being, he desperately needs a society of like-minded people.

This museum modern arts for this and is created to enable people not to get lost in endless life and not live every day like groundhog day. An important role in the construction of any object plays a selection of the site. Each of us would like to see improvements in our city of Almaty every day.

For this reason, I have carefully analyzed and selected the most suitable and relevant territory. Thus, in this thesis you will be able to study the choice of the territory for construction, analyzed by me and the decision on the general plan, architectural and planning solutions, constructive solutions.

1 Architectural and construction part

1.1 Basic information about the construction site

The diploma project was developed for "Museum of Contemporary Art with Translucent Structures" located at the address: Almaty city, Satbayev _ Nazarbayev street".

The project was developed for the following construction conditions:

Humidity zone - normal;

Climatic region - II: temperate continental climate;

Snow region - II, the standard value of the weight of the snow cover is 1,2 kPa;

Wind region - I, standard value of wind pressure - 0.23 kPa;

Climatic parameters of the cold season: air temperature of the coldest day: -30 :C; air temperature of the coldest five-day period: -23˚C;

The construction area is earthquake-prone, the magnitude is 8 - 8 points;

The construction site is located in the zone of residential and administrative buildings, the relief of the site is calm.

The average elevation of 650m is taken as the mark of the existing land.

1.2 Natural-climatic and engineering-geological conditions

The characteristic features of the climate of this territory are: an abundance of sunlight and warmth, continentality, hot long summers, relatively cold winters with alternating thaws and cold snaps, large annual and daily amplitudes of air temperature fluctuations, dry air and changes in climatic characteristics with terrain altitude.

Table 1 - Air temperature

Weathr statin	months												per year
	1	2	3	4	5	6	7	8	9	10	11	12	
Average monthly and average annual air temperature, ˚C													
Almay	-6.8	-5.2	1.9	10.8	16.2	20.7	23.4	22.3	16.9	9.7	0.8	-4.8	8.8
Average maximum air temperature, Celsius degree													
Almay	-1.3	0.2	7.1	16.5	21.7	26.5	29.7	28.8	23.4	15.9	6.2	0.4	14.6
Absolute maximum air temperature, ˚C													
Almay	17	19	26	33	35	39	43	40	36	31	25	19	43
Average minimum air temperature, ˚C													
Almay	-11.1	-9.5	-2.4	5.6	10.9	15.2	17.6	16.3	11.0	4.6	-3.3	-8.8	3.8
Absolute minimum air temperature, ˚C													
Almay	-35	-38	-25	-11	-7	2	7	5	-3	-11	-34	-32	-38

The coldest month - January is characterized by negative temperatures minus 6.6-16.5-16C (for plains and foothills). The hottest month is August. The average temperature for the plains is plus 24 to plus 26° celsius degree. The absolute maximum temperature reaches plus 36.7 to plus 41.5 in the same zone.The main data on the snow cover are given in Table 2.

Table 2 – Snow cover

Weather station	months									Highest values for the winter		
	9	10	11	12	1	2	3	4	5	Average.	Max.	Min.
Average monthly snow height, *cm*												
Almaty	0	2	9	24	30	25	13	1	0	21	66	9

With distance from the mountains, the wind regime changes. The average annual wind speed is 2.3 m / s. The wind breakthrough reaches 28 m / s. The lowest average monthly wind speeds throughout the entire territory are observed in winter (December, January), and the highest - in summer.

Table3 - Wind

Wind Weather Station	months												Per year
	1	2	3	4	5	6	7	8	9	10	11	12	
Average wind speed by months and per year, $\frac{m}{c}$													
Almaty	0.6	0.6	0.6	0.8	0.8	0.8	0.8	0.8	0.8	0.6	0.6	0.6	1.3
Maximum wind speed and wind vane breakthrough, м/с													
Almaty	9	9	20	>18	>18	16	18	16	10	12	8	8	>18

Table4 - Periodicity of different wind directions, %

Weather station	Direction							Calm
	N	NE	E	SE	S	SW	W	NW	
Almaty	20	9	9	17	20	9	9	7	26

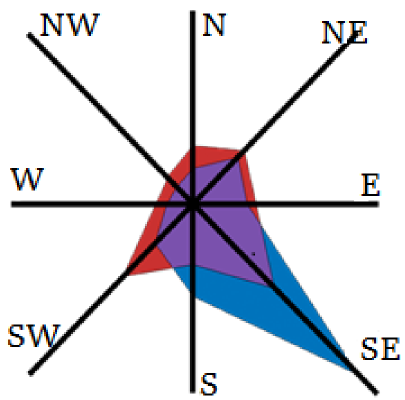

Figure 1 - Wind rose according to the weather station in Almaty

1.3 General plan. Improvement of the territory

The master plan has been developed for the entire territory of the construction land plot. The plot with a total area of 2 hectares, allocated for construction, located in the city of Almaty, has a rectangular shape. The plot allocated for construction is free of buildings. An 8.0 meter wide driveway is provided for the territory of the facility; the pavement is made of asphalt concrete on a crushed stone base. Improvement and gardening of the site provided for by the project reduces the overall dust content and eliminates local sources of dust.

Table 5 - Technical and economic indicators for the general plan

Name of area	Indicator
Land area	1.5a
Built-up area	$3278m^2$
Building factor	0,104
Landscaping area	$4451{,}4m^2$
Landscaping factor	0.297
Hard surface area	$8992{,}1m^2$
Territory utilization rate	0,745

The area around the building is landscaped and landscaped. The building has hard surfaced access roads.

1.4 Space-planning solution

This project, the Museum of Modern Iokusstv, was developed on the basis of the current rules of the rules, Height of floors 5,100m. 1st floor (temporary halls and administration, cultural and developmental bridges) 2nd floor (exhibition halls, workshops and restoration rooms) 3rd floor (exhibition hall)

The structural system of the building consists of an incomplete frame and monolithic reinforced concrete. According to the constructive scheme, girders, consisting of beams resting on them slabs for the relative elevation 000, the elevation of the honest field of the 1st way is taken. The highest point is 21,600. The main staircase, elevators of the engineering equipment shaft are located in the concrete core of stiffness in the middle of the front side of the building.

1.5 Constructive solutions of the object

The structural scheme of the building is a frame, while at the level of the basement, reinforced concrete columns and walls are load-bearing (that is, it is a frame-link system). Spatial immutability is ensured by external and internal heating bricks, reinforced concrete columns and girders, and a hard floor plate made of precast reinforced concrete slabs.

Foundations – the foundation is made isolated footing with thickness of 500mm. Isolated footings can consist either of reinforced or non-reinforced material. For the non-reinforced footing however, the height of the footing has to be bigger in order to provide the necessary spreading of load.

Walls - the outer walls of the basement are monolithic reinforced concrete walls with a thickness of 400 mm, the outer walls of the first and second floor are 300 mm thickness and the walls are monolithic reinforced concrete. Internal walls with a thickness 250 mm should also be made of foam blocks on cement-sand mortar C25/30 with reinforcement of the masonry with 4Bp1-100 / 4Bp1-100 reinforcing meshes every 5 rows of masonry in height;

Covering slabs - monolithic reinforced concrete floor slabs with a thickness of 200mm.

Beams - reinforced concrete with a section of 600x300;

Lintels - bar for buildings with masonry walls, series 1.038.1-1 issue 1;

Windows - installation of PVC windows in accordance with GOST 21519-2003. Sill boards are metal-plastic.

Doors - installation of internal wooden doors in accordance with GOST 6629-88, PVC doors in accordance with GOST 309702002, installation of metal external doors in accordance with GOST 31173-2003.

The blind area is concrete along the entire perimeter of the building with a width of 1.0 m.

External finishing - from external facade plaster and, if necessary, a decorative layer.

1.6 Thermal calculation of the outer wall

I have used glazing system for the outer wall of the structure. The insulated glasses are used in outer walls, for this reason the thermal calculation for the outer wall is not need to calculate.

2 Design section

2.1 Calculation of dead loads

The dead load includes loads that are relatively constant over time, including the weight of the structure itself, and immovable fixtures such as walls, plasterboard or carpet. The roof is also a dead load. Dead loads are also known as permanent or static loads.

Floor and wall loads are presented in the form of table 2.

Table 8 - Dead loads

Applied loads	Characteristics of loads, kg/m^2
1 Specific weight**:**	Auto
1.1 Floor construction: for basement floor:	
Membrane waterproofing layer, δ=25 mm, ρ=1400 $\frac{kg}{m^3}$	$0.025 \cdot 1400 = 35$
Concrete preparation δ=110 mm, ρ=1700 $\frac{kg}{m^3}$	$0.11 \cdot 1700 = 187$
cement-sand plaster δ=50 mm, ρ=1600 $\frac{kg}{m^3}$	$0.5 \cdot 1600 = 80$
Total	302 kg/m^2 = 2.96 kN/m^2
for typical floors:	
Tile flooring δ=25 mm, ρ= 2400$\frac{kg}{m^3}$	$0.025 \cdot 2400 = 60$
Finishing lath mortar δ=50 mm, ρ=1600 $\frac{kg}{m^3}$	$0.05 \cdot 1600 = 80$
Waterproofing (Membrane) δ=20 mm, ρ=1400 $\frac{kg}{m^3}$	$0.02 \cdot 1400 = 28$
Soundproofing δ=20 mm, ρ=45 $\frac{kg}{m^3}$	$0.025 \cdot 45 = 1.125$
Foamed concrete for thermal insulation δ=50 mm, ρ=1000 $\frac{kg}{m^3}$	$0.05 \cdot 1000 = 50$
Total	219.125 kg/m^2 = 2.1489 kN/m^2
for flat roof:	
Reinforced cement-sand plaster δ=50 mm, ρ=1600 $\frac{kg}{m^3}$	$0.1 \cdot 1600 = 160$
Vapor barrier (low-Density Polyethylene sheets) δ=0.25 mm, ρ=940 $\frac{kg}{m^3}$	$0.00025 \cdot 940 = 0.235$
Thermal insulation – PIR(Polyisocyanurate) boards δ=100 mm, ρ=500 $\frac{kg}{m^3}$	$0.1 \cdot 500 = 50$

Waterproofing (Membrane) δ=20 mm, ρ=1400 $\frac{kg}{m^3}$	$0.02 \cdot 140 = 28$
Total	238.2 kg/m^2 = 2.33 kN/m^2
Loads	Characteristic of loads, kg/m

Continuation of table ?

Applied loads	Characteristics of loads, kg/m^2
1.2 Wall construction	
Internal self-supporting walls (wall height 3m)	
Autoclaved aerated concrete AAC blocks (Foam concrete block) δ=250 mm, ρ=600 $\frac{kg}{m^3}$	$0.25 * 5.1 \cdot 600 = 765$
Thermal insulation (foam board) δ = 54 mm, ρ = 40 $\frac{kg}{m^3}$	$0.054 \cdot 5.1 \cdot 40 = 11.016$
Vapor barrier (low-Density Polyethylene sheets) δ=1 mm, ρ=940 $\frac{kg}{m^3}$	$0.001 \cdot 5.1 \cdot 940 = 4.794$
gypsum plasterboard δ=15мм, ρ=800 $\frac{kg}{m^3}$	$0.015 \cdot 5.1 \cdot 800 = 61.2$
Total	842 kg/m = 8.257 kN/m

Collecting lateral soil pressure

Type of soil bases for foundations – sand and gravel (category C)

$$\gamma = 1.73 \text{ т/м3}$$
$$\varphi = 35°$$
$$c = 0$$
$$h = 4 \text{ m}$$
$$q = 0.6 \text{ Т/м2}$$

Active pressure

The intensity of the horizontal active soil pressure from its own weight γ, at a depth of h = y = 4 m should be determined by the formula:

$$P_\gamma = [\gamma \cdot h \cdot \lambda_г - c \cdot 2\sqrt{\lambda_г}]y/h = [1.73 * 4.1 * 0.27 - 0 * 2\sqrt{0.27}]4.1/4.1 = 1.915\ \frac{t}{m^2}$$

where:

$$\lambda_г = tg^2\left(45 - \frac{\varphi}{2}\right) = tg^2\left(45 - \frac{35}{2}\right) = 0.27$$

Passive pressure:

$$\lambda\ for\ \varphi = 26° - 0.38$$
$$\lambda_= 0.26$$
$$P_q = q * \lambda \text{ t/m}^2$$
$$P_q = 0.6 * 0.26 = 0.156 \text{ t/m}^2$$

$$=> P = 1.915 + 0.156 = 2.93 \text{ т/м2}$$

Live loads according to EN 1991
Building category – C3 (Museum)
-floor – 5 kN/m^2
- staircase – 2 $\frac{kN}{m^2}$
- balconies – 2.5 $\frac{kN}{m^2}$
- Unexploited roof – 0.5 $\frac{kN}{m^2}$

Calculating snow load

Almaty city - II snow region [1]:

$$\mu_i = 0.8, C_e = 1, C_t = 1, s_k = 1.2$$

$$s = \mu_i \cdot C_e \cdot C_t \cdot s_k = 0.8 \cdot 1 \cdot 1 \cdot 1.2 = 0.96\ kPa$$

where C_e –enviromental factor;
C_t –thermal coefficient;
s_k – the characteristic value of the snow load on the ground;
μ_i – snow load shape factor

Calculation of wind load

Almaty city is located in the II wind region, $q_b = 0.39$ kPa, wind speed – 25 m/s

The dimensions of the building are 79 x 67 x 16.3 m, Almaty is the II wind region.

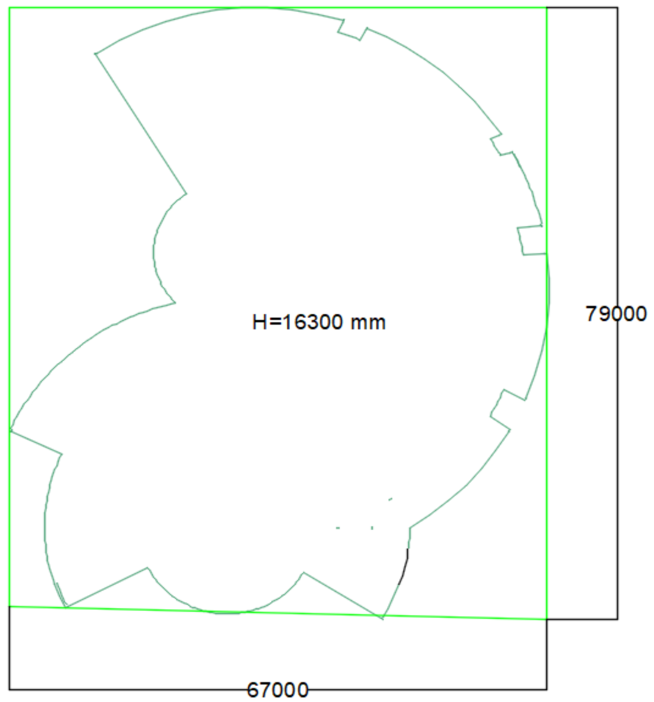

Figure 2 - Building plan

Calculation of wind load by OX

We divide the building in height into zones corresponding to the base height for the external pressure z_e according to the standard at $b = 67$ m ; $h = 16.3 < b = 67$ m:

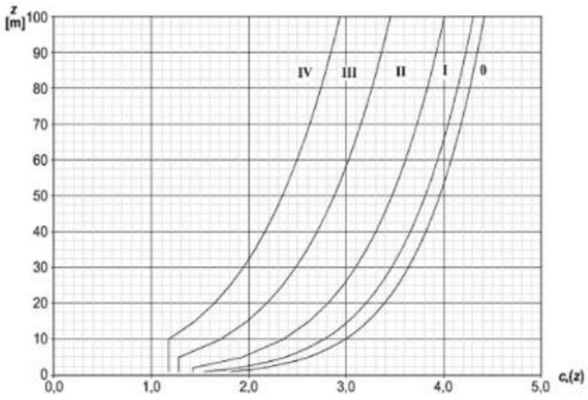

Figure 3 – Graphic rendering of exponent ratio $C_e(Z)$ for r $C_e = 1.0, k_i = 1.0$

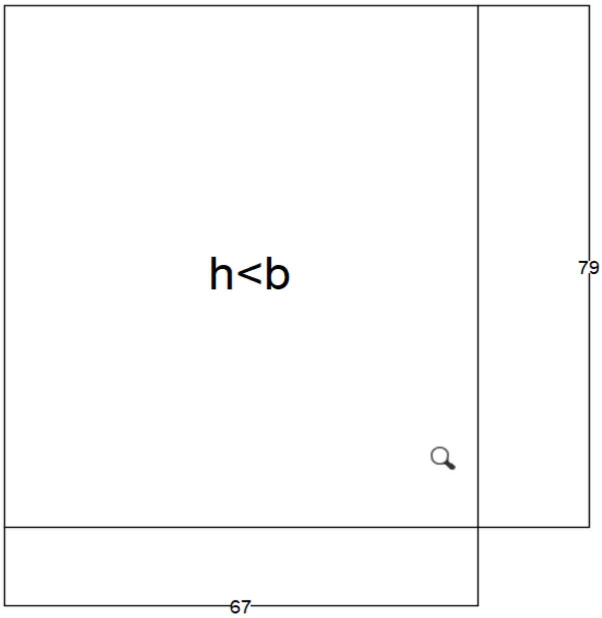

Figure 4 - Base height Z_e depending on h and b and the profile of the velocity head

Basic velocity wind pressure for wind region II, q_b = 0.39 kPa
Wind pressure w_e is equal to:

$$w_e = c_e(z) \cdot q_b \cdot c_e$$

At z_e = 16.3 m: $c_e = 0.8$; Z_e = 16.3m; $c_e(67) = 1.4$

$$w_e = 1.4 \cdot 390 \cdot 0.8 = 436.8\,Pa = 44.52\,kg/m^2$$

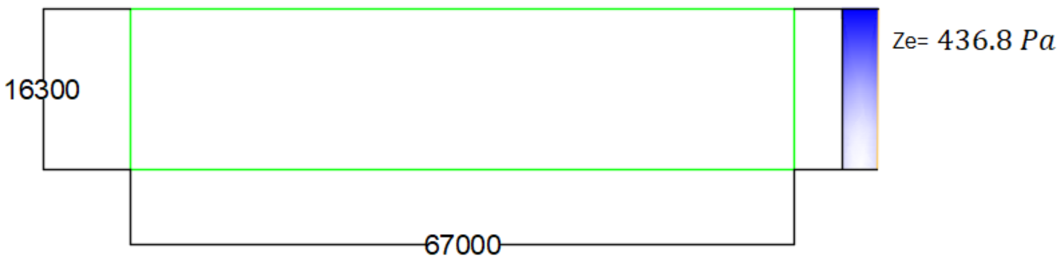

Figure 5 - Diagram of wind pressure

External pressure on the sides:
External pressure coefficients c_{pe} .
Wind pressure w_e is equal to:

Table 9 - Values of wind pressure

A	$c_{pe} = -1.2$	$c_e(16.3) = 1.4$	$w_e = 1.4 \cdot 390 \cdot (-1.2) = -655.2$ Pa $= -66.78$ kg/m^2
B	$c_{pe} = -0.8$	$c_e(16.3) = 1.4$	$w_e = 1.4 \cdot 390 \cdot (-0.8) = -374.4$ Pa $= -38.16$ kg/m^2
C	$c_{pe} = -0.5$	$c_e(16.3) = 1.4$	$w_e = 1.4 \cdot 390 \cdot (-0.5) = -234$ Pa $= -23.85$ kg/m^2
D	$c_{pe} = +0.7$	$c_e(16.3) = 1.4$	$w_e = 1.4 \cdot 390 \cdot (+0.7) = +327$ Pa $= +33.3$ kg/m^2
E	$c_{pe} = -0.3$	$c_e(16.3) = 1.4$	$w_e = 1.4 \cdot 390 \cdot (-0.3) = -140.4$ Pa $= -14.31$ kg/m^2

Wind loads are applied at the floor level:

At the level of the 1st floor: take into account half of the floor (2550 mm) plusfoundation above ground level (1000 mm). The design strip for the 1st floor is 2550 mm.

Typical floors calculated strip - 5100 mm.

At the roof level - 2550 mm.

For the windward side, two zones in the first zone from 0 to 16.3 m include floors 1-3 floors + roof.

Table 10 - Pressure across the floors of the building

	First floor
D	$+33.3 \cdot 3.55 = 118.33\ kg/m = \ 1.16\ kN/m$
A	$-66.78 \cdot 3.55 = -237.0 kg/m$= -2.32 kN/m
B	$-38.16 \cdot 3.55 = -135.46\ kg/m = \ -1.32\ kN/m$
C	$-23.85 \cdot 3.55 = -84.66\ kg/m = \ -0.83\ kN/m$
E	$-14.31 \ \cdot 3.55 = -50.8\ kg/m = \ -0.498\ kN/m$
	Typical floor 2-3
D	$+33.3 \cdot 5.1 = 170\ kg/m = \ 1.755\ kN/m$
A	$-66.78 \cdot 5.1 = -340.57 kg/m = \ -3.33\ kN/m$

B	$-38.16 \cdot 5.1 = -194.61 kg/m = -1.90\ kN/m$
C	$-23.85 \cdot 5.1 = -121.63\ kg/m = -1.19\ kN/m$
E	$-14.31 \cdot 5.1 = -72.98\ kg/m = -0.715\ kN/m$
	Roof
D	$+33.3 \cdot 2.55 = 84.9\ kg/m = 0.832\ kN/m$
A	$-66.78 \cdot 2.55 = -170.3\ kg/m = -1.67 kN/m$
B	$-38.16 \cdot 2.55 = -97.3\ kg/m = -0.95\ kN/m$
C	$-23.85 \cdot 2.55 = -60.8\ kg/m = -0.596\ kN/m$
E	$-14.31 \cdot 2.55 = -36.5\ kg/m = -0.358\ kN/m$

Wind load calculation according to OY

We divide the building in height into zones corresponding to the base height for the external pressure z_e according to the standard at $b = 79$ м; $h = 16.3\ m < b = 79$ m:

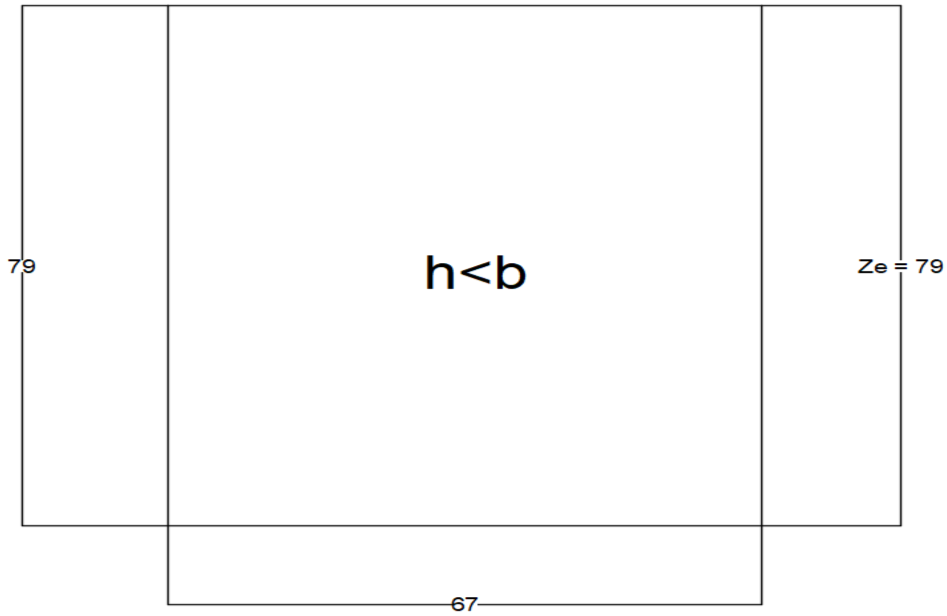

Figure 6 - base height z_e depending on h and b and the profile of the velocity head

Basic velocity wind pressure for wind region II, q_b = 0.39 kPa

Wind pressure w_e is equal to:

$$w_e = c_e(\mathrm{z}) \cdot q_b \cdot c_e$$

At z_e = 16.3 m: $c_e = 0.8$; Z_e = 16.3m; $c_e(79) = 1.4$

$$w_e = 1.4 \cdot 390 \cdot 0.8 = 436.8\ Pa = 44.52\ kg/m^2$$

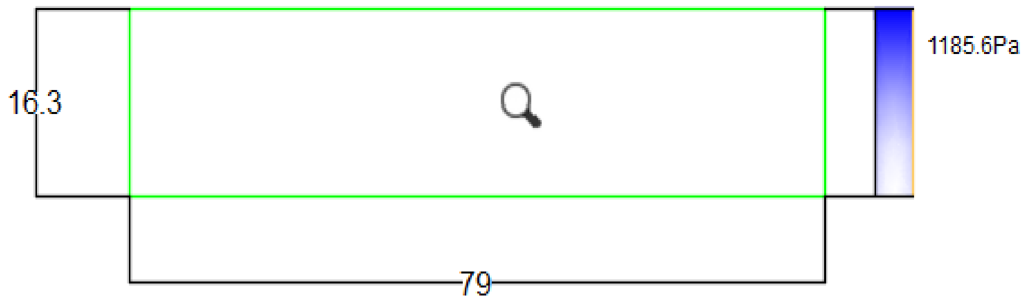

Figure 7 - Diagram of wind pressure

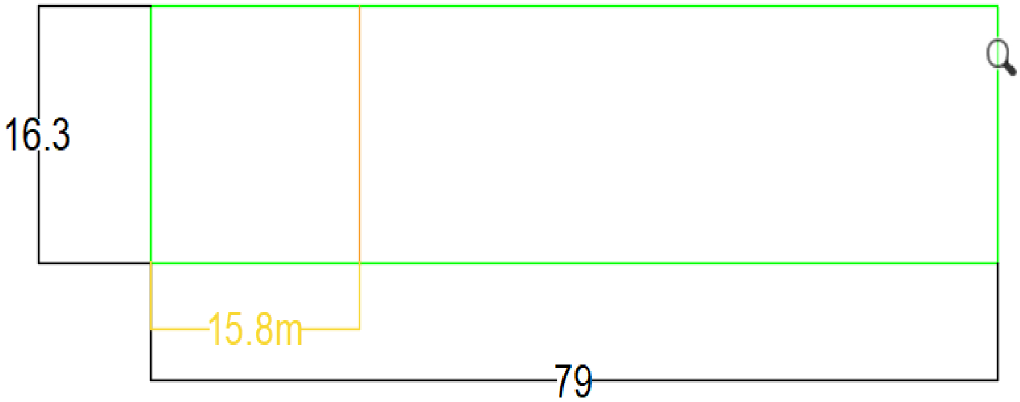

Figure 8 - Scheme of division into zones of lateral sides

Wind pressure w_e is equal to:

Table 11 - Values of wind pressure

A	$c_{pe} = -1.2$	$c_e(16.3) = 1.4$	$w_e = 1.4 \cdot 390 \cdot (-1.2) = -655.2\ \text{Pa} = -66.78\ \text{kg/m}^2$
B	$c_{pe} = -0.8$	$c_e(16.3) = 1.4$	$w_e = 1.4 \cdot 390 \cdot (-0.8) = -374.4\ \text{Pa} = -38.16\ \text{kg/m}^2$
C	$c_{pe} = -0.5$	$c_e(16.3) = 1.4$	$w_e = 1.4 \cdot 390 \cdot (-0.5) = -234\ \text{Pa} = -23.85\ \text{kg/m}^2$
D	$c_{pe} = +0.7$	$c_e(16.3) = 1.4$	$w_e = 1.4 \cdot 390 \cdot (+0.7) = +327\ \text{Pa} = +33.3\ \text{kg/m}^2$
E	$c_{pe} = -0.3$	$c_e(16.3) = 1.4$	$w_e = 1.4 \cdot 390 \cdot (-0.3) = -140.4\ \text{Pa} = -14.31\ \text{kg/m}^2$

Wind loads are applied at the floor level:

At the level of the 1st floor: take into account half of the floor (2550 mm) + foundation above ground level (1000 mm). The design strip for the 1st floor is 2500 mm.

Typical floors calculated strip - 5100 mm.

At the roof level - 2550 mm.

For the windward side, two zones in the first zone from 0 to 35.9 m include floors 1-6 floors; in the second with 7-11 + roof.

Table 12 - Pressure across the floors of the building

	1st floor
D	$+33.3 \cdot 3.55 = 118.33\ kg/m = \ \ 1.16\ kN/m$
A	$-66.78 \cdot 3.55 = -237.0 kg/m$= -2.32 kN/m
B	$-38.16 \cdot 3.55 = -135.46\ kg/m = \ -1.32\ kN/m$
C	$-23.85 \cdot 3.55 = -84.66\ kg/m = \ -0.83\ kN/m$
E	$-14.31\ \cdot 3.55 = -50.8\ kg/m = \ -0.498\ kN/m$
	Typical floor 2-3
D	$+33.3 \cdot 5.1 = 170\ kg/m = \ \ 1.755\ kN/m$
A	$-66.78 \cdot 5.1 = -340.57 kg/m = \ -3.33\ kN/m$
B	$-38.16 \cdot 5.1 = -194.61 kg/m = \ -1.90\ kN/m$
C	$-23.85 \cdot 5.1 = -121.63\ kg/m = \ -1.19\ kN/m$
E	$-14.31\ \cdot 5.1 = -72.98\ kg/m = \ -0.715\ kN/m$
	Roof
D	$+33.3 \cdot 2.55 = 84.9\ kg/m = \ \ 0.832\ kN/m$
A	$-66.78 \cdot 2.55 = -170.3\ kg/m = \ -1.67 kN/m$
B	$-38.16 \cdot 2.55 = -97.3\ kg/m = \ -0.95\ kN/m$
C	$-23.85 \cdot 2.55 = -60.8\ kg/m = \ -0.596\ kN/m$
E	$-14.31 \cdot 2.55 = -36.5\ kg/m = \ -0.358\ kN/m$

2.2 Calculation of seismic loads

Sand and gravel soil - class C

According to the soil conditions $a_g = 0.528\ g > 0.08g$ therefore, the calculation for the determination of seismic loads along the X and Y axes is necessary.

where $a_g > 0{,}4g$; $a_{gv}/a_g = 0.9$:

$$a_{vg} = a_g \cdot 0.9 = 0.528g \cdot 0.9 = 0.47g > 0.25g \Rightarrow$$

Calculation according to horizontal:

$$a_g = 0.528g, q = 3$$

$$T_B = 0.20\ \text{c}, T_c = 0.72\ \text{c}$$

With a value of the coefficient of behavior q = 3:

At $0 \leq T \leq 0.25$:

$$S_d\ (T) = \max \left\{ \begin{array}{c} a_g\ \ \left[\frac{2}{3} + \frac{T}{T_B}\left(\frac{2.5}{\text{q}} - \frac{2}{3}\right)\right] = 0.528\left[\frac{2}{3} + \frac{T}{0.20}\left(\frac{2.5}{3} - \frac{2}{3}\right)\right] \\ = 0.528\ (0.66 + 0.83T) \\ \\ , but\ not\ less\ than\ \ a_g\ \ \cdot \frac{2.5}{\text{q}}\ = 0.528 * \frac{2.5}{3} = 0.44 \end{array} \right\}$$

At $0,25 \leq T < 0,96$:

$$S_d\ (T) = \ a_g\ \frac{2.5}{q}\ = 0.528\ \frac{2.5}{3} = 0.44$$

At $0.96 \leq T$:

$$S_d\ (T) = \max \left\{ \begin{array}{c} a_g\ \left[\frac{2.5}{q}\left(\frac{T_c}{T}\right)\right] = 0.258 \cdot \frac{2.5}{5}\left(\frac{0.96}{T}\right) = 0.124 \\ , but\ not\ less\ than\ \beta\ \ a_g\ \ = 0.2\ a_g\ \ = 0.2 * 0.258 = 0.052 \end{array} \right\}$$

$$= \max \left\{ \begin{array}{c} \frac{0.124}{T} \\ 0.052 \end{array} \right\}$$

Table 13 - Values of ordinates of the spectrum of calculated reactions at q = 3

T, c	0	0.25	0.50	0.96	1.20	1.50	2.0	2.50	3.0
Se(T), в долях g	0.028	0.129	0.129	0.129	0.103	0.083	0.062	0.052	0.052

Calculation of the acceleration S_d (T) by the formulas (4.15); (4.16); (4.17) NTP PK 08-01.1-2017 «Design of earthquake-resistant buildings and structures "and the construction of the schedule is carried out in the Excel 2020 program.

2.3 Analysis

The 7 load cases are defined in my structure and according these load case the structure is analyzed, the load cases are illustrated in following figures.

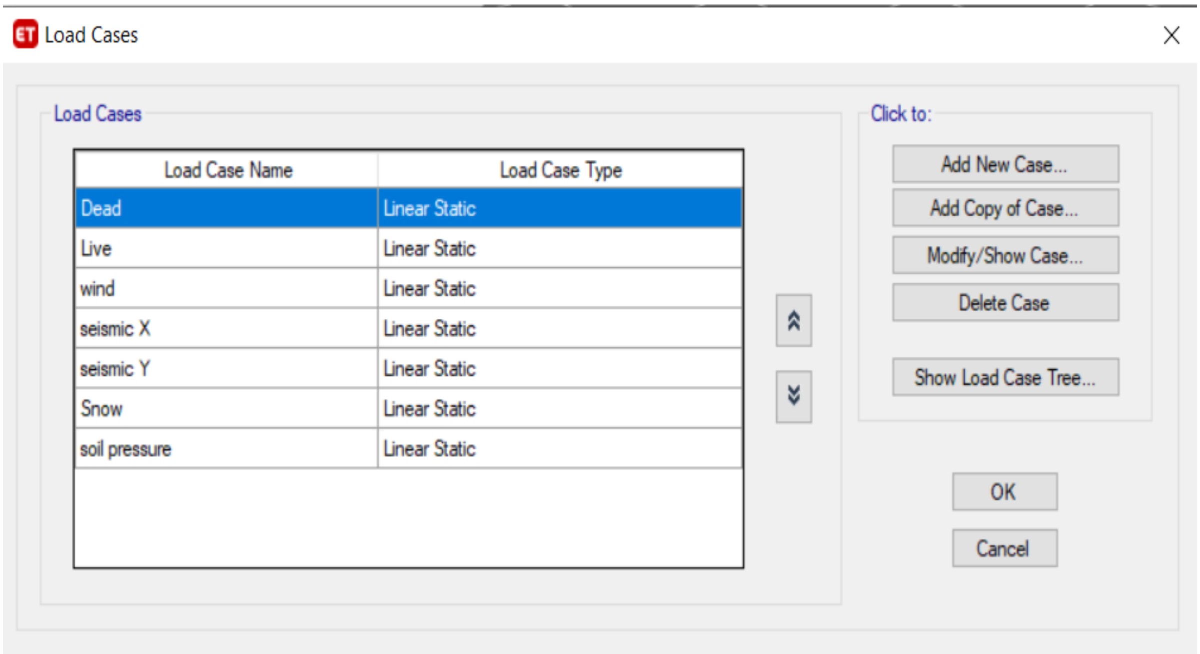

Figure 9 - Editing load case

Then we proceed to the loading of our building itself that are shown in Figure A.1, Figure A.2 and Figure A.3 in Appendix A.

2.4 Combinations of action for permanent design situation (basic combination)

All coefficient and formulas are taken from СП РК EN 1990 bases for designing loading structure. We can calculate manually by the following formulas.

$$\sum_{j\geq 1} \gamma_G \cdot G_K + \gamma_p \cdot \mathrm{p} + \gamma_Q \cdot Q_K + \sum_{i>1} \gamma_Q \cdot \Psi_{0.1} \cdot Q_k \tag{2}$$

$$\sum_{j\geq 1} \gamma_G \cdot G_K + \gamma_p \cdot \mathrm{p} + \gamma_Q \cdot \Psi_{0.1} \cdot Q_K + \sum_{i>1} \gamma_Q \cdot \Psi_{0.i} \cdot Q_k \tag{3}$$

$$\sum_{j\geq 1} \gamma_G \cdot G_K + \gamma_p \cdot \mathrm{p} + \gamma_Q \cdot Q_K + \sum_{i>1} \gamma_Q \cdot \Psi_{0.i} \cdot Q_k \tag{4}$$

where $\gamma_G = 1.35$ –for permanent loads;
G_K – sum of permanent loads;;
$\gamma_Q = 1.5$ – for temporary loads ;
Q_K – sum of temporary loads;
Ψ_0,Ψ_1,Ψ_2 – in table НП.А1.1.
Combinations of actions for seismic design situations

$$\sum_{j\geq 1} G_{kj} + \mathrm{p} + A_{Ed} + \sum_{i>1} Q_{k.i} \cdot \Psi_{2.i} \tag{5}$$

Table 13 - The values of ψ

Воздействия	ψ_0	ψ_1	ψ_2
Приложенные нагрузки в зданиях, категории (см. EN 1991-1-1):			
Категория A: бытовые, жилые зоны	0,7	0,5	0,3
Категория B: офисные площади	0,7	0,5	0,3
Категория C: зоны для собраний	0,7	0,7	0,6
Категория D: торговые площади	0,7	0,7	0,6
Категория E: складские площади	1,0	0,9	0,8
Категория F: зоны дорожного движения для транспортных средств весом ≤ 30 кН	0,7	0,7	0,6
Категория G: зоны дорожного движения для транспортных средств весом от 30 кН до 160 кН	0,7	0,5	0,3
Категория H: покрытия (крыши)[a]	0,7	0	0
Снеговые нагрузки на здания (см. EN 1991-1-3)*:			
Для районов, находящихся на высоте H > 1000 м над уровнем моря	0,7	0,5	0,2
Для районов, находящихся на высоте H ≤ 1000 м над уровнем моря	0,5	0,2	0
Ветровые нагрузки на здания (см. EN 1991-1-4)	0,6	0,2	0
Температурные воздействия (исключая пожары) на здания (см. EN 1991-1-5)	0,6	0,5	0
а) См. также 3.3.2(1) EN 1991-1-1.			

Then the combinations of design load combinations will look in accordance with Figures 8.

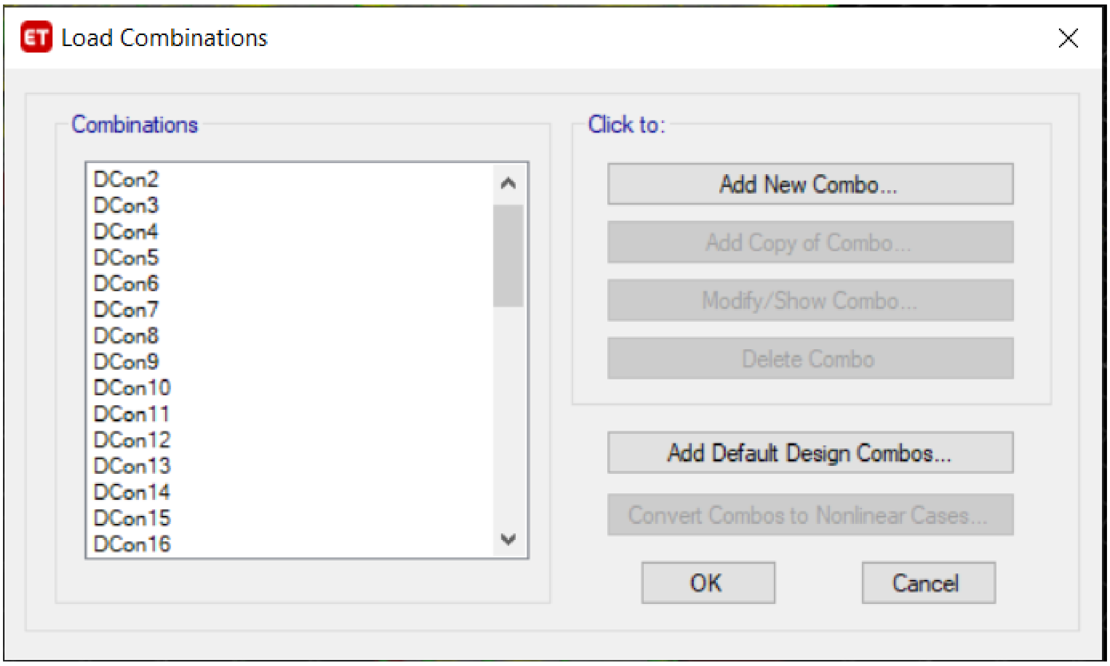

Figure 10 - Combination of actions

2.5 Ultimate strains and bases

Industrial and civil one-story and multi-storey buildings with a full frame: the same, with the device of reinforced concrete belts or monolithic floors, as well as buildings with a monolithic structure, Average s_ (max, μ) = 10 cm., Respectively, according to the standard (SP RK 5.01-102- 2013-Base, According to [1], the maximum settlement of the base is s_ (max, μ) = 10 cm)

For our design scheme, the maximum drift is 18 mm, which satisfies the condition which is shown in Figure A.4 in Appendix A,.

$s \leq s_{max,\mu}$

$18\ \text{мм} \leq 100\ \text{мм}$

The relative difference in sediment is:

$\text{RS} = (\frac{\Delta s}{L})_u,$

where L is the distance between the axes of the foundation blocks in the direction of horizontal loads, and in guyed supports - the distance between the axes of the compressed foundation.

According to Appendix B [1], the relative draft should not exceed 0.002.

Then, according to FigureA.5 in Appendix A, we get that the relative draft is:

$\frac{11}{20000} = 0.00055 < 0.002$

Conidian is met

2.6 Deflection of the slab and girder

The appearance and overall serviceability of the supporting structure may be compromised if the calculated deflection of a beam, slab or cantilever beam, near a constant combination of actions, exceeds L / 250 span. According to the standard (sn pk en 1992-1-1 + np <Design of reinforced concrete structures for buildings>, according to sub-clause 7.4 Control of deflections).

a) For plat

The deflection of the floor slab is determined according to Figure A.5 in Appendix A

The deflection is 18mm

According to subparagraph the deflection of the slab should not exceed a value equal to:

$$\frac{l}{250} = \frac{9000}{250} = 36 \text{ мм}$$

2.7 Maximum horizontal displacement from the wind

According to paragraph EN1991 10.14 of Table 22 [3], the maximum horizontal displacements from the wind are calculated by the formula:

Maximum horizontal displacements from the wind $= \frac{h}{500}$

where h - is the height of multi-storey buildings, equal to the distance from the top of the foundation to the axis of the roof girder.

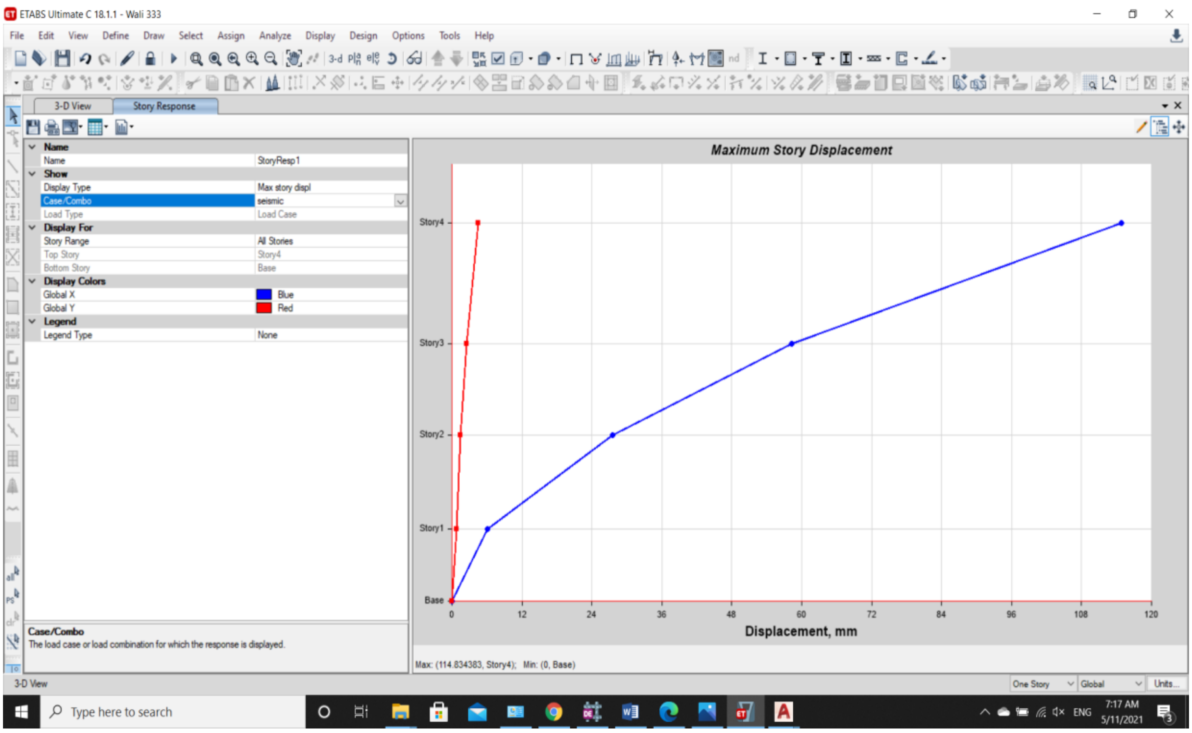

Figure 11 – Movements from the wind along the X axis

The maximum movement along the X axis is 0.5 mm.

$0.5 \text{ мм} < \frac{45000}{500} = 90 \text{ мм}$

The condition is met.

The maximum displacement along the Y-axis is 1.03 мм according Figure A.6 in Appendix A.

$1.03 < \frac{45000}{500} = 90 \text{ мм}$

The condition is met.

2.8 Checking the regularity of buildings in the plan

To begin with, let's check the building for regularity in terms of X. To do this, we use the formula according the Figure A.7 in Appendix A.

$100 - \frac{\delta_{max}+\delta_{min}}{2 \cdot \delta_{max}} \cdot 100$

$100 - \frac{0.279+0.019}{2 \cdot 0.247} \cdot 100 = 48.3\, percent$

According the Figure A.8 in Appendix A.

$$100 - \frac{\delta_{max} + \delta_{min}}{2 \cdot \delta_{max}} \cdot 100$$

$$100 - \frac{28.4 + 22}{2 \cdot 28.4} \cdot 100 = 11.2\ \%$$

According the Figure A.9 in Appendix A.

$100 - \frac{\delta_{max}+\delta_{min}}{2 \cdot \delta_{max}} \cdot 100$

$$100 - \frac{114.8 + 105.6}{2 \cdot 114.8} \cdot 100 = 4 percent$$

According the Figure A.10 in Appendix A.

$$100 - \frac{\delta_{max} + \delta_{min}}{2 \cdot \delta_{max}} \cdot 100$$

$$100 - \frac{0.53 + 0.01}{2 \cdot 0.53} \cdot 100 = 49.09 ercent$$

According the Figure A.11 in Appendix A.

$$100 - \frac{\delta_{max} + \delta_{min}}{2 \cdot \delta_{max}} \cdot 100$$

$$100 - \frac{50.2 + 38.9}{2 \cdot 50.2} \cdot 100 = 11.2 ercent$$

According the Figure A.12 in Appendix A.

$$100 - \frac{\delta_{max} + \delta_{min}}{2 \cdot \delta_{max}} \cdot 100$$

$$100 - \frac{193.5 + 178.1}{2 \cdot 193.5} \cdot 100 = 3.9 ercent$$

Since not all values exceed 25%, our building is irregular in plan along the OX and OY axes.

We take all the displacement values from the ETABS software package (story response)

2.9 Selection of reinforcement Beams

Longitudinal reinforcement calculation:

Rectangular beam ($40\ x\ 70\ cm$)

Normal concrete class $25\ /\ 30$ ($f_{ck}\ =\ 25, ϒc\ =\ 1.5, f_{cd}\ =\ acc\ *\ f_{ck}\ /\ ϒc\ =\ 1\ \cdot\ 25\ /\ 1.5\ =\ 16.67\ MPa$).

Reinforcement class S500 ($f\_yk\ =\ 440\ MPa, f\_v\ =\ f\_yk\ /\ ϒ\_s\ =\ 440\ /\ 1.15\ =\ 382.6\ MPa$), $M_{Eds} = 1257\ kN.m.$

The values are taken from the Etabs program

Where, $d = h - c_2 = 700 - 40 = 660mm$. The required area of the longitudinal reinforcement is determined according to Fig. B.1. Appendix B.

Find the value

$$\alpha_{Eds} = \frac{M_{Ed}}{f_{cd} \cdot b \cdot d^2}$$

$$\alpha_{Eds} = \frac{1257 \cdot 10^3}{16.67 \cdot 10^6 \cdot 0.4 \cdot 0.7^2} = 0.384 \geq a_{Eds}, lim = 0.372$$

As $\alpha_{Eds} = 0.384 > \alpha_{Eds}, lim = 0.372$(see figure B.1. Appendix B) For given cross-sectional dimensions and concrete class, compressed reinforcement is required.

Calculation of bending members using the dimensionless binding coefficient P according to Table B.4 of Appendix B

Selection of the cross-sectional area of the stretched $A_{s1}$and compressed A_{s2} fittings are produced using table. B.4. Appendix B for determining the bearing capacity of bending elements of rectangular cross-section with double reinforcement using a dimensionless coupling coefficient k_d.

The cross-sectional areas of tensileA_{s1} and compressed A_{s2} reinforcement, if compressed reinforcement is required by calculation, are determined by the formulas:

$$k_d = \frac{d(cm)}{\sqrt{\frac{M_{Eds}(kN.m)}{b(m)}}} (cm, table\ B4\ of\ Appendix\ B) \qquad 2.1$$

$$M_{Eds} = M_{Ed} - N_{Ed} \cdot z_{s1} = 1257kN.m\ (N_{Ed} = 0)$$

$$k_d = \frac{66cm}{\sqrt{\frac{1257\ kN.m}{0.4}}} = 1.18 \cong 1.19$$

To ensure sufficient bearing capacity of the element, the relative height of the compressed zone $\xi = \frac{x}{d}$ when applying a linearly elastic (general) calculation should not exceed the following value $\xi_{lim} = 0.45cm$

We define k_d according to the table B.4. appendix B. for bending elements rectangular section with double reinforcement for $\xi_{lim} = 0.45cm$ we get $k_{s1} = 2.77 \cong 2.74$ and $k_{s2} = 0.40$.

$$\frac{c_2}{d} = \frac{4cm}{66cm} = 0.06$$

Acording to the B.4.

$$\rho_1 = 1; \ \rho_2 = 1$$

$$A_{s1}(cm^2) = p_1 \cdot k_{s1} \cdot \frac{M_{Eds}(kN.m)}{d(cm)} + \frac{N_{Ed}(kN)}{43.5}; \qquad 2.2$$

$$A_{s1} = 1 \cdot 2.77 \cdot \frac{1257(kN.m)}{66(cm)} + \frac{0(kN)}{43.5} = 33.21cm^2$$

We accept $(7\phi 25)\ S500\ (A_{s1} = 34.36\ cm^2)$

$$A_{s2}(cm^2) = p_2 \cdot k_{s2} \cdot \frac{M_{Eds}(kN.m)}{d(cm)}; \qquad 2.3$$

$$A_{s2} = 1 \cdot 0.40 \cdot \frac{1257kN}{66\ cm} = 7.61\ cm^2$$

We accept: $3\phi\ 20\ S500\ (A_{s2} = 7.63\ cm^2)$.

Calculation of transverse reinforcement class $S235(f_{yk} = 235MPa, f_{ywd} = 235MPa)$. Longitudinal reinforcement class $S500(f_{yk} = 500MPa, f_{yd} = 382.6MPa,\ E_s = 20 * 10^4)$; sectional area of tensile reinforcement$A_{s1} = 57.7\ cm^2 (6\phi\ 36)$

Required: Determine the area and spacing of the transverse reinforcement (use the method truss analogy).

To do this, we define the shear force that concrete can perceive by the formula:

$$V_{Rd,c} = \left\{\left(\frac{0.18}{\gamma_c}\right) \cdot k \cdot (100\rho_l \cdot f_{ck})^{\frac{1}{3}}\right\} \cdot b_w \cdot d,\ \ kN \qquad 2.4$$

but not less

$$V_{Rd,c,min} = \{0.0035 \cdot k^{\frac{3}{2}} \cdot f_{ck}^{\frac{1}{2}}\} \cdot b_w \cdot d, \qquad kN$$

where

$$k = 1 + \sqrt{\frac{400}{700}} \leq 2, k = 1 + \sqrt{\frac{400}{700}} = 1.756;$$

$$\rho_l = \frac{A_{s1}}{b_w \cdot d} = \frac{5770}{400 * 700} = 0.02 \leq 0.02$$

$d = h - c = 700 - 30 = 670;$

$$V_{Rd,c} = \left\{\left(\frac{0.18}{1.5}\right) \cdot 1.756 \cdot (100 * 0.02 \cdot 25)^{\frac{1}{3}}\right\} \cdot 400 \cdot 700 = 217363N = 217.4\ kN$$

$$V_{Rd,c,min} = \left\{0.0035 \cdot 1.756^{\frac{3}{2}} \cdot 25^{\frac{1}{2}}\right\} \cdot 400 \cdot 700 = 11402N = 11.4kN$$

According the Etabs calculation$\mathrm{V_{Ed}} = 180.95kN$

$V_{Rd;c,min} < \mathrm{V_{Ed;max}} < \mathrm{V_{Rd;c}}, max$= ; 11.4 kN < 180.95 kN <217.4 kN

The step of the transverse reinforcement is determined by the formula:

$$s \leq 0.75d$$

$$s \leq 0.75 \cdot 700 = 525\ mm$$

We accept the step of the transverse reinforcement s = 525mm

$$A_{sw} = \frac{\mathrm{V_{Ed;max}} \cdot \mathrm{s}}{\mathrm{d_z}\ f_{sw} \cos \Upsilon} \tag{2.5}$$

Where according etabs $\mathrm{V_{Ed;max}} = 609.7$(lateral reinforcement in a given section.

We set the angle of inclination of the cracks to the horizontal $\Upsilon = 21.8^{\circ}$

The first design section is assigned at a distance($d_z = 660\ mm$)

$f_{sw} = 235$

$$A_{sw} = \frac{609.7 \cdot 10^3 \cdot 525}{660 \cdot 235 \cot 40^{\circ}} = 1719.8\ mm^2 = 17.2\ \text{см}^2$$

We accept: nine rebar by diameter of twelve 9 $\phi 12\ S500$ ($A_{sw} = 18.09\ cm^2$).

In this case, the following conditions must be met:

$$\frac{\mathrm{A_{sw}} \cdot \mathrm{f_{sw}}}{\mathrm{b_w} \cdot s} \leq 0.5 \cdot \mathrm{v} \cdot \mathrm{f_{cd}} \tag{2.6}$$

Where v_ coefficient, taking into account the reduction in the strength of concrete in compression under tension and equal for heavy concrete:

$$v = 0.6\left(1 - \frac{f_{ck}}{250}\right) = 0.6\left(1 - \frac{25}{250}\right) = 0.54 \geq 0.5$$

$$\frac{18.09 \cdot\ 235}{400 \cdot\ 525} \leq 0.5\ \cdot\ 0.54\ \cdot\ 16.67$$

$0.020 \leq 0.44$(the condition is met

$$\mathrm{V_{Ed;max}} < \mathrm{V_{Rd;c}}, max = \frac{\mathrm{v} \cdot \mathrm{f_{cd}} \cdot \mathrm{b_w} \cdot \mathrm{d_z}}{\cot 40 + \tan 40} = \frac{0.54 \cdot 16.67 \cdot 400 \cdot 660}{\cot 40 + \tan 40} = 2725940N = 2726kN$$

$\mathrm{V_{Ed;max}}$ =609 kN $< \mathrm{V_{Rd;c}}, max = 2726kN$, the condition is met.

Other sections are calculated in the same way.

2.10 Manual Calculation of Circular Columns

Longitudinal reinforcement calculation:
Circular column ($\emptyset 70\ cm$)
Normal concrete class $25\ /\ 30$ ($f_{ck} = 25, \Upsilon c = 1.5, f_{cd} = acc \cdot f_{ck}\ /\ \Upsilon c = 1 \cdot 25\ /\ 1.5 = 16.67\ MPa$).
Reinforcement class S500 ($f\_yk = 440\ MPa, f\_v = f\_yk\ /\ \Upsilon\_s = 440\ /\ 1.15 = 382.6\ MPa$), $M_{Eds} = 651\ kN.m, V_{Ed} = 336.91$kN
The values are taken from the Etabs program

2.10.1 Determination of Longitudinal forces From Design Loads

First we need to find the length of column:

$$lc = hf - hsl = 5100 - 70 = 5030mm$$

Area of Column:

$$d = 0.7m$$

$$A = \pi(d/2)2 = 3.14\ (0.7/2)2 = 0.3846m2$$

Load area of the middle column with a grid of columns 8×4.6 = 36.8 m^2.
Constant load: -from overlapping according to the formula from 45 [9]:

$$N_1 = \gamma_n g A_{\text{гр}} \tag{2.7}$$

where g – floor Design load,
$A_{\text{гр}}$–middle column cargo area

$$N_1 = 0.95 \cdot 9.885 \cdot 36.8 = 642.3 \text{ kN}$$

Column dead weight according to the formula from 47 [9]:

$$N_3 = \gamma_n \gamma_f A_C H_{\text{эт}} \rho \tag{2.8}$$

where, A_c – Column Area;
$H_{\text{эт}}$– Floor height;

$$N_3 = 0.95 \cdot 1.1 \cdot 0.3846 \cdot 5.1 \cdot 25 = 51.2 \text{ kN}$$

-from the coating is determined by the formula from 48 [9]:

$$N_4 = \gamma_n \gamma_f g_{\text{покр}} A_{\text{гр}} \tag{2.9}$$

Where $g_{\text{покр}}$–temporary load from the coating;

$$N_4 = \gamma_n \gamma_f g_{\text{покр}} A_{\text{гр}} = 0.95 \cdot 1.1 \cdot 5 \cdot 36.8 = 192.3 \text{ kN},$$

The total constant load is:

$$N_{\text{пост}} = (336.91 + 194) \cdot 2 + 194 \times 3 + 192.3 = 1836.12\ kN.$$

Live load: -from the overlap is determined by the formula from 49 [9]:

$$N_5 = \gamma_n \gamma_f \vartheta \mathrm{A}_{\text{гр}} n_{\text{перекр}} \quad (2.10)$$

Where ϑ – temporary design load

$$N_5 = 0.95 \cdot 1.2 \cdot 5 \cdot 36.8 \cdot 3 = 629.28 \text{ kN}$$

-from snow is determined by the formula from 50 [1]:

$$N_6 = \gamma_n \gamma_f p \mathrm{A}_{\text{гр}} \quad (2.11)$$

Where p – snow load

$$N_6 = 0.95 \cdot 1.4 \cdot 0.96 \cdot 36.8 = 47 \text{ kN}$$

Longitudinal force acting on the column:

$$\text{N} = V_{Ed} = N_{\text{пост}} + N_{\text{врем}} = -2200\ kN\ .$$

Shear Force according to ETABS software:

N=336.91KN

M=651KNm

2.10.2 Selection of section and calculation of the sectional area of reinforcement

Effective length of column:

$$l_0 = 0.7 \cdot l = 0.7 \cdot 5030 = 3521\text{mm}$$

Calculate the eccentricity of column [10]

$$e0 = \frac{lc}{400} \quad (2.12)$$

$$e_0 = \frac{35210}{400} = 8.8\text{mm}$$

$$M_{Ed} = e_0 \cdot N \quad (2.13)$$

$$M_{Ed} = 0.0095 \cdot 2200.1 = 209\text{kNm}$$

Calculate the slenderness value:

$$\lambda = \frac{4 \cdot l_0}{d} \quad (2.14)$$

$$\lambda = \frac{4 \cdot 3521}{700} = 15.76$$

Design shear force caused by the load on column:

$$V_{Ed} = \frac{N_{Ed}}{(Acf_{cd})} \quad (2.15)$$

V_{Ed} = -2200000/3846×16.67 = -33.64
V_{Ed} = -336918/(3846×16.67) = -5.15

$$a_{Eds} = \frac{M_{Ed}}{(Ac\ h\ f_{cd})} \tag{2.16}$$

a_{Eds} = 651000000/(384600× 700 ×16.67) = 0.014
ω_{tot} = 0.5

The total area of the longitudinal reinforcement in the section [10].

$$A_{s,tot} = \frac{\omega_{tot}\mathrm{Ac}}{\frac{f_{yd}}{f_{cd}}} \tag{2.17}$$

$$A_{s,tot} = \frac{0.5 \cdot 384600}{26.39} = 7286\ mm^2$$

A_{s1} = A_{s2} = 3643 mm^2, accept 14 rebar by diameter twenty five(14Ø25 S500).
The step is taken based on the conditions:
- No more than 500 mm;
- No more $20d_{min}$.
The step is taken equal to 400 mm.
1) Checking the percentage of column reinforcement:

$$\mu = \frac{As}{Ac} \cdot 100\% = \mu = \frac{8144}{384600} \cdot 100\% = 2.1\%$$

2) Assign the diameter of the cross bars:

dsw≥0.25ds = 0.25 · 36 = 9 mm (according to the design rules, the smallest the diameter of the transverse reinforcement bars in the frames must be at least 6mm, so we take dsw = 10mm (A-I).

3) Checking for load-bearing capacity and stability:

Checking the bearing capacity of a column is reduced to checking the condition:

$$N \le \varphi(R_b Ac + R_{sc} A_{s,tot}) \tag{2.18}$$

Determine the value of the buckling factor φ (according to Table 6.1. SP52-101-2003):

l / h = 3940/700 = 5.6 => φ = 0.88
$2500 \le 0{,}88*(16.67*10^6*0{,}3846+695*10^6*8144*10^{-6})$
2500 KN ≤49808KN

4) Column stability check is performed according to the condition:

$$\sigma = \frac{N}{\varphi \cdot A} \le Rb*\gamma c \tag{2.19}$$

$$\sigma = \frac{2200}{0.88 \cdot 0.3846} \le 176.67*1.5 = 6.38MPa \le 25.5MPa$$

Condition is met

3 Technological section

3.1 Initial information for underground parts of the building

Depending on the work performed, units of measurement of volumes of earthly work can be as in cubic meters, as well as in square meters. Primitive, standard geometric shapes are used in the calculations of soil volumes.

Short, basic data on the condition of the soil and its characteristics: loam, heavy without application and with the addition of crushed stone, gravel, pebbles up to 10 percent by volume.

This category of soil - C;

Transportation distance - 2 km;

Marking the bottom of the pit - -3.8 m;

Construction dimensions - 67x79m;

Level of groundwater

Table 14 - The main characteristics of the soil

Name	Unit measurements	Numeric data
Soil group		
Average soil density		
Initial ratio loosening		
Residual coefficient loosening		
Slope steepness (m)		

3.2 Calculation of the volume of earthworks

Before proceeding with the determination of the volume of the excavation, it is necessary to calculate the length and width of the excavation at the top and at the bottom, since the steepness of the slope differs from 1, we cannot develop a pit with vertical walls.

Construction of industrial structure foundations with the preparation of temporary excavations includes works listed in table 3.2

Table 15 – Foundations with the preparation of temporary excavations

(Name of processes)	Unit of measure	(Volume of work)	
		(on one base)	(in total)
The construction of temporary fencing	m		372
Removal of top soil)	m^3		1535
Soil excavation in the pit (trench) and trench access to the pit	m^3		570
Excavation of soil underrun	m^3		$568.54m^3$
Concrete preparation for foundations	m^3		24.5
Reinforcement installation, incl			71940

Cantinuation of table 15 - Foundations with the preparation of temporary excavations

a) grids installation	pieces/t		50358
b) frames installation	pieces/t		21582
Formwork installation)	m^2		1194.48
Concreting of foundations	m^3		224.8
Formwork removal	m^2		-
Foundation waterproofing	m^2		1448.4
Backfilling	m^3		9600
Soil compaction	m^2		24000
Final land planning	m^2		1293
Removal of temporary fencing	m		372

3.2.1 The construction of temporary fencing

Prior to the construction work necessary to perform the construction temporary fencing, fencing perimeter, m, determined by the formula:

$$P_{fen} = (20 + l_1) \cdot 2 + (20 + l_2) \cdot 2 \quad (3.1)$$

Where l_1, l_2– length and width of the structure in plan, m.

Distance from the axis of the building in each direction is 20 m.

$$P_{fen} = (20 + 67) \cdot 2 + (20 + 79) \cdot 2 = 372\text{m}$$

3.2.2 Removal of top soil

During pit excavation removal of top soil to be implemented at the area

$$S_1 = (10 + l_{1s.t} + 10) \cdot (10 + l_{2s.t} + 10), (m^2) \quad (3.2)$$

where $l_{1s.t}$– the pit length at the top, m;

$l_{2s.t}$– the pit width at the top, m,

Where

$$l_{1s.t} = l_{1s.b} + 2mh \quad (3.3)$$

$$l_{2s.t} = l_{2s.b} + 2mh \quad (3.4)$$

where $l_{1s.b}$ – the pit length at the bottom;

$l_{2s.b}$ – the pit width at the bottom.

$$l_{1s.b} = l_1 + (1,3x2), \text{ m} \quad (3.5)$$

$$l_{2s.b} = l_2 + (1,3x2), \text{ m} \quad (3.6)$$

where m– slope steepness factor;

h–formation level (the height of the pit), m;

1,3m– distance between the axis and slope bottom, destined for a person access to the structure; annex № 1. table.2

l_1, l_2– length and width of the structure in plan, respectively, m.

$$l_{1s.b} = 67 + (1,3\cdot2) = 69.64 \text{ m}$$

$$l_{2s.b} = 79 + (1,3\cdot2) = 81.64\text{m}$$

$$l_{1s.t} = 69.64 + 2\cdot0.75\cdot3.80 = 75.34$$

$$l_{2s.t} = 81.64 + 2\cdot0.75\cdot3.80 = 87.34$$

So:

$$S_1 = (10 + 75.34 + 10) \cdot (10 + 87.34 + 10) = 10234\ m^2$$

The total volume of top soil, m^3 removal is calculated by the formula:

$$V_{s.r} = S_{1(a)} x 0,15m, \quad (3.7)$$

$$V_{s.r} = 10234 \cdot 0.15m = 1535m^3$$

3.2.3 Soil excavation in the pit

Pit volume determination.

$$V_p = \frac{h}{6} \cdot [(2\cdot l_{1s.b} + l_{2s.t})\ l_{2s.b} + (2\cdot l_{1s.t} + l_{1s.b})\cdot l_{2s.t}],\ (m^3) \quad (3.8)$$

Where, h– depth of pit, m.

$$V_p = \frac{3.8}{6} \cdot [(2 \cdot 69.64 + 87.34)81.64 + (2 \cdot 75.34 + 69.64)87.64 = 23946.4m^3$$

Earthworks quantity of the trench access to the pit is calculated by the formula:

$$v_{tr.a} = \beta\left(\frac{\text{b}\times\text{h}^2}{2} + \frac{h^3\times m}{3}\right) \quad (3.9)$$

where B – factor of access trench bottom construction, $\beta=\frac{100}{i}$;

i – access slope, % (for the project can be accepted 10% and I:10=10);

h– depth of pit, m.

b–access trench width on the bottom, is accepted independently and equals 3,5 (with one–way traffic) or 6 (with two– way traffic), m;

m–slope construction factor

All soils for backfilling, forming further the foundation basis for the equipment, floors, a perimeter walk, access roads to be compacted. During determination of filled and compacted layers' thickness, number of passes of soil compacting machines it is reasonable to implement it.

$$v_{tr.a} = 10\left(\frac{6\times3.8^{\ 2}}{2} + \frac{3.8^3\times0.75}{3}\right) = 570.4m^3$$

3.2.4 Excavation of soil shortage

In the course project, a manual soil treatment was adopted. Mechanization of cutting of under burden is carried out according to ENIR Collection E2. Earthwork. Issue 1. Mechanized and manual excavation.

The volume of soil shortage is calculated by the formula

$$V_{\text{shortage}}=F_p \cdot\Delta h_{sh},\ (m^3) \tag{3.10}$$

where, F_p – area of the pit (trench) bottom:

For area of 67x79 of the building:

$$F_p = l_{1s.b.}\cdot l_{2s.b.}\ \ldots.\ 12$$

$$F_p = 69.64\cdot81.64 = 5685.4\ \text{m}^2$$

Δhsh – $\frac{0.05}{0.2}$ – quantity of soil shortage level during excavation, m.

$$V_{shortage} = 5685.4 \cdot 0.1 = 568.54m^3$$

3.2.5 Concrete preparation for foundations

In soft soils for monolithic foundations is arranged concrete preparation from lean concrete.

The quantity of concrete preparation for one foundation is:

$$W_p = F_p \cdot h_p,\ m^3 \tag{3.11}$$

Where h_p – thickness of concrete preparation, h_p=0,1m;

p – area of preparation:

$F_p = \text{a}_1 \cdot b_1,\ m^2$

Where, a_1 and b_1 – the dimensions of concrete preparation, ref. foundation section [4].

$$F_{p1} = 23 \cdot 1 = 23\ m^2$$

$$F_{p1}=5 \cdot 23 = 115\ m^2$$

$$F_{p2}= 25 \cdot 1= 25\ m^2$$

$$F_{p2} = 2 \cdot 25 = 50\ m^2$$
$$F_{p3} = 6 \cdot 5 = 30\ m^2$$
$$F_{p3} = 4 \cdot 6 = 24\ m^2$$
$$F_{p4} = 2 \cdot 13 = 26\ m^2$$
$$F_p = 23+25+50+30+24+26 = 245\ m^2$$

So

$$W_p = 245 \cdot 0.1 = 24.5 m^3$$

3.2.6 Reinforcement installation

Reinforcement consumption for the strip foundation**:**

$$G_1 = g \cdot V_{s/f},\ t \tag{3.12}$$

Where, g – reinforcement frame consumption for $1m^3$ of concrete, kg/m^3 (100–150 kg/m^3);

$$V_{s/f} = (h_{f\ (s)} \cdot 0,3 \cdot P_{base.}) + (h_{f\ (b)} \cdot 0,8 \cdot P_{base}),\ m^3 \tag{3.13}$$

Where $V_{s/f}$ – volume of strip foundation, m^3;

$h_{f\ (b)}$ – the height of the foundation base, ref. monolithic strip foundation;

$h_{f\ (s)}$ – the height of the structure basement, ref. monolithic strip foundation section;

P_{base} – total foundation length per the scheme

$$P_{base} = 67+79 = 146 \text{ m}$$
$$V_{s/f} = (4.8 \cdot 0,3 \cdot 146) + (3.8 \cdot 0,8 \cdot 146) = 654 m^3$$
$$G = 110 * 654 = 71940 \text{ kg}$$

Reinforcement weight distribution between grid and frame conditionally accepted as: for the grid–0,7G_1; for the frame – 0,3G_1. 21582

$$\text{Grid} = 0.7*71940 = 50358 \text{ kg}$$
$$\text{Frame} = 0.3*71940 = 21582 \text{ kg}$$

3.2.7 Formwork installation

The quantity of formworks is equal to the area of the surfaces form. It is necessary to count the area of rectangular side faces of the foundation and trapezoidal inner glass surfaces. The scheme of foundations reinforcement, type of reinforcement structures and reinforcing bars consumption in real conditions is included in the working drawings of the foundations. In the Course Project the amount of reinforcement work is defined as follows. Accepted the foundation reinforcement in the form of a horizontal grid at the bottom and vertical spatial frame at the entire height of the concrete preparation to the top of column footing [2].

3.2.8 Concreting of foundations

Concrete quantity in the foundations is determined by geometry formulas with the use of plan and foundation section drawn earlier

For the strip foundation:

$$V_{s/f}=(h_{f\ (s)} \cdot 0{,}3 \cdot P_{base.}) + (h_{f\ (b)} \cdot 0{,}8 \cdot P_f),\ m^3 \quad (3.14)$$

Where $V_{s/f}$– volume of strip foundation, m^3;

$h_{f\ (b)}$ – the height of the foundation base, ref. monolithic strip foundation section;

$h_{f\ (s)}$ – the height of the structure basement, ref. monolithic strip foundation section;

P_f – total foundation length per the scheme (8 page).

$$V_{s/f}=(3 \cdot 0{,}3 \cdot 146) + (0.8 \cdot 0{,}8 \cdot 146) = 224.8m$$

3.2.10 Foundation waterproofing

In the course project adopted the following form of waterproofing – waterproofing coating. Painting is done by applying bituminous mastics to the surface to be painted.The number of applied layers is 2. Waterproofing is carried out in accordance with E4-3- 184.

For the strip foundation [5]:

To calculate the amount of work necessary to find the surface waterproofing area.

$$S_{waterproof} =[(h_{f\ (s)} \cdot P_{\text{exterior walls}}) + ((0{,}25 + 0{,}3) \cdot P_{\text{exterior walls}})] \cdot 2,\ m^2$$

Where $h_{f\ (s)}$ – the height of the structure basement, ref monolithic strip foundation section (figure.3);

$P_{\text{exterior walls}}$– perimeter of the exterior walls of the building.

P = 204 m (according to my scheme)

$$S_{waterproof} =[(3 \cdot 204) + ((0{,}25 + 0{,}3) \cdot 204)] \cdot 2 = 1448.4\ m^2$$

3.2.11 Backfilling

The volume of soil to be backfilled in the pit gaps, in structures with basements is calculated by the formula:

$$v_{b.f} = \frac{v_{p} - v_{s/f} - v_{cellar}}{1+K_{rl}} \quad (3.15)$$

Where $V_{s/f}$– volume of strip foundation, m^3;

V_{cellar}– volume of cellar:

$$V_{cellar} = l_1 \cdot l_2 \cdot h_{f\ (b)}, m^3$$

$$V_{cellar} = 67 \cdot 79 \cdot 0.8 = 4234.4 m^3$$

Where K_{rl} – Index of residual soil loosening.

$h_{f\ (s)}$ – the height of the structure basement, ref. monolithic strip foundation section;

$$v_{bf} = \frac{23946.4-224.8-4234.4}{1+1.03} = 9600\ m^3$$

3.2.12 Soil compaction

Compaction volume is measured mainly by the area of compaction that can be found, given by the average value of the compacted layer thickness:

$$v_{com} = \frac{v_{bf}}{h_c}\ m^2 \quad (3.16)$$

Where V_{bf} – backfilling volume, m^3;

h_c– compacted layer thickness, 0.2÷0.4 m.

$$v_{com} = \frac{9600}{0.4} = 24000\ m^2$$

3.2.13 Final land planning

The final planning is made after the completion of all excavations and communication devices:

$$S_{planning} = S_{1(a)} - S_{building}, m^2$$

Where $S_{1\ (a)}$ – cutting area of the vegetation layer of the pit;

$S_{building}$– area of the building.

$$S_{planning} = 5293 - 4000 = 1293\ m^2$$

3.2.14 Removal of temporary fencing

After finishing the construction work necessary to remove the construction temporary fencing, fencing perimeter determined by the formula (for the pit):

$$P_{fen} = (20 + l_1) \cdot 2 + (20 + l_2) \cdot 2,\ m,$$

Where l_1, l_2– length and width of the structure in plan, respectively m;

Distance from the axis of the building in each direction is 20 m.

$$P_{fen} = (20 + 67) \cdot 2 + (20 + 79) \cdot 2 = 372\ m$$

3.3 Method choice of complex mechanized earthworks process

3.3.1 Selection of the bulldozer

During the comprehensive mechanization, the processes are performed by machine sets, complementing each other and linked to each other on the basic parameters and the location in the processing chain.

Table 16 – Earthmovers recommended for top soil removal

The average distance of soil haulage	Up to 50	50 to 70	70 to 150
Recommended equipment	Bulldozer on the tractor basis with the power, kW (l.s.)		
Equipment features	Up to 59	Equipment features	Up to 59

I going to choose bulldozer on the tractor basis with the power 70-150 KW the tractor I need *DET250* and bulldozer *DZ – 34s*

Shift operating of the bulldozer is calculated per the formula

$$P_{sh.o} = \frac{60 \cdot T \cdot q \cdot \alpha \cdot Ctime}{T_l + T_s + \frac{l_r}{V_r} + \frac{l_n}{V_n}} \qquad (3.17)$$

where T – bulldozer working hour in a shift, 8h;

q – the soil volume moved with a dump m^3. (Annex. No. 1 of tab. 7);

α – factor, including the loss of soil in the process of haulage, α = 1+ 0,005$\cdot l_r$;

C_{time}– Factor of the equipment usage in time (during haulage of loosened rock material 0.75; in other cases – 0.8);

T_l – Time for a set of soil category = 0.24 min

T_s – Time spent on switching speeds = 0.17 mi

l_r, l_n – estimated haulage distance with the load and empty, $l_r = l_n$= 79m is determined by each student individually;

V_r, V_n –bulldozer speed during soil transportation (charged) and forward drive; V_r = 2.3 $\frac{km}{h} = 38.33\ \frac{m}{min}$

V_n = 6.4 $\frac{km}{h}$ = 106.3 $\frac{m}{min}$

$$P_{sh.o} = \frac{60 * 8 * 60 * 7.5 * (1 + 0.005 * 79) * 0.75}{0.24 + 0.17 + \frac{79}{38.33} + \frac{79}{106.6}} = 48560$$

3.3.2 Selection of the excavator

Selection of excavator depends on the soil volume in the pit (trench) (annex. №. 1 of tab. 6). To determine the cost of $1m3$ of soil in the pit (trench) for each excavator type:

$$c_{(1,2)} = \frac{1.08c_{eqp-shift}}{p_{shf.pr}} \tag{3.18}$$

We select this excavator *E-10011E (D)* old *(E-1003)*

Where 1.08– factor including overheads;

$C_{eqp.-shift}$ – cost of equipment– shift of excavator = 35.9;

$P_{shf.pr.}$ – Excavator shift production, including soil excavation for dump and with loading in vehicles.

Shift production can be calculated by the following formula:

$$P_{shf.pr.(1,2)} = \frac{V_{k(tr)}}{\sum N_{qp-shift}} \tag{3.19}$$

Where $\sum N_{qp.-shift}$– total number of equipment–shifts of excavator.

For the pit:

$$\sum N_{qp-shift} = \frac{V_k}{100} H_{sd} + \frac{V_{tr,a}}{100} H_{sd} \tag{3.20}$$

Where H_{sd}– standard duration of the excavation cycle;

V_k–soil quantity of the pit;

$V_{tr.a.}$–Access trench quantity.

$$\sum N_{qp-shift} = \frac{23946.4}{100} * 25.4 + \frac{570.4}{100} * 25.4 = 6227$$

$$P_{shf.pr.(1,2)} = \frac{23946.4}{6227} = 3.88$$

$$c_{(1,2)} = \frac{1.08 * 35.9}{3.84} = 10.0$$

To be determined the specific capital investments for the development of 1 m^3

of soil in the pit (trench) for each type of excavators:

$$C_{sp.(1,2)} = \frac{1.07C_{i.e}}{P_{shf}} \tag{3.21}$$

Where $C_{i.e.}$ – inventory estimated cost of excavator (annex. №1. tab.3)

$P_{shf.}$ – Number of excavator work shifts in a year. Approximately it can be accepted as 350 shifts for machines with bucket capacity of up to $0.65m^3$ inclusive and 300 –for the bucket more than $0{,}65m^3$.

$$C_{sp.(1,2)} = \frac{1.07 * 21.96}{350} = 0.06$$

The final selection of the excavator is produced on the basis of comparison of specific reduced development costs of $1m^3$ of soil [2]:

$$P_{sp(1,2)} = c_{(1,2)} + E_n . C_{sp(1,2)} \tag{3.22}$$

Where E_n – normative factor of effectiveness of capital investments, equal to 0.15;

$$P_{sp(1,2)} = 10 + (0.15 \cdot 0.06) = 10.21$$

The operational capacity of the excavator is calculated using the formula:

$$P_{sh.o.} = T \cdot 60 \cdot g \cdot n \cdot K_l \cdot K_b \tag{3.23}$$

Where T–shift duration, 8 hour;

g –bucket volume;

n – number of cycles per minute $\frac{60}{}$;

K_l – bucket volume usage factor (annex. №1. Table. 23);

K_b – shift percent uptime (0,8–0,85);

t_c – time of one cycle.

$$P_{sh.o.} = 8 \cdot 60 \cdot 1 \cdot 2.2 \cdot 0.8 \cdot 0.85 = 718$$

3.3.3 Selection of mechanisms for soil compaction

Shift operating performance of rollers is calculated by the formula:

$$P_{sh.o} = \frac{(B-b)*V*1000*h*T}{m} 0.85 \tag{3.24}$$

Where, B– width of compaction line (annex. №1. Table. 4) = 2.5m

b – width of overlap of adjacent lines (0.1–0.2 m) = 0.15m

ν – average speed (4–6 km / h) = $5\frac{km}{h}$ =

h – width of the condensed layer, m (annex. №1. Table. 4) = 50
m– Required number of blows or passes (8…10) = 9

$$P_{sh.o}\frac{(2.5-0.15)*5*\frac{1000m}{60min}*1000*50*8*60}{9}0.85=5092.59$$

So we select rammer *D-471V***.**

3.4 Selection of vehicles for the construction of excavations

As a set of equipment for haulage of extra soil out of pit (trench) and ensuring of joint work with excavator to be chosen dump trucks. Dump trucks are selected by two parameters: the capacity of the body and carrying capacity. Carrying capacity and brand of dump truck are shown in (Annex №1. table 12).

The dump truck MA3–525 (MAZ–525) was selected with the following characteristics:
Characteristic: Dump truck Onboard
Loading capacity, t: 25

The solid soil volume in excavator bucket is determined:

$$V_{soil}=\frac{V_{buck}*c_f}{c_{fr}} \tag{3.25}$$

Where, V_{buck}–accepted volume of excavator bucket = 1 m3;
c_f–bucket filling factor (for front shovel from 1 to 1.25) = 1.15;
The backhoe – from (0.8 to 1) = 0.9;
C_{fr}– Initial increase soil volume later developments (annex. №1.tab.1) = $1.2m^3$;

$$V_{soil}=\frac{1*1.15}{1.2}=0.95\ m^3$$

The soil volume in excavator bucket is determined:

$$Q = Vsoil \cdot \mathcal{V} \tag{3.26}$$

Where, $\mathcal{V}$–average soil density (on ENIR), for clay–1600 kg/m3.
Q = 0.95 × 1800 = 1710 kg
Number of soil buckets, loaded into dump truck body:

$$n=\frac{P}{Q} \tag{3.27}$$

Where, P– truck carrying capacity (annex. №1. tab.14) = 25 ton = 25000 kg

$$n = \frac{25000}{1710} = 14.61 = 15$$

The solid soil volume in excavator bucket, loaded into dump truck body is determined:

$$V = V_{soil} \cdot n. = 0.95 * 15 = 14.25$$

The duration of one work cycle of the truck is calculated

$$T_c = t_1 + \frac{60L}{v_r} + t_p + \frac{60L}{V_n} + t_m \quad (3.29)$$

Where, t_1– time of soil loading (min.) determined by a formula:

$$t_1 = \frac{v*N_{tm}*60}{100} \quad (3.30)$$

Where, N_{tm} – standard of machine time per the ENiR (annex. №1 tab.22) = 32.1;

$$t_1 = \frac{14.25 \times 32.1 \times 60}{100} = 274 \text{ min}$$

L– distance of ground transportation = 1 km;

$V\ r$– average speed of loaded truck (annex. №1 tab.16.1) = 25$\frac{km}{h}$ = $416.66\ \frac{m}{min}$

$V\ n$– average speed of empty truck (annex. №1 tab.16.1) = 30 $\frac{km}{h}$ = $500 \frac{m}{min}$

tp– defrocking time (annex. №1 tab.16) = 1.3 min;

tm– duration of auxiliary operations (installation time for loading, unloading, expectation at the excavator, admission of the oncoming dump truck), min, (annex №1. table 16) = 0.5 min;

$$T_c = 302 + \frac{60 * 1000}{416.66} + 1.3 + \frac{60 * 1000}{500} = 567.3min$$

Required number of trucks:

$$N = \frac{T_c}{t_1} = \frac{567.3}{302} = 1.87 \sim 2$$

The number N is rounded to the nearest smallest integer number, including the over–fulfilment of the shift tasks during excavator work.

3.5 Work process scheme development with calculation of mine face operating conditions

During development of face parameters of excavator passes, equipped with shovel, first to be defined the largest width of the first (front) pass at the level of excavator datum level B_l in m:

$$\mathrm{B}_l = 2 \cdot 0{,}9R_{dl} \tag{3.31}$$

where, Rdl– digging radius at the level of the parking, m (annex. №1. tab.9.1) = 5 m

$$\mathrm{B}_l = 2 \times 0.9 \times 5 = 9\ m$$

The largest width of the (front) pass at the top $\mathrm{B}p$ is calculated by the formula:

$$B_p = 2\sqrt{(0{,}9R_{max})^2 - ln^{\,2}}, \tag{3.32}$$

where, R_{max}– the maximum digging radius (annex. №1. tab.9/1) = 9 m L_n– the length of working transfer (annex. №1. tab.10) = 1.75 m

$$B_p = 2\sqrt{(0.9 * 9)^2 - 1.75^2} = 15.81\ m$$

Maximum width of the second (side) excavator pass:

$$B = b_1 + b_2, \tag{3.33}$$

where, $b_{1,2}$ – the maximum distance from the axis of excavator motion to the face frontal toe, m.:

$$b_1 = 0{,}9Rdl = 0.9 \times 5 = 4.5 \text{ m}$$
$$b_2 = 0{,}7Rdl = 0.7 \times 5 = 3.5 \text{ m}$$
$$B = 4.5 + 3.5 = 8 \text{ m}$$

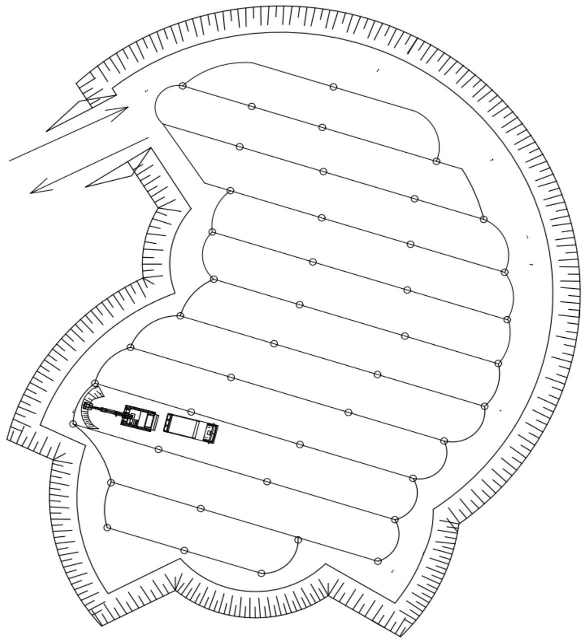

Figure 9 - Diagram of excavator pass “backhoe” during pit excavation

Dimensions of the faces depend on the excavator operating parameters – digging radius, unloading radius, depth of the face.

The width of the excavator front face – backhoe at the top (figure 11) adopted within:

$$B_l = (1{,}3 \ldots .1{,}5) \times \text{Rdl} \tag{10.4}$$

where Rdl – the largest digging radius on the level of excavator datum level. The axis of excavator movement – the axis of pass with front face;

$$B_l = 1.4 \times 5 = 7$$

The pass width with front face at the bottom:

$$b = \text{B}l - 2mh \qquad (10.$$

where, – m _slope laying coefficient = 0.5 m

h – depth of a pit = 3.8 m

$$\text{b} = 7 - (2 \times 0.5 \times 3.8) = 3.2 \text{ m}$$

The width of the side pass is accepted within:

$$Bs = (1{,}3\ldots.1{,}5)\cdot Rdl \tag{10.6}$$

$$B_s = 1.4 \times 5 = 7\ m$$

Excavation of the trench to be provided with the excavator movement along the trench axis (along the longitudinal axis of the structure) with the front face. Excavation of the separate pits for each foundation by excavator – backhoe is implemented with the front face with the excavator movement along the structure axis:

$$L = \sqrt{R_{dl}^2 (\frac{a}{2}}){}^2 \tag{10.7}$$

where. a – size on the pit (trench) top perpendicular to the axis of excavator movement, m

$$\text{a} = 1.25\ R_{dl} = 1.25 * 5 = 6.25$$

$$L = \sqrt{5^2 \times (\frac{6.25}{2})^2} = 15.625\ m$$

The quantity rdl it is possible to accept:

$$r_{dl} = \frac{c}{2} + 1 \tag{10.8}$$

where, c – base of the excavator (2,5÷3,5) = 3m.

If from the first datum level is excavated only part of the trench ($Bp > L - rdl$ pit excavation is implemented from the several excavator datum levels.

$$r_{dl} = \frac{3}{2} + 1 = 2.5$$

According ($B_p > L - r_{dl}$) we fount b on the top!

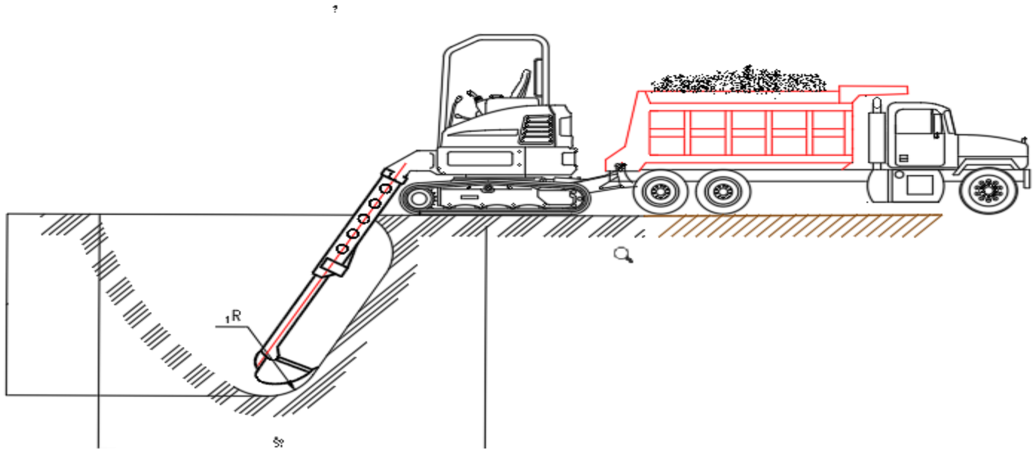

Figure 12 Scheme of the pit excavation for one foundation by excavator – backhoe from several datum level

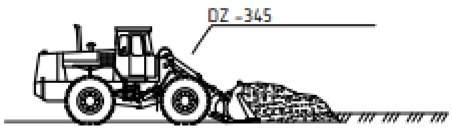

Figure 13 - The scheme of front face of excavator – backhoe: longitudinal section

3.6 Selection of the assembly crane

As an initial data in cranes selection serves the dimensions of pit for foundations and the basement of the structure, dimensions and weight of mounted structures.

Lifting height of crane hook H_r, m is calculated using the formula [5]:

$$H_r = h_1 + h_2 + h_3 + h_4 \tag{3.34}$$

Where h_1 – the height of mounted structure from the crane base (taken equal to 0);

h_2 – the height of mounted element (1.5÷2 m);

h_3 – the height from the top level of the structure to the bottom of the cargo (0.5÷1 m);

h_4 – the height of lifting equipment (2÷4.5 m).

H_r = 0+1.7+0.7+3.5=6m

In certain cases, the amount of h_4 to be selected through the catalogs of lifting equipment in relation to the mounted elements.

Crane working radius during construction of underground part L_u, m, is calculated using the formula:

$$L_u = a + c + B_p + 0{,}5 \tag{3.35}$$

Where c – slope construction, m.

$$C = (l_{1s.t.} - l_{2s.t}) /2 \tag{3.36}$$

Where, $l_{1s.t}$– length of a pit on top, m;

$l_{2s.t}$– width of a pit on top, m,

$$C = (87.34-75.34)/2 = 6m$$

Where B_p the width of structure underground part reserve zone width m;

$$B_p = (l_1 + (0{,}5 \cdot 2)) \tag{3.37}$$

$$B_p = (67+1) = 67m$$

a – the distance from the crane rotation axis to the pit edge, m, is equal to:

$$a = b/2 + 0{,}5 + r1 \tag{3.38}$$

$$a = 6/2 + 0.5 + 4.9 = 8.4m$$

Where b – width of the crane track (5÷ 7) m;

0,5 – half the width of the sleeper or sleeper unit;

r_1– minimum allowable distance from the slope base to the sleeper structure, m, accepted per..

According to the basic characteristics of the directories or catalogs to be selected corresponding crane.

Required carrying capacity of the crane is calculated using the formula:

$$Q_{cr} = (q_1 + q_2) \cdot K \tag{3.39}$$

Where, q_1–maximum weight of the mounted element, t.

$$q1 = m_{b1} + m_{c2} \tag{3.40}$$

Where m_{b1}–bucket weight (annex.1, tab.18);

m_{c2}– concrete weight (2÷2,5) t/m^{3}.

$$q_1 = 360kg+2200kg = 2560\ kg/m^3$$

Where q_2– lifting equipment and tools weight (0.1÷0,15); t;

K– factor including the deviation of lifting device weight, taken equal 1,08÷1,12.

$$Q_{cr} = (2560+150)1.1 = 3008.1 kg/m^3$$

Required working radius is determined by the formula:

$$L_{cr}^{tr} = b/2 + a_1 + c \tag{3.41}$$

where, b– width of the crane way (track), (5÷ 7), m;

a_1 – the smallest admissible distance from the slope basis to the closest support of the crane (portable, wheel, caterpillar), for tower cranes – to a sleeper design at not bulk soil.

c – the distance from the gravity center the farthest from the crane mounted element to the protruding part of the crane (taken equal to the width of the structure – l_2) m.

So we have

$$L = \frac{6}{2} + 4.9 + 67 + = 74.9m$$

$$L_{cr} = 3.1 + 4.9 + 12 = 20m$$

Acording to the data I select Mobile crane MKG-16M

3.6 Determination of work labor input and crew composition

Labor costs of processes in man–hours are determined by the formula:

$$Q_{m-day} = v \cdot N_{tr} \tag{3.42}$$

Where, V– volume of work (table 4);

N_{tr} – Standard time (table 10),

1 The construction of temporary fencing

Q_{m-day} = 372*1.2=446(workers)

2 Removal of top soil

$Qm{-}hour.$=1535*0.56=860(drivers)

3 Soil excavation in the trench and trench access to the pit

Q_{m-day} = 570 × 2.8=1596workers)

Q_{m-day} = 570 * 0.56 =319(drivers)

4 Excavation of soil underrun

Q_{m-day} = 568.54*1.64=932 (workers)

5 Concrete preparation for foundations

Q_{m-day} = 24.5*0.79=20(workers)

6 Reinforcement installation of columnar foundation manually

Q_{m-day} = 21582 * 0.022 = 474(workers)

7 Formwork installation of columnar foundation manually

Q_{m-day} = 1194.48*0.36=430(workers)

Q_{m-day} =1194.48*0.12=143(drivers)

8 Concreting of columnar foundation

$Qm{-}hour$.=224.8*1.2=270(workers)

$Q_{m-day} = 224.8 * 089 = 27$ (drivers)

9 Formwork removal of columnar foundation

Q_{m-day}=450*0.31=139 workers)

10 Foundation waterproofing

Q_{m-day}=1448.4*0.10=145 (workers)

11 Backfilling

Q_{m-day}=9600*0.039=374 (drivers)

12 Soil compaction

Q_{m-day} = 24000*0.0092=220(drivers)

13 Final land planning

Q_{m-day} = 1293*0.33=426(workers)

Q_{m-day} = 1293*0.049=63(drivers)

14 Removal of temporary fencing

Q_{m-day} = 372*0.9=334(workers)

And in man–days defined as:

$$Q_{m-day} = \frac{Q_{m-hour}}{8.2} \tag{3.43}$$

1. The construction of temporary fencing

$Q_{m-day} = \frac{446}{8.2} \approx$ 54 day (workers)

2. Removal of top soil

$Q_{m-day} = \frac{860}{8.2} \approx 105 houre$ (drivers)

3. Soil excavation in the trench and trench access to the pit

$Q_{m-day} = \frac{1596}{8.2} \approx 194 day$ (workers)

$Q_{m-day} = \frac{319}{8.2} \approx 38 day$ (drivers)

4. Excavation of soil underrun

$Q_{m-day} = \frac{932}{8.2} \approx 113\ day$ (workers)

5. Concrete preparation for foundations

$Q_{m-day} = \frac{20}{8.2} \approx$ 2.5day (workers)

6. Reinforcement installation of columnar foundation manually

$Q_{m-day} = \frac{474}{8.2} = 57 day$ (workers)

7. Formwork installation of columnar foundation manually

$$Q_{m-day} = \frac{430}{8.2} = \approx 52day \text{ (workers)}$$
$$Q_{m-day} = \frac{143}{8.2} \approx 17.4\text{day (drivers)}$$

8. Concreting of columnar foundation

$$Q_{m-day} = \frac{270}{8.2} \approx 32day \text{ (workers)}$$
$$Q_{m-day} = \frac{27}{8.2} \approx 3day\text{(drivers)}$$

9. Formwork removal of columnar foundation

$$Q_{m-day} = \frac{450}{8.2} \approx 54day \text{ (workers)}$$

10. Foundation waterproofing

$$Q_{m-day} = \frac{145}{8.2} \approx 17\ day\text{(workers)}$$

11. Backfilling

$$Q_{m-day} = \frac{374}{8.2} \approx 45day \text{ (drivers)}$$

12. Soil compaction

$$Q_{m-day} = \frac{220}{8.2} \approx 26\ day \text{ (drivers)}$$

13. Final land planning

$$Q_{m-day} = \frac{426}{8.2} \approx 52\text{day(workers)}$$
$$Q_{m-day} = \frac{63}{8.2} = 8\ day \text{ (drivers)}$$

14. Removal of temporary fencing

$$Q_{m-day} = \frac{372}{8.2} \approx 45day\text{(workers)}$$

The table is on Appendix C table 1

3.7 Preparation of work schedule

The duration of the mechanized processes is determined by:

$$P_m = \frac{N_{m.sh}}{n \times A} \tag{3.44}$$

Where, $N_{m.sh}$ – required number of machine–shift;
n – Number of machines;
A – Number of shifts per day.

Determination of the required number of machine shifts

Check the correctness of the graphics on the coefficient of uneven movement of workers:

$$K_u = \frac{n_{max}}{n_{av}} \tag{3.45}$$

Where, n_{max}– the maximum number of workers at the facility;
n_{av} – The average number of workers:

$$n_{av} = \frac{\sum Q}{P_{total}} \tag{3.46}$$

Where, Q – total labor input (labor costs);
P_{total}– Total duration determined by the schedule of work.

The tabal is on Appendix C table 2

4 Economic part

4.1 Calculation of estimated construction costs

Estimated construction cost - cash required for construction, the amount of which depends on the estimated standards and design materials in accordance with the legislation of the Republic of Kazakhstan.

In the consolidated estimate the calculation of the construction of the facility funds are divided into the following chapters:

1. The cost of preliminary work.
2. The main objects.
3. Facilities for service purposes.
4. Facilities for energy supply.
5. Objects for communication and transport.
6. External networks, sewerage, water supply.
7. Land improvement and greening.
8. Temporary buildings.
9. Unforeseen construction costs.
10. The content of the headquarters.
11. Training.
12. Survey and design work

Table 20- Calculation of the cost of the main construction projects

Title	Measure unity	Quantity your	Stoimos per unit rev.	Total estimated cost tenge: thousand
Museum with capacity of 70000 people	m2	55587	86555	757257
Total:				72725778

For a civilian building, chapter 3 contains the estimated cost of this an object like: sport complex, utility buildings; cultural buildings, designed to specialize in serving and located in the boundary of the territory allotted, as a rule, for the construction of enterprises.

Table 21 - Calculation of the cost of construction of an auxiliary building

Title	Measure unity	Quantity your	Cost for unit	Total estimated cost, thousand tenge
Checkpoint	m^3	300	86555	5548983
Total:				942255412

Table 4.3 shows the cost of equipment. Engineering cost installation is on the necessary sections of collections, and in the absence cost rate, installation cost is based on price lists and factory data.

Table 22 - Local estimates for technological equipment

No.	Name	Unit measuring	Amount, thousand tenge
1	Cost of equipment	thousand tenge	15791.1
2	The cost of setting up equipment and installation.	thousand tenge	2261
3	Total		18052.1

According to the general plan, a list of construction objects is determined, the distance engineering communications, the area of highways, railways, driveways.

For the accuracy of design estimates, design and construction organizations according to aggregated indicators calculate the estimate taking into account all the correction factors adopted with the construction area.

Table 23 - Local cost estimates for energy supply.

№	Name	Unit measuring	Quantity	Amount Cost, thousand tenge	
				Unit rev.	Total
1	Transformer	kw	60	20	1200
2	Cable networks	м	200	1.62	324
3	Telephone	м	200	2.11	422
4	Total:				1946

Table 24 - local estimates for the provision of transport.

№	Name	Unit measuring	Quantity	Amount Cost, thousand tenge	
				Unit rev.	Total
1	Highway	$м^2$	685	10	6850
2	Total:				6850

Table 25 - Local cost estimates of the main object.

No	No. of estimates and calculations other documents	Name of chapters objects, works and cost	Estimated cost, thousands			Total, thousands tenge
			builder assembly installation x works	equipment education of furniture and inventory	other cost	
1	2	3	4	5	6	7
		Chapter 2. The main objects of construction				
1	02-001	Sport complex in Atyrau city	89565.472			89565.472
2	02-001-001	Sport complex in Atyrau city	89565.472			89565.472
		Total chapter 2	89565.472			89565.47
		Total chapters 1 - 7	89565.472			89565.472
		Total chapters 1 - 9	89565.472			89565.472
		Total estimated	89565.472			89565.472
3	Code of the Republic of Kazakhstan from added 10.12.2008	Cost Tax on cost (VAT) - 14 %			10747.857	10747.857
	№ 99-IV					
		Total estimated calculation	89565.472		10747.857	1003138.329

cancalculation of investment costs for construction

Investment fees for the construction of the building include all Customer’s spent on the project and is performed as a summary estimated calculation of the object.

The following are included in the consolidated estimate calculation of the construction price:

cost stages:

- personnel training;
- the cost of services of engineering and technical workers;
- the cost of the examination of design estimates;
- the cost of survey work;
- costs for technical supervision workers.

The cost of survey and design work is calculated according to general requirements for calculating the cost of design work for the construction of the building in the Republic of Kazakhstan.

Table 26 - Calculation of the cost of survey and design work.

	Name	Indicators
	Estimated cost of repairs	100315.329
	Object difficulty category	V
	The relative percentage of design work to the main	3.18%
	Cost of survey and design work	30091
	Total price for design work	39210
	Value added tax	6506
	Total with VAT	146029.326

Pricing for survey and design work in the base price level for 2019, sets the cost in the consolidated estimate entire construction, and is the initial value when establishing the cost of state examination of construction documentation in a certain period of time.

Table 27 - Calculation of the cost of state. Expertise

No.	Name	Indicators
1	The cost of settlement design work	30091
2	The lower value of the cost of survey and design work is	28091
3	The cost of state. expert work corresponding to the bottom the value of the survey and design work	503.6
4	The upper value of the PIR	31091
5	The cost of state. expert work relevant top the value of the design and survey	650.5

Continuation of tabe 27 - Calculation of the cost of state. Expertise

6	The cost of these works for 2001	774.3
7	All indexes included	32504
8	Value added tax	3258

4.3 Technical and economic indicators of the project

At the initial stage of planning, it was supposed to use credit funds for the implementation of this project. Moreover, according to the requirement of the legislation of the Republic of Kazakhstan, 15 percent of the total investment should be financed at own expense. Required Investments on construction of the facility is 80.5 billion tenge.

At the same time, own funds amount to 560 million tenge. Survey and design work, as well as on-site preparatory work is carried out at our own expense.

The planned profit of the facility is 121.3 million tenge. Selling price object 2 billion tenge. The cost of 1 m 2 is 510 thousand te

CONCLUSION

The building I am planning is “Museum of Contemporary Art with Translucent Structures in Almaty’’. That is why it is one of the factors that have a detrimental effect I thought that cars pollute the atmosphere and this is a harmful effect I calculated the results.

One of the main sources of air pollution in construction harmful substances emitted from motor vehicles. That's We must take into account the pollution of the air with these harmful substances. That's what we are perform the above calculations.

Based on the results of those calculations - in our construction that the operating vehicles do not pollute the air much showed.

Thus, the above calculations are based on the territory of the object Harmful concentrations threshold possible was dosage showed lower

concentrations. Therefore, in the object Calculations from sources of pollution may be limited can be assumed to be.

The location of the projected object is significant for the environment does not have a negative effect.

The following results were achieved during the writing of the diploma project:

The architectural solution of the building is, first of all, the lifting structures should be stabilized in the right choice. Modern construction is high allows you to use a series of positional systems, including monolithic skeletal leading position. The structure of light farms has a large range construction of structures, reinforced concrete slabs, crossbars and beams as a necessity. Prefabricated ceilings and covers application of industrial work in the construction of the building allows to reduce the term;

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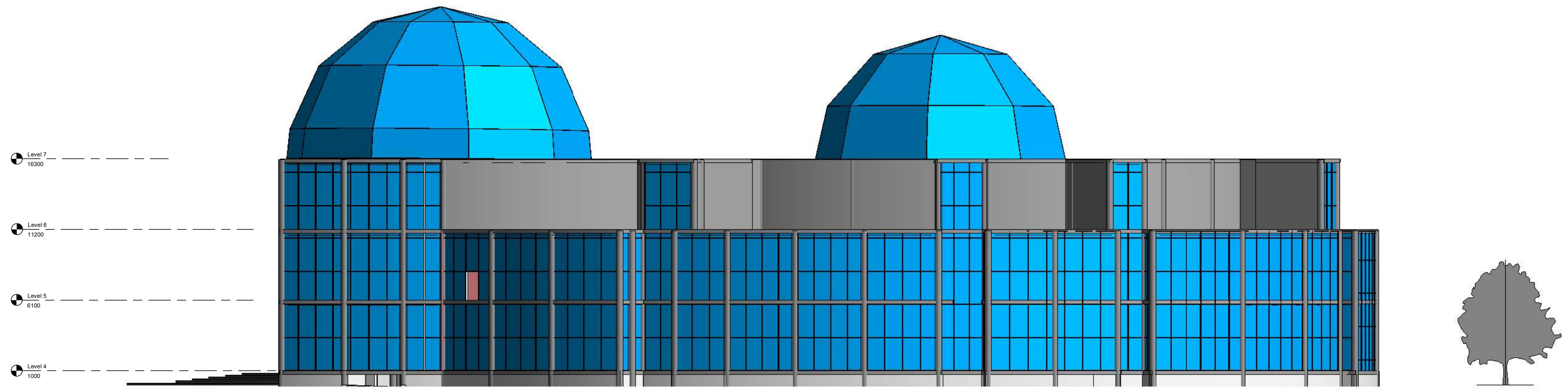
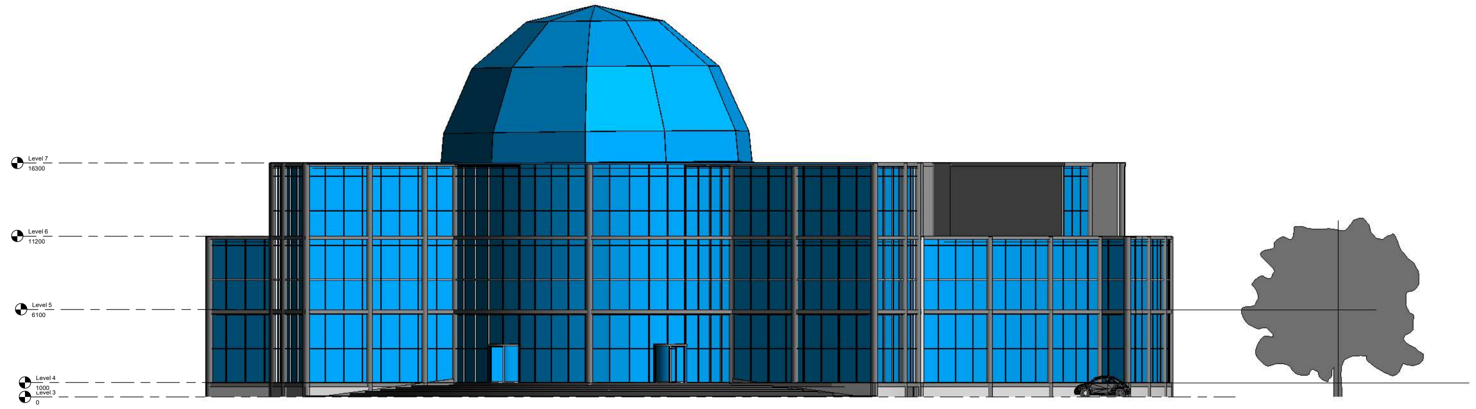
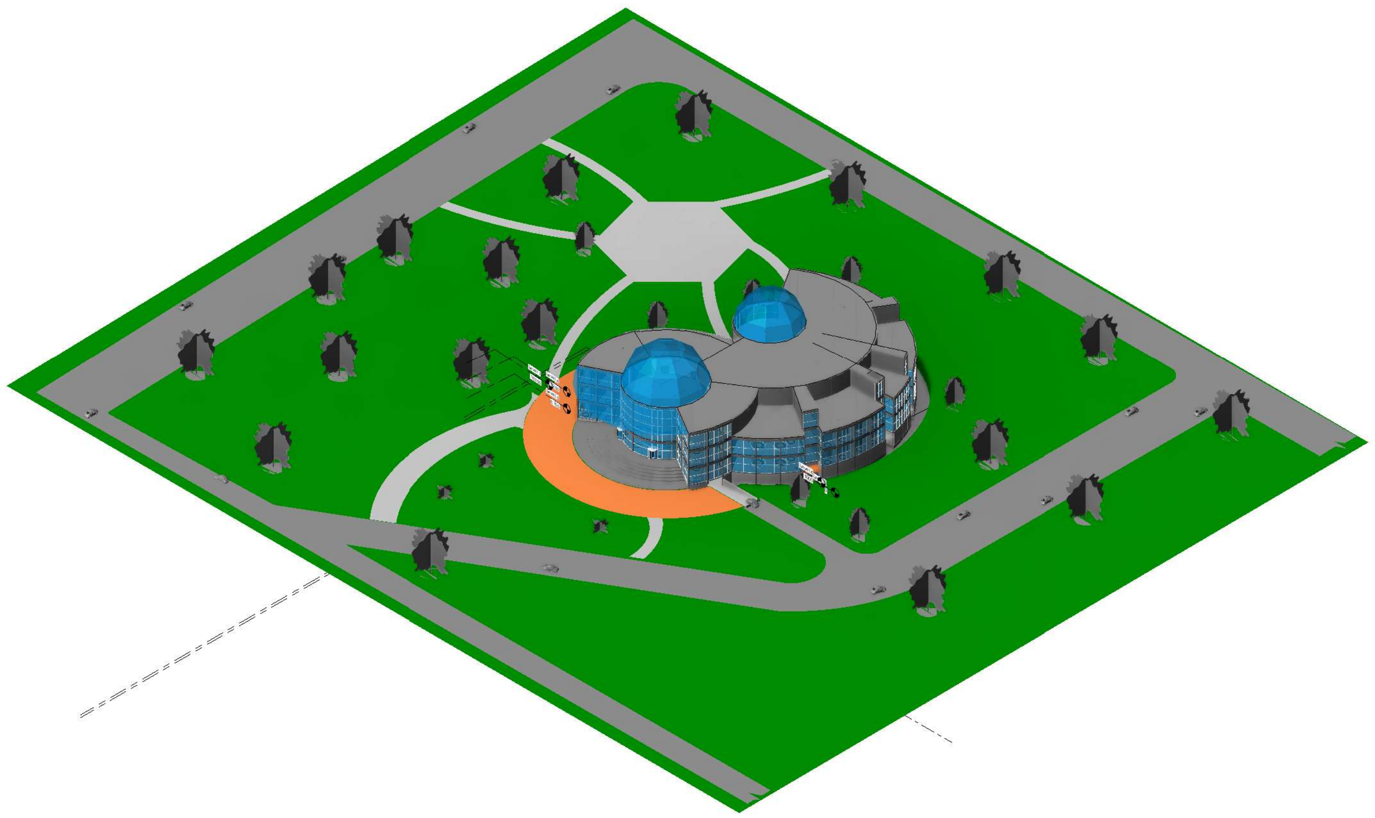
Side View



Frount View



3D View



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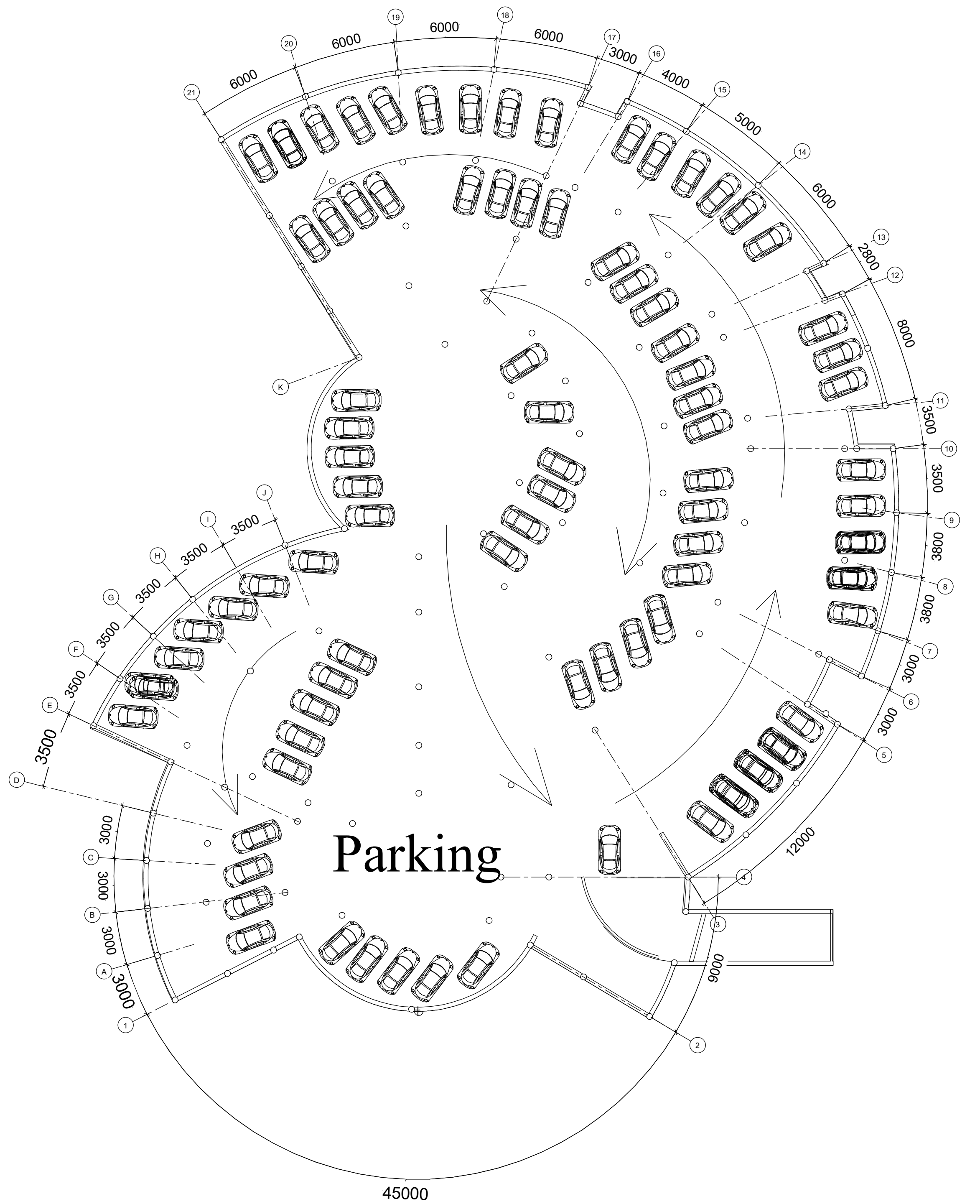
						Museum of Contemporary Art with Translucent Structures in Almaty
Chan	Num.	par	List	Sing	Date	
Head of Dep	KozyukovaN.V.					Architectural and analytical part
Supervisor	Nashiraliev Zh.T.					
Consultant	Nashiraliev Zh.T.					
N.controller	Bek A.A					
Created	Ahmadi.W.A					Elevation

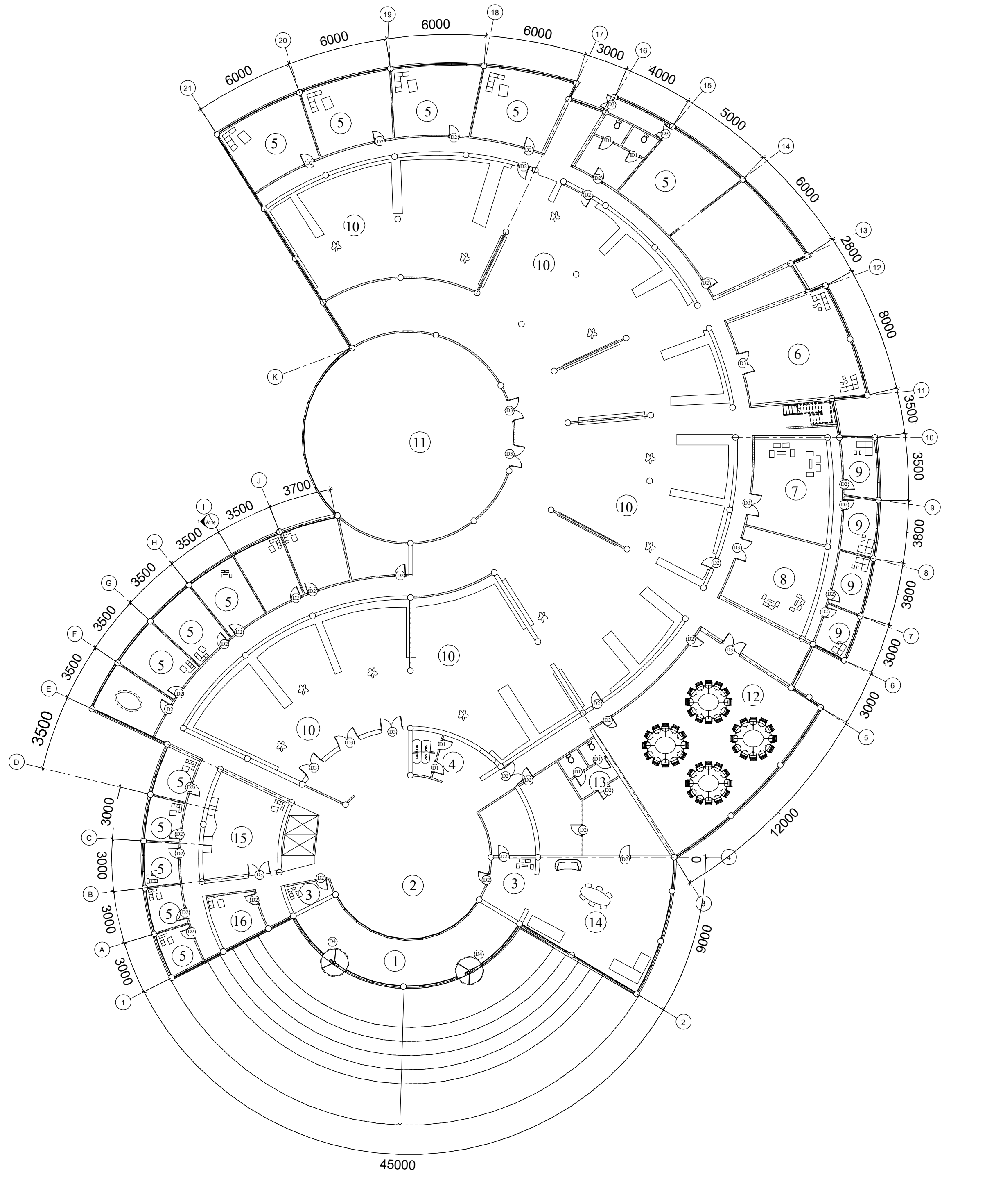
Stage	List	Lists
DP	1	9

Civil Engeneering and building materials department

Basement



Ground floor



Ground floor specifications on Appendix A (table 1)

Dimention of Doors

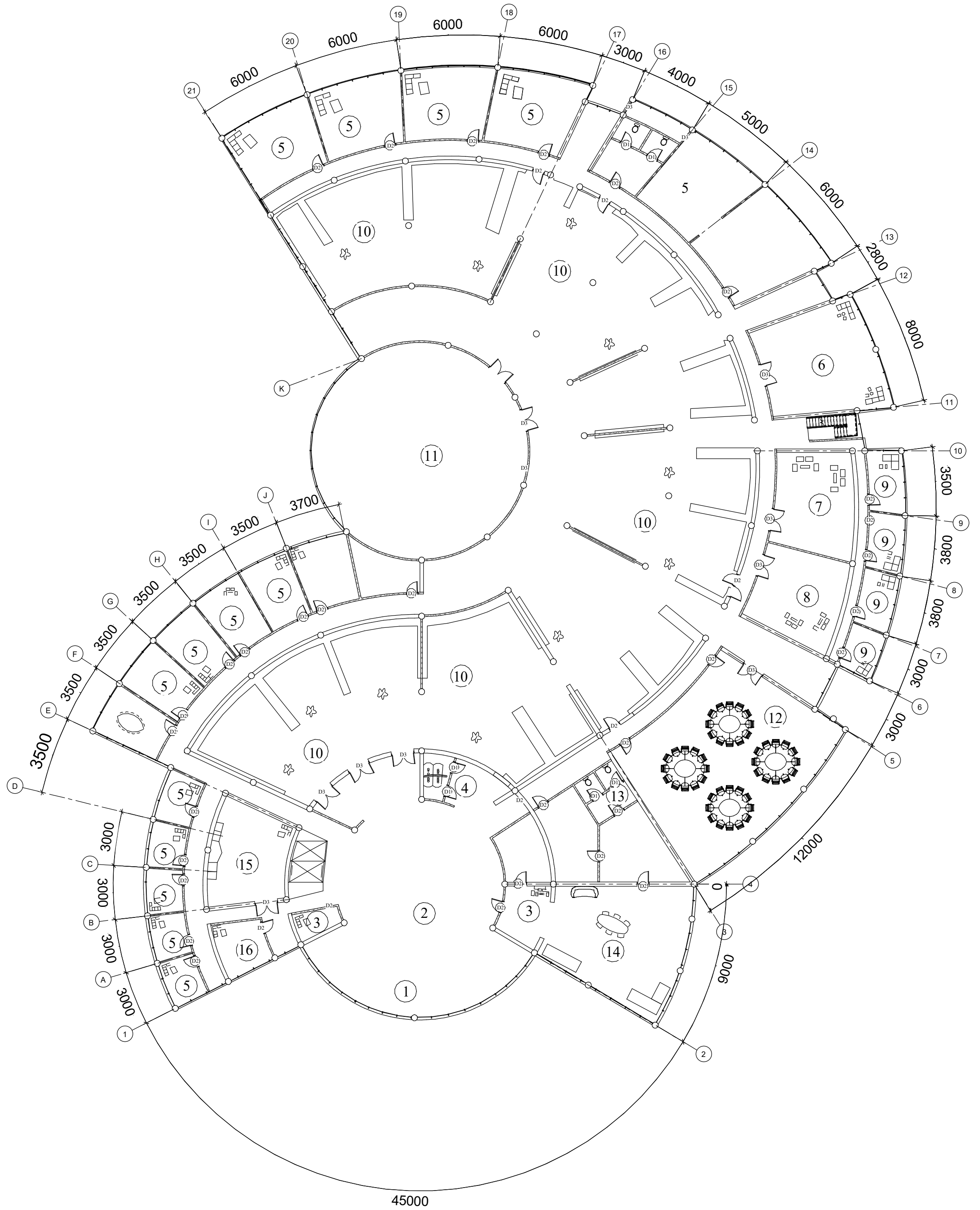
No	Door	Dimension
1	D1	700x2000mm
2	D2	800x2000mm
3	D3	1800x2000mm
4	D4	2400x2600mm

Chan	Num.	par	List	Sing	Date	KazNITU - 5B072900-Civil Engeneering-02.08.02 - 2021 - 2021 - DP
						Museum of Contemporary Art with Translucent Structures in Almaty
Head of Dep	KozyukovaN.V.					Architectural and analytical part
Supervisor	Nashiraliev Zh.T.					
Consultant	Nashiraliev Zh.T.					
N.controller	Bek A.A					
Created	Ahmadi.W.A					Basement and Ground floor

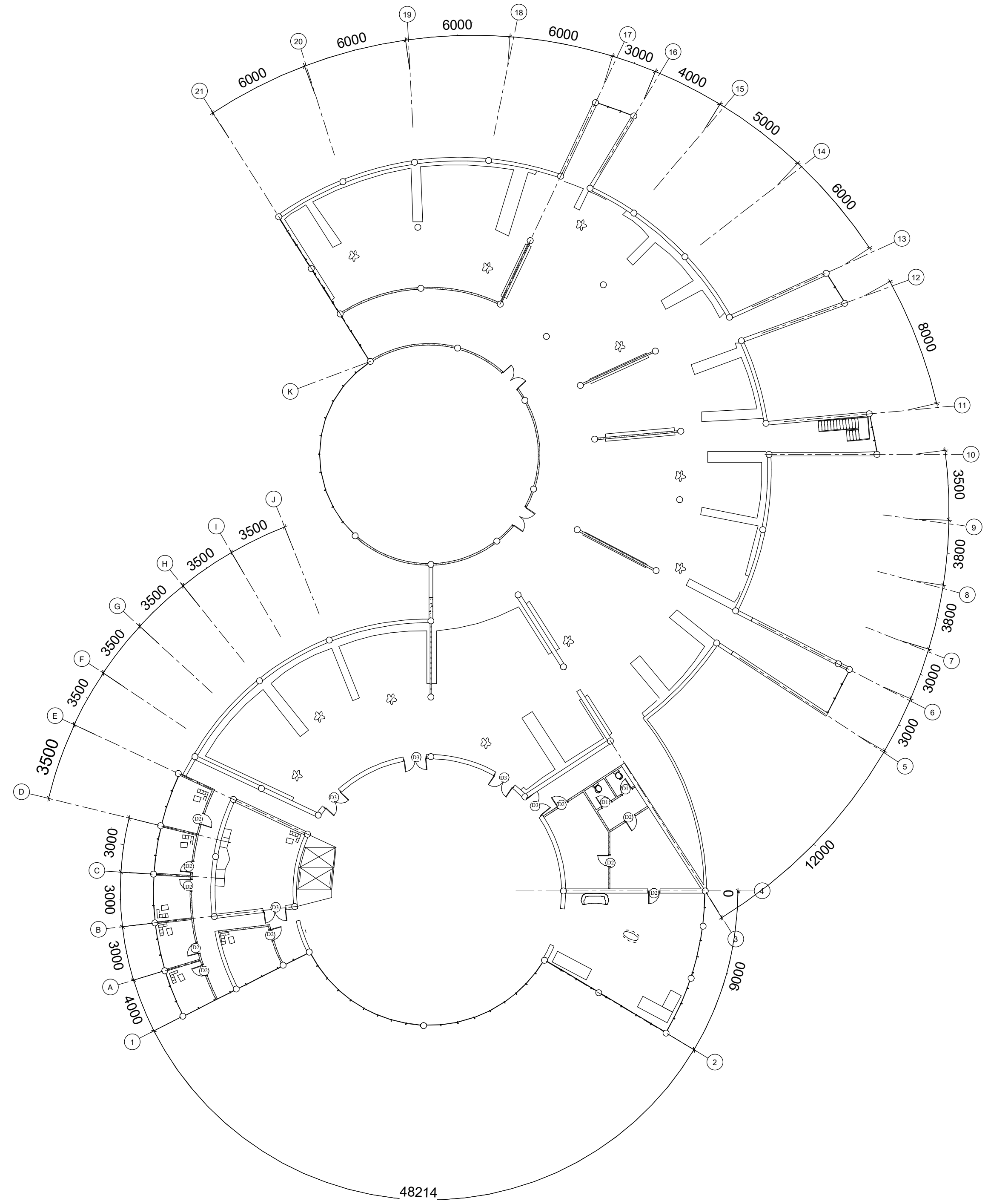
Stage	List	Lists
DP	2	9

Civil Engineering and building materials department

Plan on level +6100



Plan on level +11200



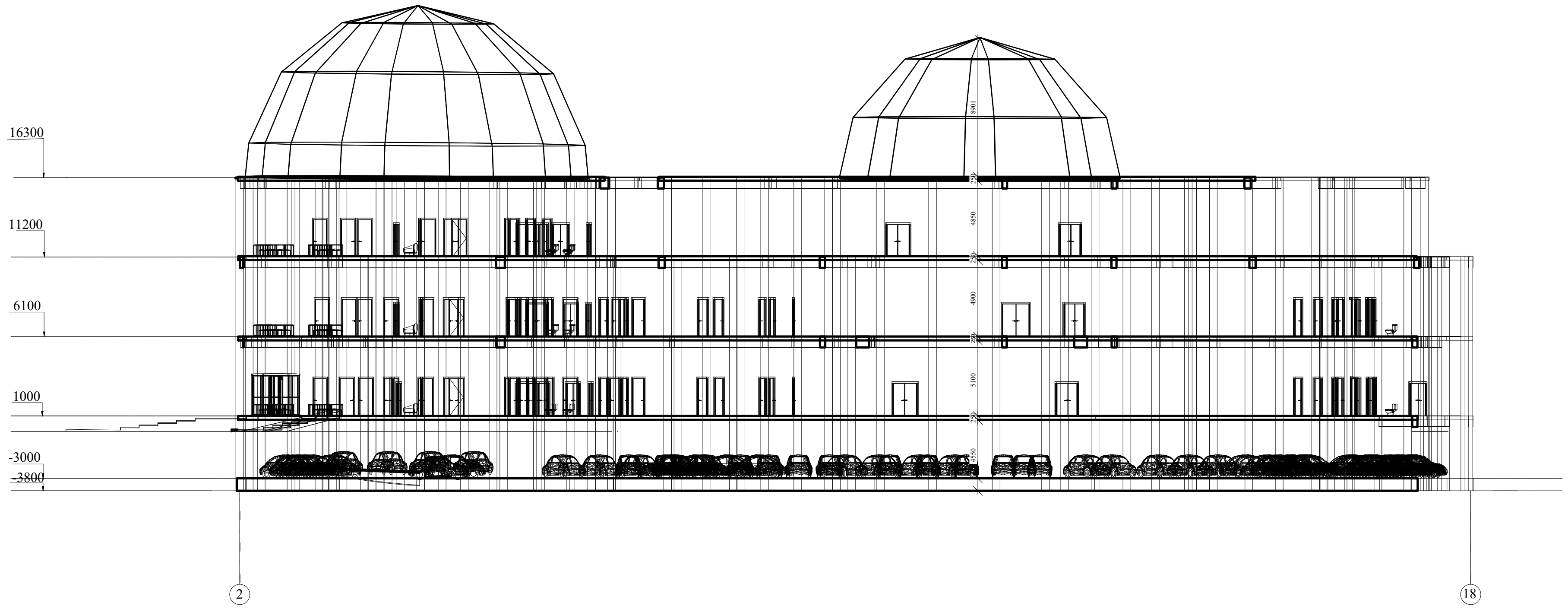
Dimention of Doors

No	Door	Dimension
1	D1	700x2000mm
2	D2	800x2000mm
3	D3	1800x2000mm

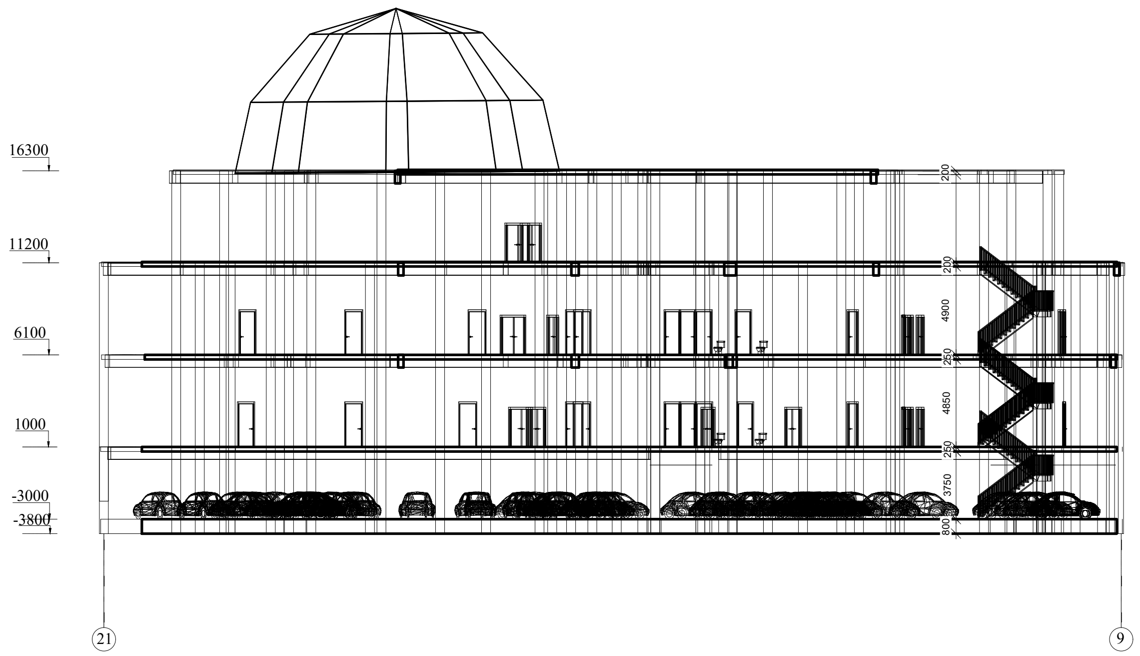
Ground floor specifications on Appendix A (table 1)

						KazNITU - 5B072900-Civil Engeneering-02.08.02 - 2021 - 2021 - DP			
						Museum of Contemporary Art with Translucent Structures in Almaty			
Chan	Num.	par	List	Sing	Date				
Head of Dep		KozyukovaN.V.				Architectural and analytical part	Stage	List	Lists
Supervisor		Nashiraliev Zh.T.					DP	3	9
Consultant		Nashiraliev Zh.T.							
N.controller		Bek A.A				Second and third floors	Civil Engeneering and building materials department		
Created		Ahmadi.W.A							

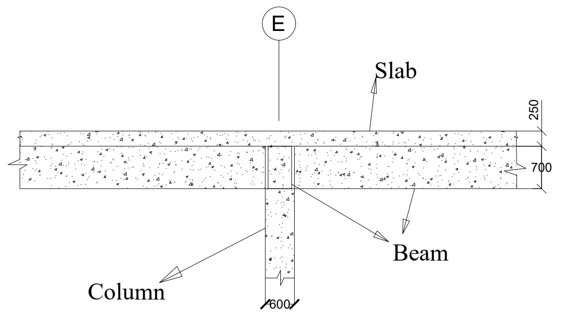
Section A



Section B



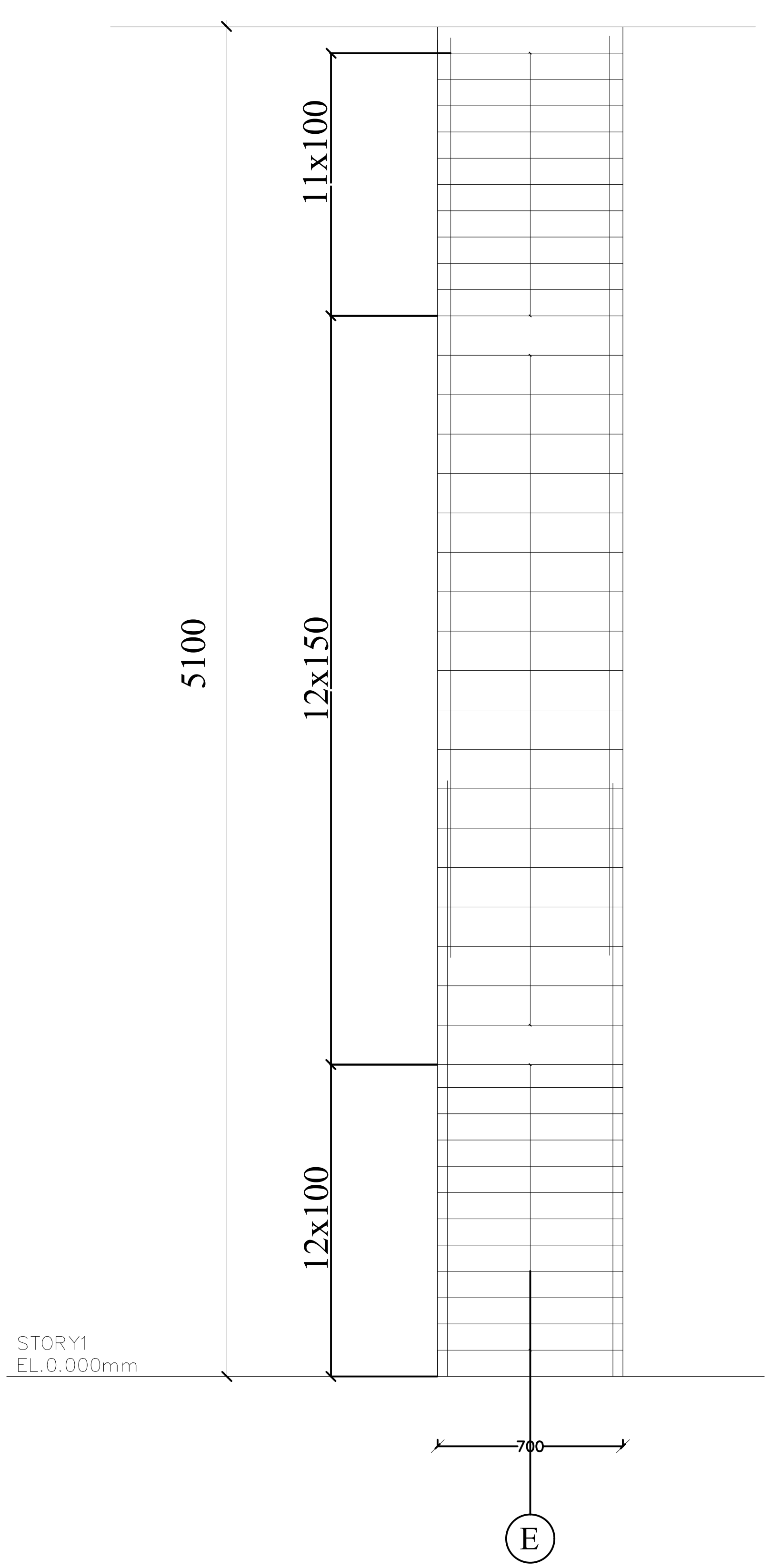
Junction A



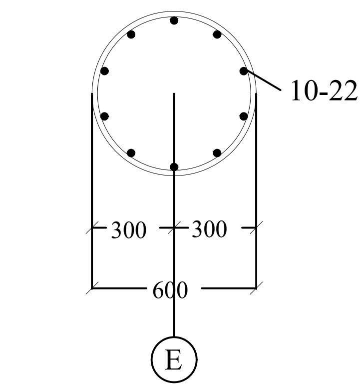
					KazNITU - 5B072900-Civil Engeneering-02.08.02 - 2021 - 2021 - DP	
Chan	Num.	par	List	Sing	Date	Museum of Contemporary Art with Translucent Structures in Almaty
Head of Dep	KozyukovaN.V.				Architectural and analytical part	Stage: DP; List: 4; Lists: 9
Supervisor	Nashiraliev Zh.T					
Consultant	Nashiraliev Zh.T					
N.controller	Bek A.A					
Created	Ahmadi.W.A				Sections and Junctions	Civil Engeneering and building materials department

Monolithic column

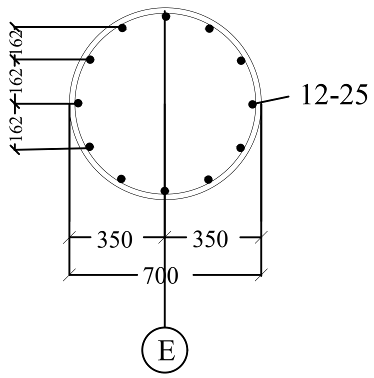
CC71:Elevation-1
(Scale1:30)



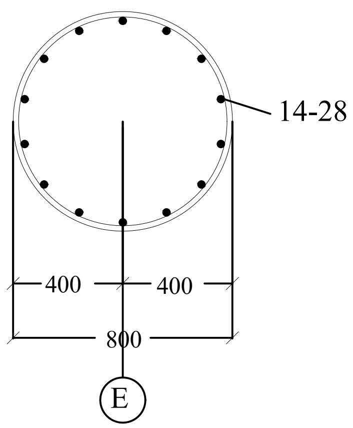
CC71:Section A
(Scale1:15)



CC71:Section B
(Scale1:15)



CC71:Section C
(Scale1:15)



Column reinforcement specification

Position	Designation	Diameter steel grade	Qty	Mass units Kg	Note
		К-1			
1	EU 2-2004	Ø32S500 L=5100	14	32.81	
2	EU 2-2004	Ø10S275 L=1947.8	41	1.207	
		Materials			
		Бетон С 30/37			50

Steel consumption sheet

Mark products	Reinforcement products				
	Class				Total
	S240		S500		
	EU 2-2004		EU 2-2004		
	Ø10	Total	Ø32	Total	
К-1	49.5	49.5	1345.21	1345.21	1394.7

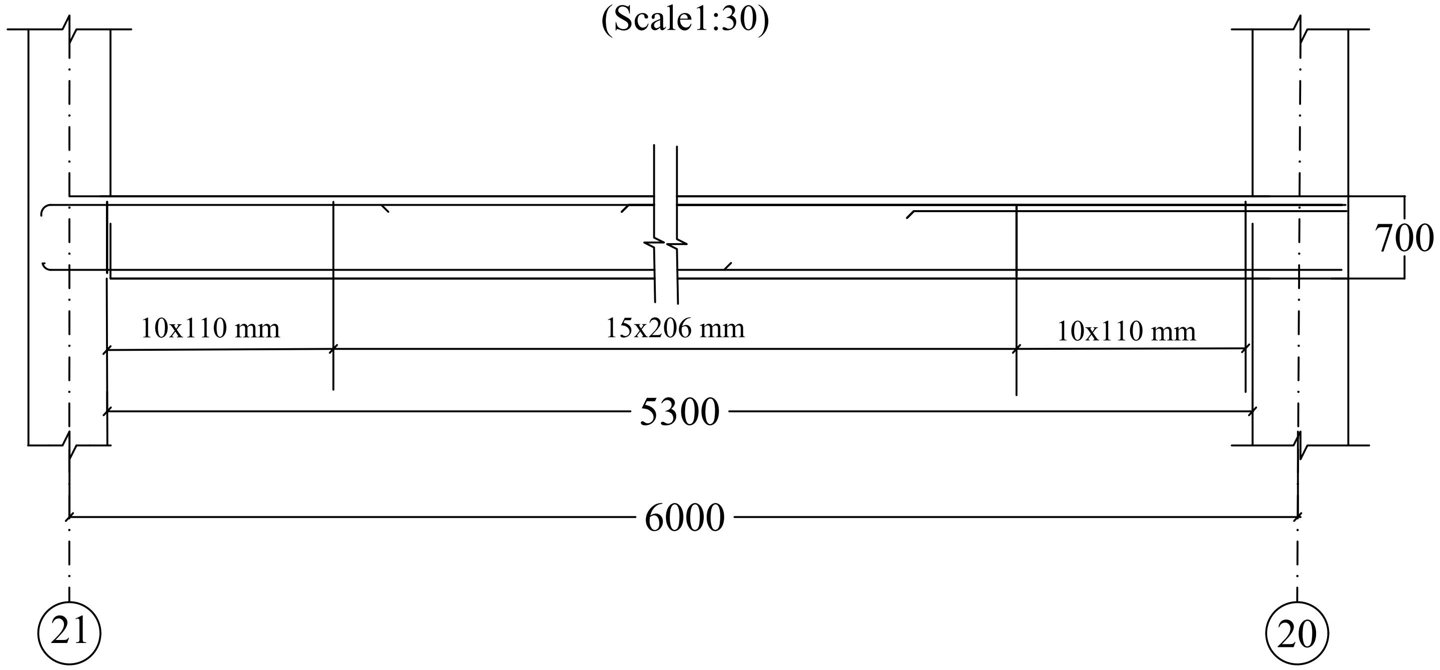
						KazNITU - 5B072900-Civil Engeneering-02.08.02 - 2021 - 2021 - DP
						Museum of Contemporary Art with Translucent Structures in Almaty
Chan	Num.	par	List	Sing	Date	
Head of Dep		KozyukovaN.V.				Calculation and design part
Supervisor		Nashiraliev Zh.T				
Consultant		Nashiraliev Zh.T				
N.controller		Bek A.A				
Created		Ahmadi.W.A				CC71 Column

Stage	List	Lists
DP	5	9

Civil Engeneering and building materials department

Monolithic Beam

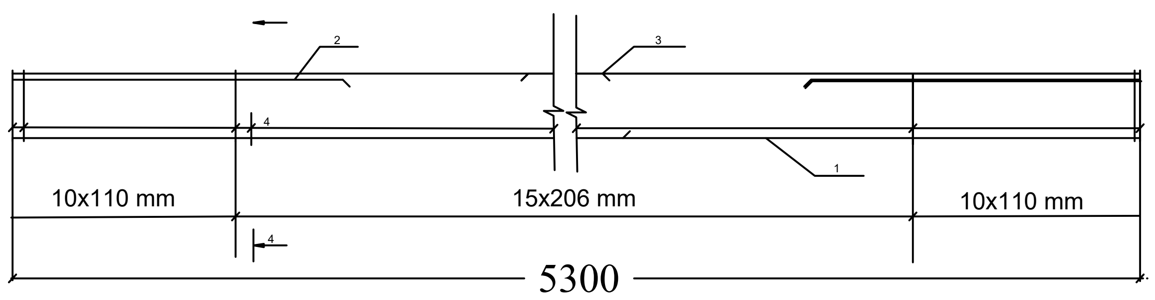
CB1:Elevation-1
(Scale1:30)



Beam reinforcement specification

Position	Designation	Diameter steel grade	Qty	Mass units Kg	Note
		К-1			
1	EU 2-2004	Ø25S500 L=5300	6	20.4	
2	EU 2-2004	Ø20S500 L=5300	3	13.06	
		Ø12S240 L=1900	35	1.17	
		Materials			
		Concrete C 30/37			35

Frame K-1



Steel consumption sheet

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<tr><td colspan="4">Class</td><td colspan="2"></td><td rowspan="4">Total</td></tr>
<tr><td colspan="2">S240</td><td colspan="2">S500</td><td colspan="2">S500</td></tr>
<tr><td colspan="2">EU 2-2004</td><td colspan="2">EU 2-2004</td><td colspan="2">EU 2-2004</td></tr>
<tr><td>Ø12</td><td>Total</td><td>Ø25</td><td>Total</td><td>Ø20</td><td>Total</td></tr>
<tr><td>К-1</td><td>40.96</td><td>40.96</td><td>122.4</td><td>122.4</td><td>39.18</td><td>39.18</td><td>202.54</td></tr>
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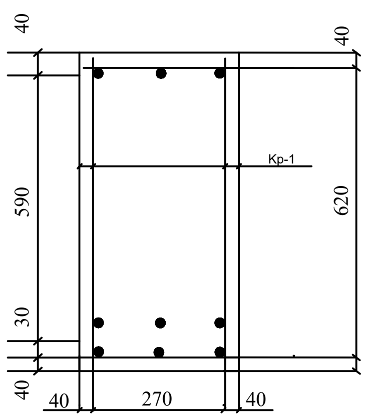
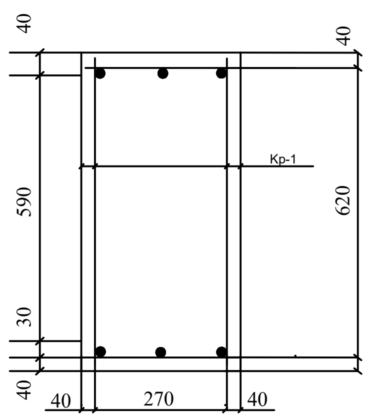
1-1



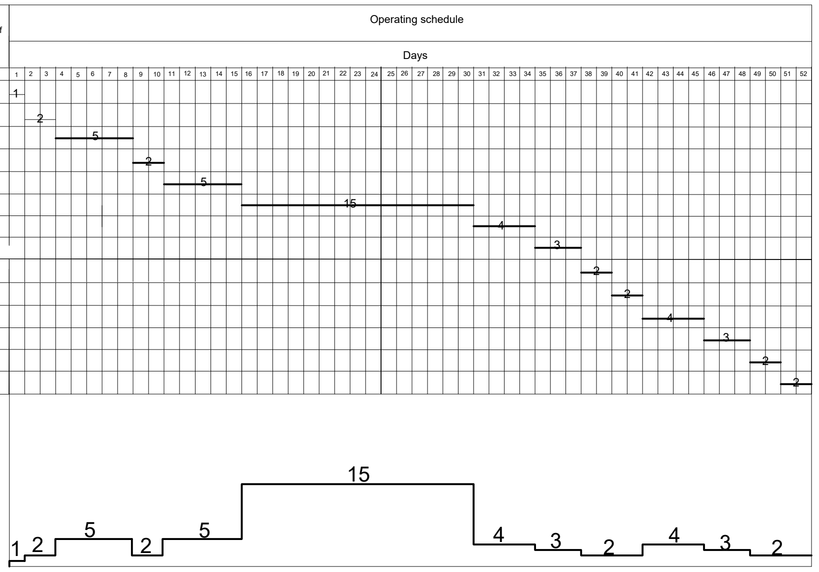
2-2



Chan	Num.	par	List	Sing	Date	KazNITU - 5B072900-Civil Engeneering-02.08.02 - 2021 - 2021 - DP			
						Museum of Contemporary Art with Translucent Structures in Almaty			
Head of Dep	KozyukovaN.V.					Calculation and design part	Stage	List	Lists
Supervisor	Nashiraliev Zh.T						DP	6	9
Consultant	Nashiraliev Zh.T								
N.controller	Bek A.A								
Created	Ahmadi.W.A					Beam	Civil Engineering and building materials department		

Earthworks technological map

№	Name of works	Volume of work: Unit mea...	Volume of work: Quantity	Labor cost, h–d	The required cars: Name	The required cars: Number shf . pr	Duration, days (P)	Number of changes (A)	Number of workers in change,n
1	2	3	4	5	6	7	8	9	10
1	The construction of temporary fencing	1 м	372	446	DET250	2	1	2	2
2	Removal of top soil	1000 м^2	1535		E-10011E (D)	1	2	3	4
3	Soil excavation in the pit	100 м^3	570	1596	E-10011E (D)	2	5	2	4
4	Excavation of soil into vehicles	100 м^3	568.5	932		2	2	2	8
5	Concrete preparation for foundations	1м^3	24.5	20	DEK-25G	2	5	3	7
6	Reinforcement installation		21582	476	DEK-25G	2	15	2	6
7	Formwork installation	1м^2	1194	430	RVM 42	2	4	2	7
8	Concreting of foundation	т	224.8	270		1	3	1	4
9	Formwork removal	1 м^3	450	139	DEK-25G	1	2	3	5
10	Foundation waterproofing	м^2	1448	145		2	2	2	2
11	Backfilling	1м^2	9600	-	DET250	2	4	3	2
12	Soil compaction	100 м^2	24000	-	D-471V	1	3	2	2
13	Final land planning	100 м^3	1293	426		2	2	2	4
14	soil compaction	100 м^2	372	334		1	2	1	8



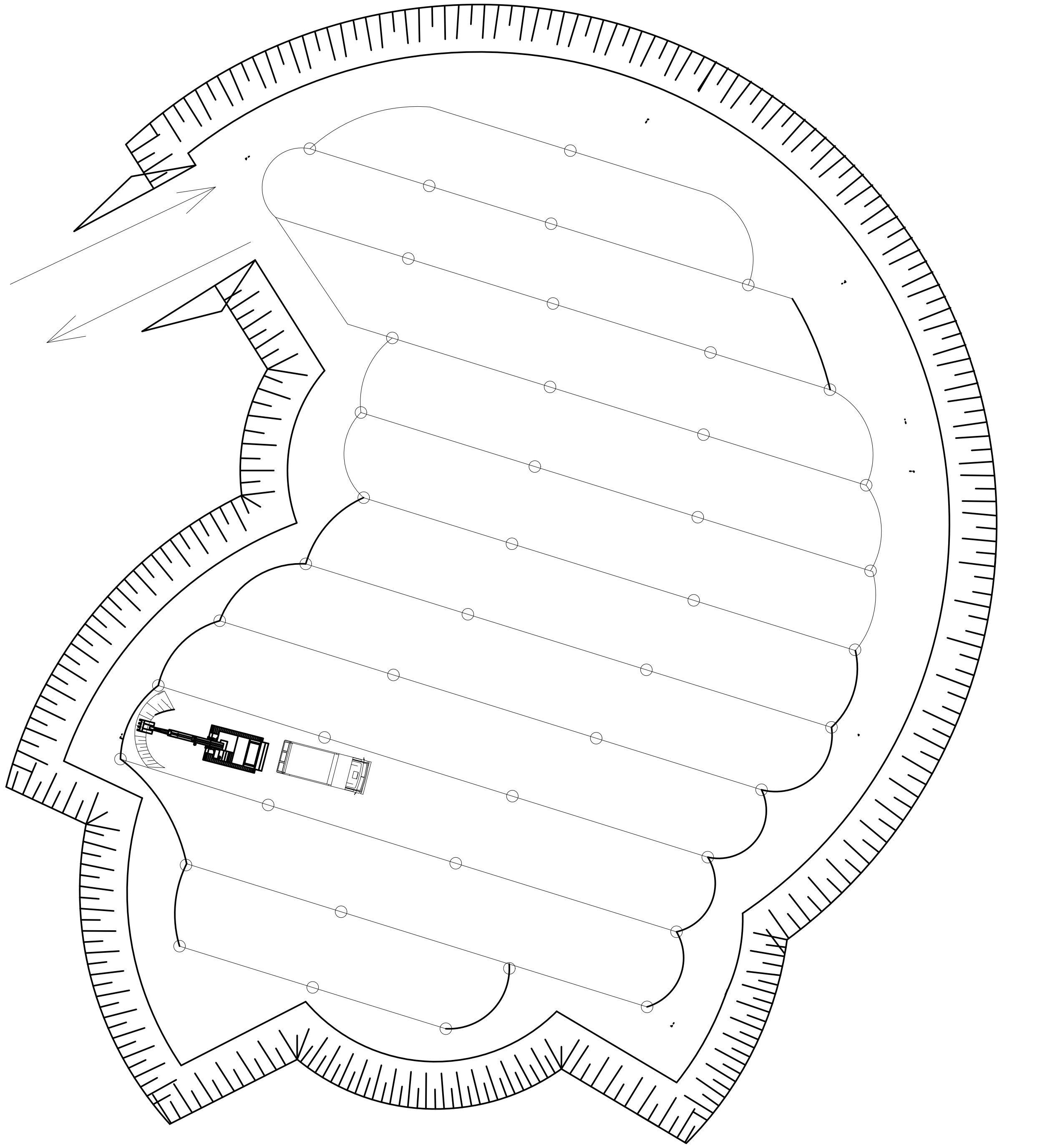
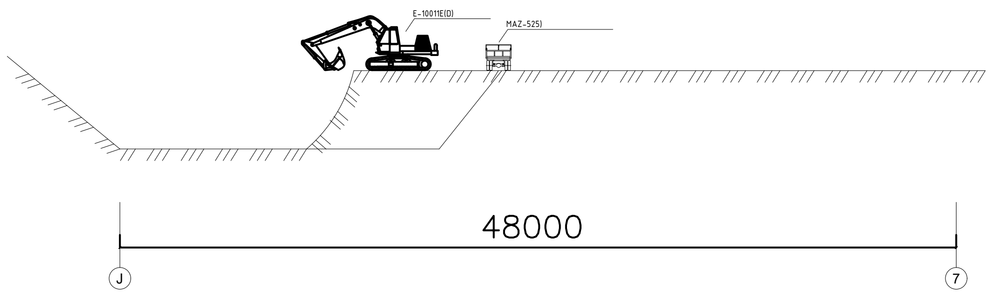
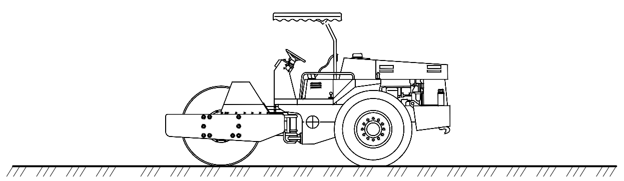


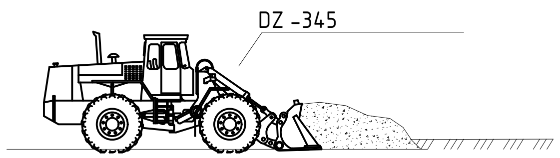
Diagram of the development of a pit with an excavator equipped backhoe with loading into a vehicle



Compaction of layer



Cutting off the vegetation layer



Statement of the needs of machines and mechanisms

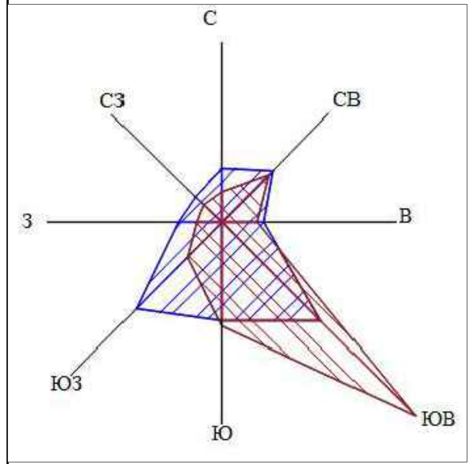
Name	Mark	Appointment
1.Bulldozer	DZ-345	Cutting off the vegetation layer, backfilling
2. Backhoe excavator	E-10011E(D) old (E-1003)	Development of soil into dumps and vehicles
3. Self-propelled roller	D-471V	Soil compaction
4. Dump truck	MAZ-525	Removal of soil
5. Concrete pump	ABN 75/32	Concrete supply
6. Mobile crane	MKG -16M	Delivery of goods

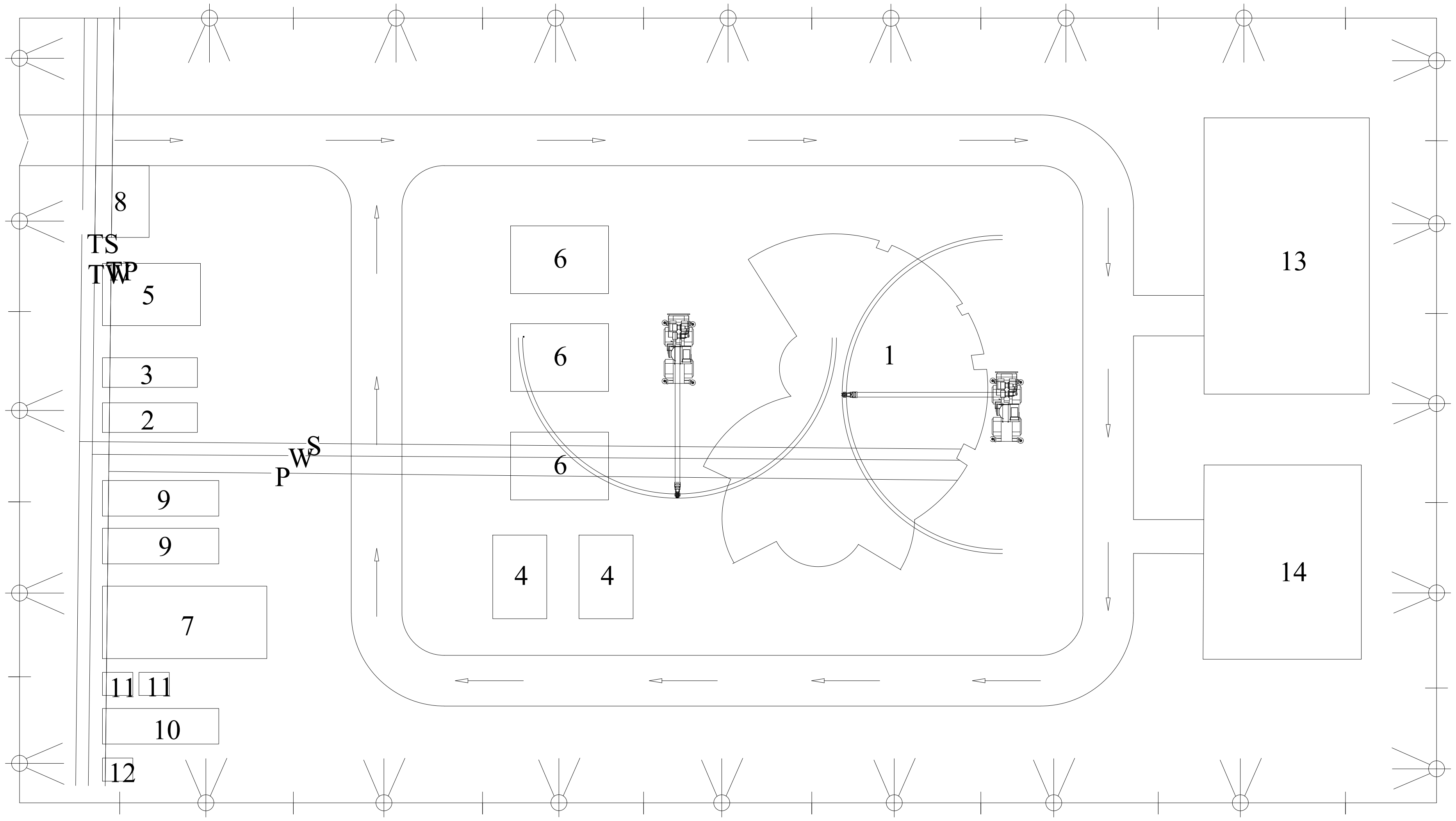
Technical and economic indicators

№	Name	Unit rev.	Quantaty
1	Labor costs	man-day	6320
2	Duration	days	52

Chan	Num.	par	List	Sing	Date	KazNITU - 5B072900-Civil Engeneering-02.08.02 - 2021 - 2021 - DP			
						Museum of Contemporary Art with Translucent Structures in Almaty			
Head of Dep	KozyukovaN.V.					Organization and technological part	Stage	List	Lists
Supervisor	Nashiraliev Zh.T						DP	7	9
Consultant	Nashiraliev Zh.T								
N.controller	Bek A.A					Eearth Work	Civil Engineering and building materials department		
Created	Ahmadi.W.A								

Building General Plan





Symbols

- Temporary fencing
- Gate
- External lighting
- Direction of movement
- S — Permanent sewerage
- W — Permanent water supply
- P — Permanent power line
- TS — Temporary sewage
- TW — Temporary water supply
- TP — Temporary power line

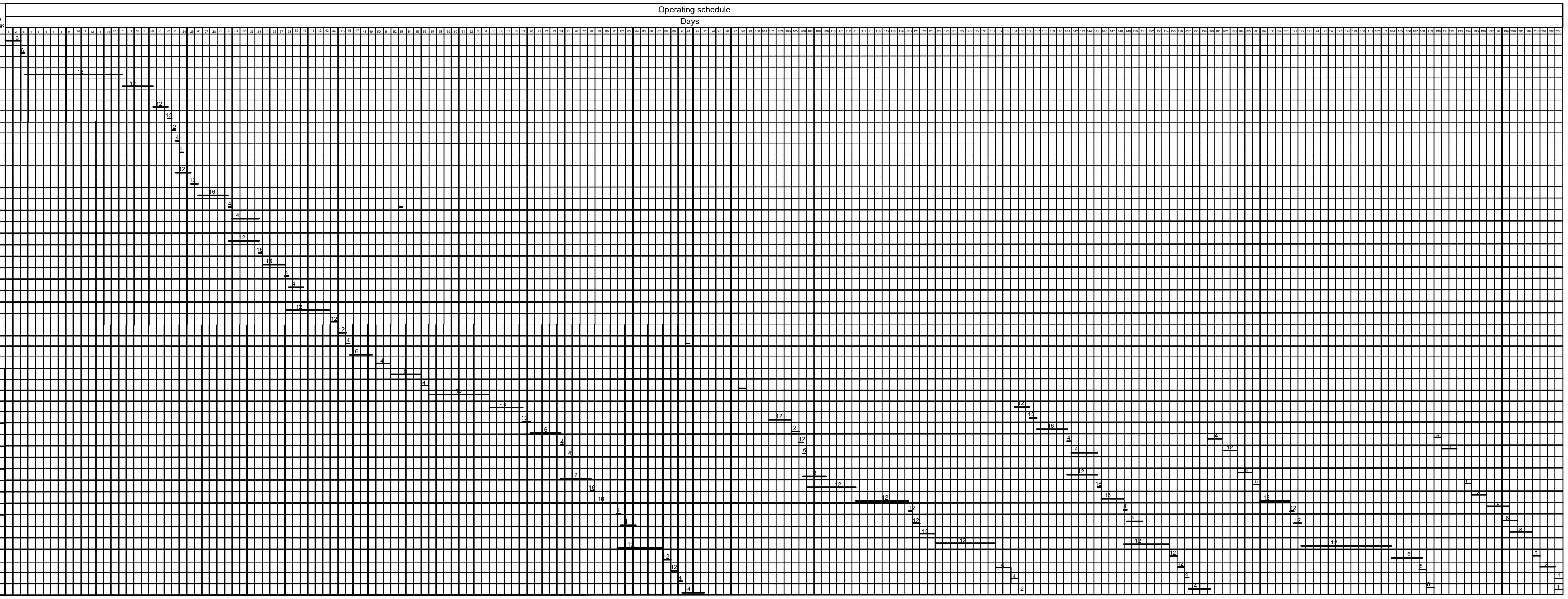
Explication of temporary buildings and structures

1 Building under construction
2 Superintendent's office
3 Office of masters
4 Workshop
5 Workshop
6 Warehouse
7 Dining room
8 Security point
9 common room
10 Shower room
11 Restroom
12 Transformer
13 Parking
14 Trash can

Chan	Num.	par	List	Sing	Date	KazNITU - 5B072900-Civil Engeneering-02.08.02 - 2021 - 2021 - DP			
						Museum of Contemporary Art with Translucent Structures in Almaty			
Head of Dep		KozyukovaN.V.				Organization and technological part	Stage	List	Lists
Supervisor		Nashiraliev Zh.T					DP	8	9
Consultant		Nashiraliev Zh.T							
N.controller		Bek A.A							
Created		Ahmadi.W.A				General Plan	Civil Engeneering and building materials department		

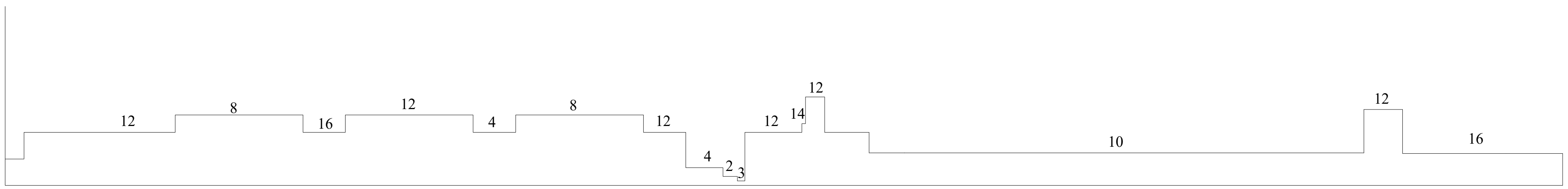
Calendar Schedule

№ п/п	Name of works	Scope of work: unit of measure	Scope of work: Quantity	labor costs man / day	The required cars: Name	The required cars: Numer of cars need	Duration Days	number of shifts	Numer of workers in change ,n
1	temporary fence	1 м	372	18			2	2	2
2	cutting off the vegetation layer	1000 м²	1535		DZ-345	5	1	2	1
3	excavation	100 м³	570		E-10011E(D)				
4	excavation of soil into vehicles	100 м³	568.5		Hitachi ZX350LCK-5G	50	15	3	4
5	manual excavation	1м³	570	170			4	3	6
6	device of monolithic structures. (foundation)								
7	formwork device	1м²	1908	95,4			8	3	4
8	reinforcement work	т	55,9	39,1			2	3	4
9	concrete placement	1 м³	789,6	21,7			1	3	4
10	concrete care	100 м²	18,52	0,972			0,5	1	2
11	dismantling	1м²	1908	23,8			4	3	2
12	device of monolithic structures. (column)								
13	formwork device	1 м²	2122,5	06,1			8	3	4
14	reinforcement work	т	43,6	46,8			6	3	2
15	concrete placement	1 м³	766,8	143,8			12	3	4
16	concrete care	100 м²	0,74	0,04			0,5	1	2
17	dismantling	1м²	2122,5	39,8			6,5	3	2
18	device of monolithic structures. (wall)								
19	formwork device	1 м²	9279,9	289,9			12	3	8
20	reinforcement work	т	92,2	99,1			4	3	8
21	concrete placement	1 м³	1738,6	239,1			10	3	8
22	concrete care	100 м²	8,76	0,46			0,5	1	2
23	dismantling	1м²	9279,9	173,9			7	3	8
24	device of monolithic structures. (floor)								
25	formwork device	1 м²	15768	433,6			18	3	4
26	reinforcement work	т	136,6	99,1			4	3	4
27	concrete placement	1 м³	1198,8	83,9			3	3	4
28	concrete care	100 м²	157,68	8,3			2	2	2
29	Dismantling	1м²	15768	177,4			12	2	2
30	foundation waterproofing	100 м²	32,25	6,05			1,5	2	2
31	backfilling	100 м³	87,78		Komatsu D85ESS-2A	4,4	2	2	1
32	soil compaction	100 м²	17,48		Hamm HD 90	0,6	0,5	1	1
33	device of monolithic structures. (columns)								
34	formwork device	1м²	3537,5	176,8			15	3	4
35	reinforcement work	т	176,5	172,1			14	3	4
36	concrete placement	1 м³	199	37,3			4,5	3	4
37	concrete care	100 м²	54,82	2,87			1,5	3	4
38	Dismantling	1м²	3537,5	66,3			5,5	3	2
39	device of monolithic structures. (walls)								
40	formwork device	1 м²	4148,9	129,6			16	2	4
41	reinforcement work	т	372,5	400,4			33	3	4
42	concrete placement	1 м³	3171	436			36	3	4
43	concrete care	100 м²	82,23	4,3			2	3	4
44	Dismantling	1м²	4148,9	77,8			6	3	4
45	device of monolithic structures. (floors)								
46	formwork device	1 м²	26037,5	716,1			59	3	4
47	reinforcement work	т	521,5	247,7			21	3	4
48	concrete placement	1 м³	5210	364,7			30	3	4
49	concrete care	100 м²	137,05	7,2			2	3	4
50	dismantling	1м²	26037,5	292,9			24,5	3	4



$$K_{нер} = \frac{n_{max}}{n_{ср}} = \frac{16}{20.02} = 0.79 \leq 1.15$$

$$n_{ср} = \frac{Q}{П} = \frac{4125}{206} = 20.02$$



Statement of the needs of machines and mechanisms

Name	Mark	Appointment
1.Bulldozer	DZ-345	Cutting off the vegetation layer, backfilling
2. Backhoe excavator	E-10011E(D) old (E-1003)	Development of soil into dumps and vehicles
3. Self-propelled roller	D-471V	Soil compaction
4. Dump truck	MAZ-525	Removal of soil
5. Concrete pump	ABN 75/32	Concrete supply
6. Mobile crane	MKG -16M	Delivery of goods

Technical and economic indicators

№	Name	Unit rev.	Quantaty
1	Labor costs	man-day	4125
2	Duration	days	206

Chan	Num.	par	List	Sing	Date

KazNITU - 5B072900-Civil Engeneering-02.08.02 - 2021 - 2021 - DP

Museum of Contemporary Art with Translucent Structures in Almaty

Head of Dep	KozyukovaN.V.	
Supervisor	Nashiraliev Zh.T	
Consultant	Nashiraliev Zh.T	
N.controller	Bek A.A	
Created	Ahmadi.W.A	

Organization and technological part

Stage	List	Lists
DP	9	9

Calendar Schedual

Civil Engineering and building materials department

Appendix A

Table 1- Floor specification

No	Name	Area
1	Entery	52.35 m^2
2	Salon	153.86 m^2
3	Admision	23.5 m^2
4	Electric room	16.58 m^2
5	Officc	35.96 m^2, 58.25 m^2
6	Ancient Room	69.5 m^2
7	Cultural Room	65.23 m^2
8	Cultural Room	59.36 m^2
9	Customer Room	10.2 m^2
10	Big Show	1500.29 m^2
11	Literary Cottage	254.34 m^2
12	Meeting Room	145.35 m^2
13	Toalit	20 m^2
14	Waiting Room	96.5 m^2
15	Religious Room	82.4 m^2
16	Office	25.34 m^2
17	Lift	6 m^2

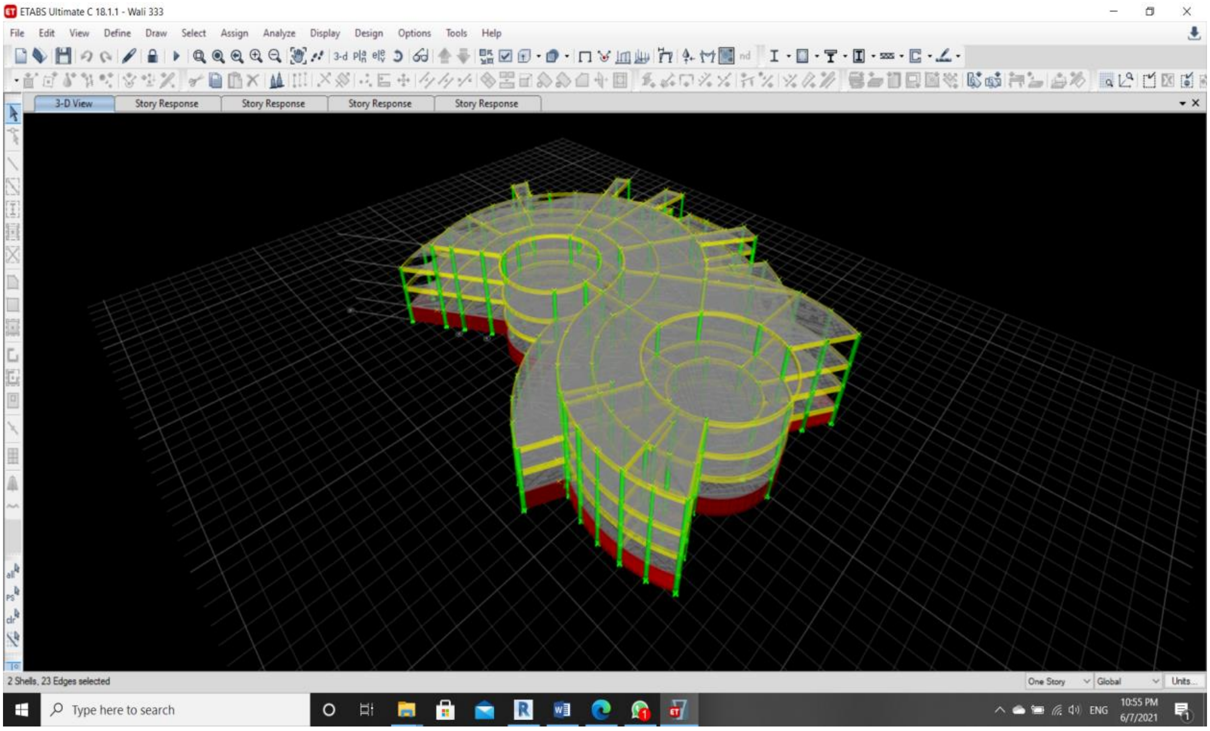


Figure A.1 – Extruded view of my building on Etabs 18

Appendix B

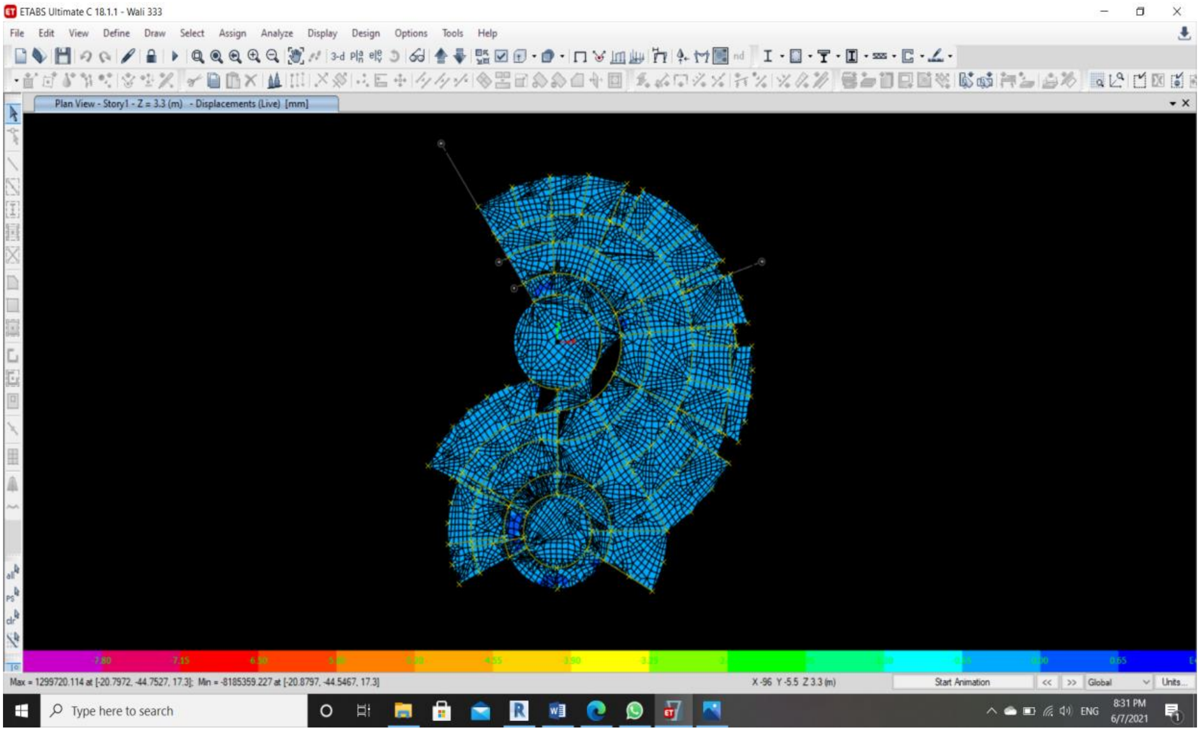


Figure B.1 – slab deflection along Z axis

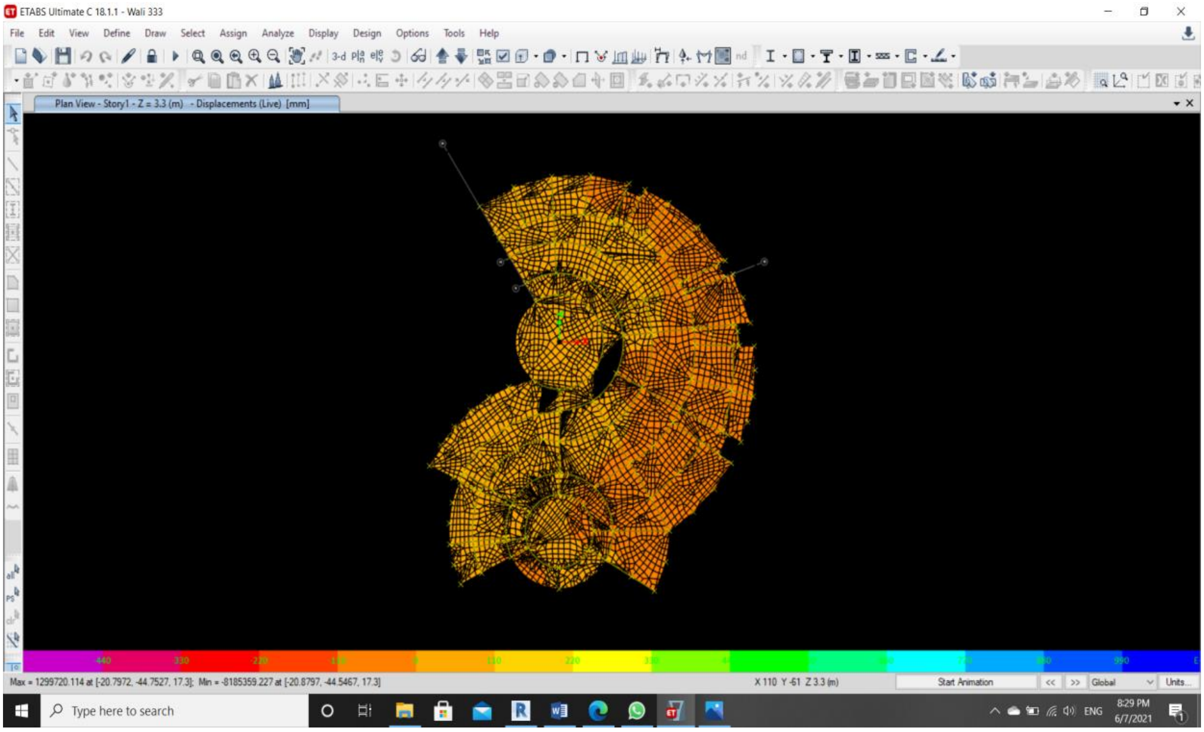


Figure B.2 – Isofields of base dirift along the x and y axis

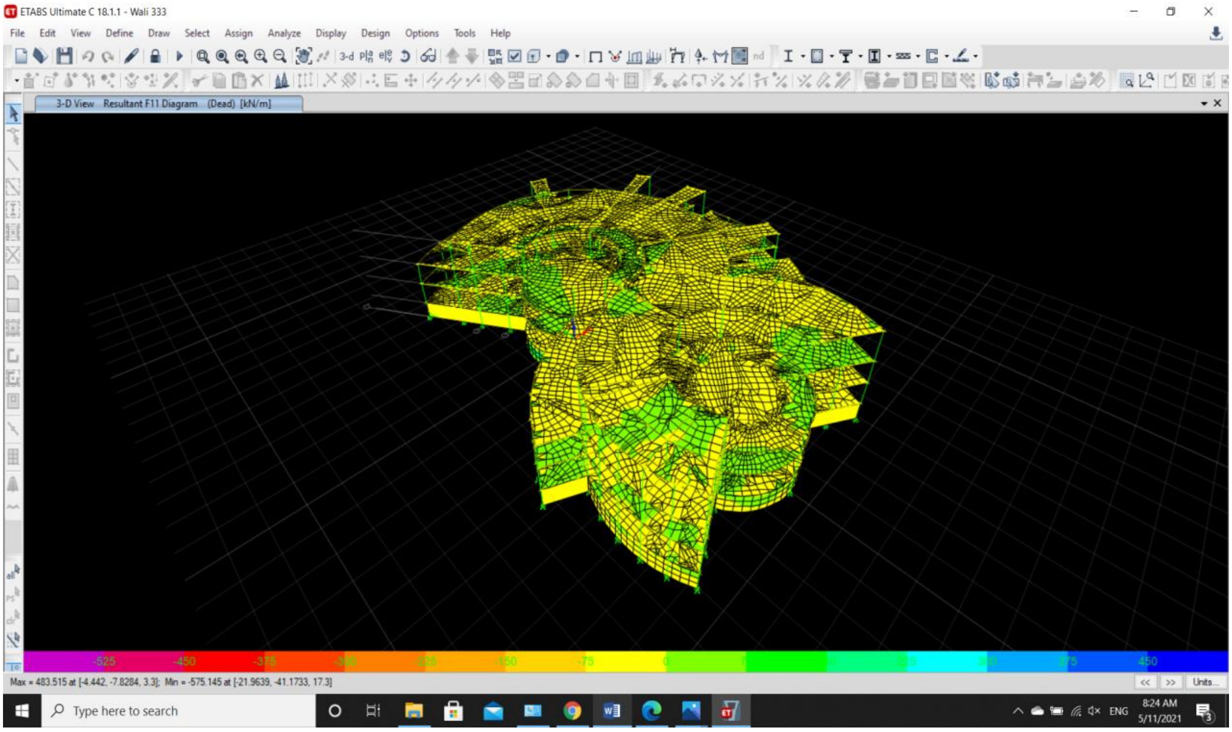


Figure B.3 – Stress on floor due to dead load

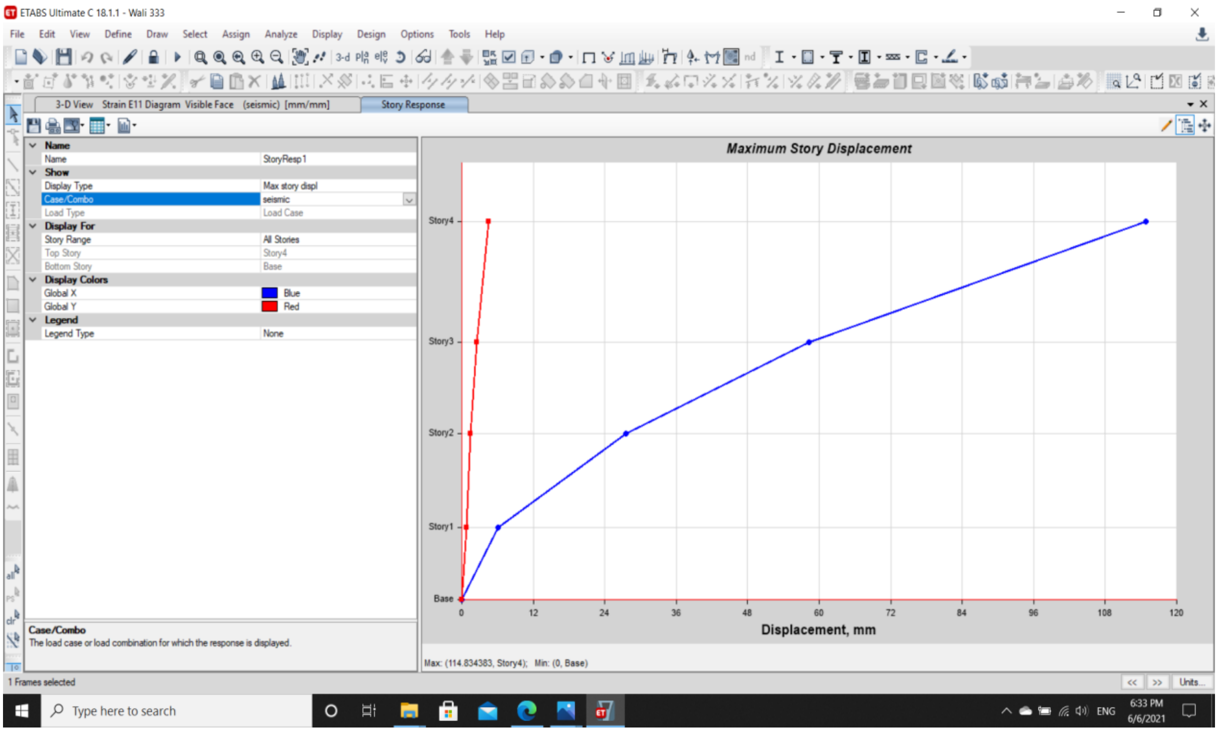
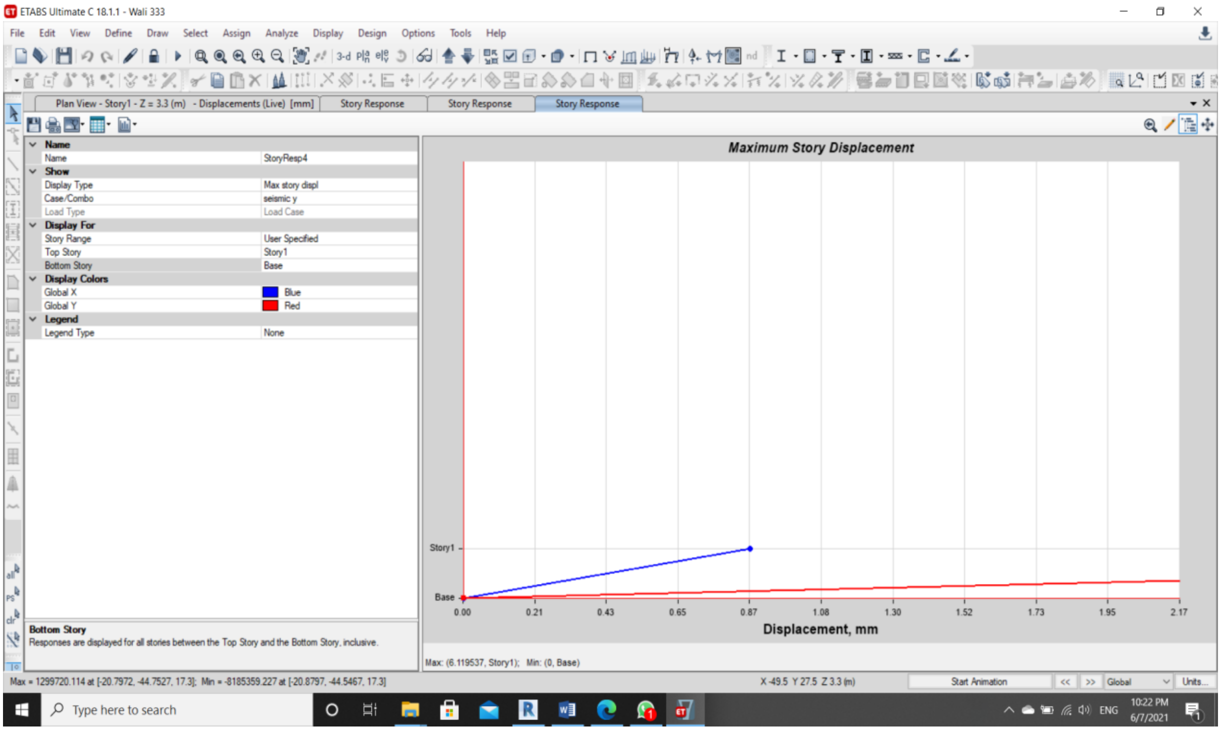
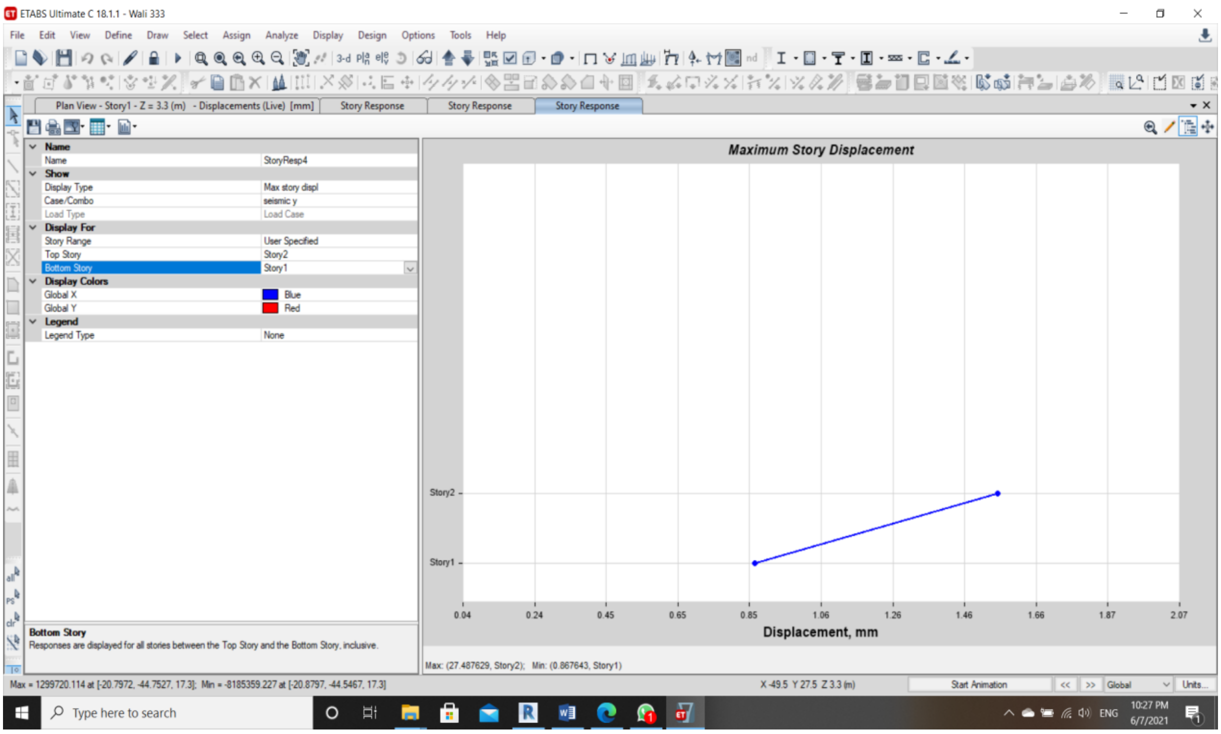


Figure B.4 – Displacement from the seismic along the X andY-axis

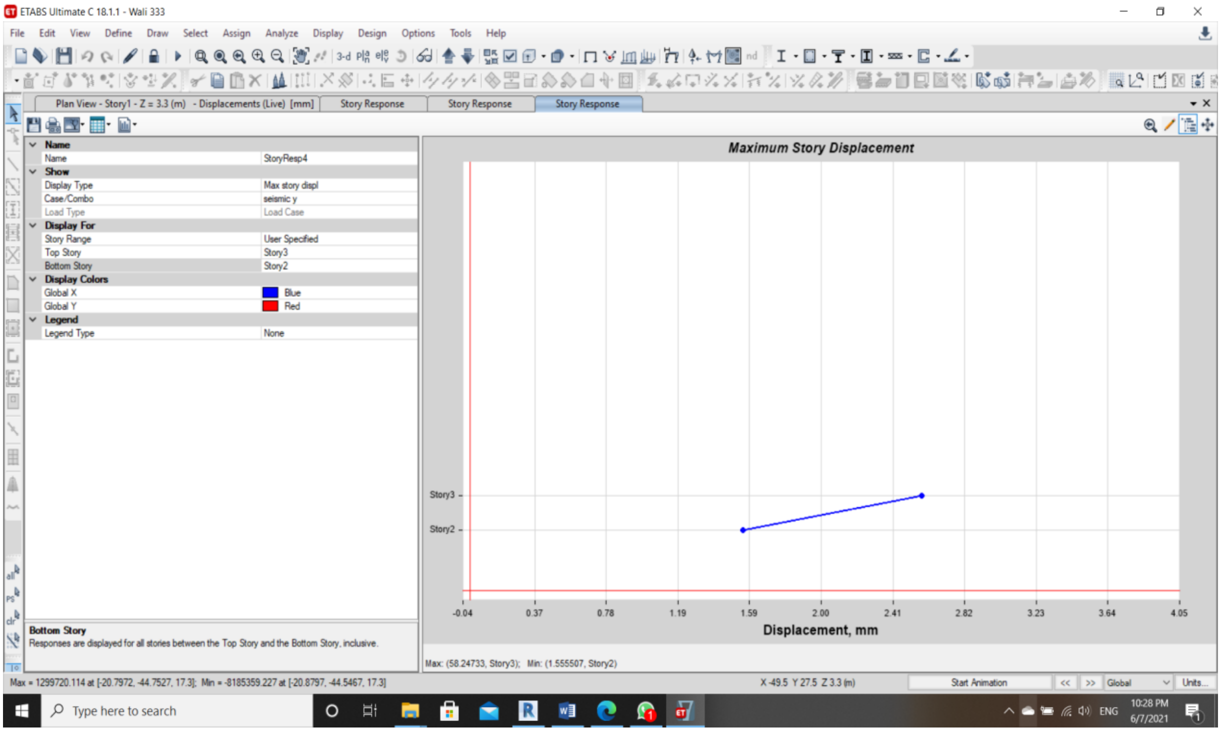


Figures B.5 - Diagram of displacements of the Base and Story 1 from seismic along Y

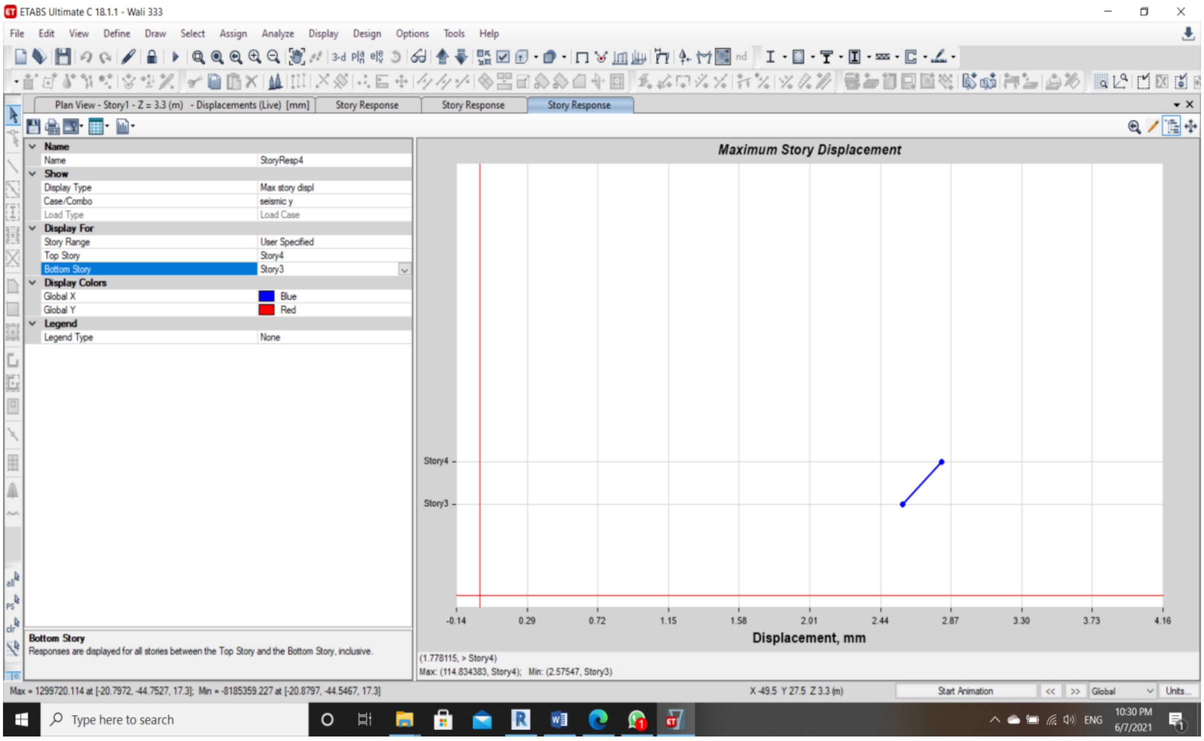
Continuation of Appendix B



Figures B.6 - Diagram of displacements of the Story 1 and Story 2 from seismic along



Figures B.7 - Diagram of displacements of the Story 2 and Story 3 from seismic along Y



Figures B.7 - Diagram of displacements of the Story 3 and Story 4 from seismic along Y

Appendix C

Table 2- Cost calculations of machine time, labor costs and salary

№	(Name of processes	Justification (ENIR, No., table, point))	Unit of measure	Volume of work	Standard time		Quotation, u.e.		Labor costs		Salary	
					Working h–h.	Drivers of m–cm	Working	Drivers	Working, h–d	Drivers of m–cm	Working	Drivers
1	2	3	4	5	6	7	8	9	10	11	12	13
1	The construction of temporary fencing		10m	372	1.2	-	1.3		446	-	54	-
2	Removal of top soil		1000 m^2	1535	-	0.56	-	0.6	-	860	-	105
3	Soil excavation in the trench		100 m^2	570	2.8	3.56	1.48	1.7	1596	319	194	38
4	Excavation of soil underrun		m^3	568.5	1.64	-	0.54	-	932	-	113	-
5	Concrete preparation for foundations		m^3	24.5	0.79	-	0.49	-	20	-	2.5	-
6	Formwork removal of columnar foundation		ton	21582	0.022	-	15	-	474	-	57	-
7	Formwork removal of columnar foundation		m^2	1194	0.36	0.12	0.35	0.17	430	143	52	7.4
8	Concreting of columnar foundation		m^3	224.8	1.2	0.89	0.34	0.31	270	27	32	3
9	Formwork removal of columnar foundation		m^2	450	0.31	-	0.08	-	139	-	54	-

Continuation of Appendix C

Continuation of Table B.1- Cost calculations of machine time, labor costs and salary

10	Foundation waterproofi ng		100 m^2	144 8	0.10	-	7.15	-	14 5	-	17	-
11	Backfilling		m^2	960 0	-	0.03 9	-	1.58	-	37 4	-	45
12	Soil compaction		100 m^2	240 00	-	0.00 92	-	0.26	-	22 0	-	26
13	Final land planning		100 m^2	129 3	0.33	0.04 9	1.58	1.65	42 6	63	52	8
14	Removal of temporary fencing		100m	372	0.90	-	1.05	-	33 4	-	45	-

Table 2. Planned schedule of works

s	Volume of work			The required cars					
	Unit measurements	Quantity	Labor cost, h–d	The required cars	Number $shf \cdot pr$	Duration, days (P)	Number of changes (A)	(Number of workers in change, n	Structure of crew)
1	2	3	4	5	6	7	8	9	10
The construction of temporary fencing	m	372	446		2	1	2	10	Worker
Removal of top soil	m^3	1535	-	DET250	1	2	3	2	Driver
Soil excavation in the pit (trench) and trench access to the pit	m^3	570	1596	E-10011E (D)	2	10	2	4	Worker
Excavation of soil underrun	m^3	568.5	932	E-10011E (D)	2	3	2	4	Worker
Concrete preparation for foundations	m^3	24.5	20		2	5	3	8	Reinforc e Concrete worker

Continuation of Appendix C

Continuation of Table B.1 Planned schedule of works

Reinforcement installation	t	21582	74	DEK–25G	2	20	2	7	lo cksmith
Formwork installation	m^2	1194	430	DEK–25G	2	4	2	6	Reinforc ed
Concreting of foundation	m^3	224.8	270	RVM 42	1	3	1	7	Reinforc ed Concrete worker
Formwork removal	m^2	450	139	DEK–25G	1	2	3	4	carpenter
Foundation waterproofing	m^2	1448	145		2	2	2	5	Worker
(Backfilling	m^3	9600	-	DET250	2	4	3	2	Driver
Soil compaction	m^2	24000	-	D-471V	1	3	2	2	Driver Worker
Final land planning	m^2	1293	426		2	2	2	4	Driver Worker
Removal of temporary fencing	m	372	334		1	2	1	8	Worker

Appendix D

OBJECT ESTIMATE

Estimated Cost	**8451110000**	Thous.Tenge
Normative Labor Intensity	**13.213**	Thous.pers.h
Estimated Wages	**5495.41**	Thous.Tenge

Compiled in prices for 01.1. 2001 y

№ п/п	No. of estimates and calculations	Name of works and costs	Estimated Cost, Thous. Tenge				Normative Labor Intensity	Estimated Wages
			construction and installation works	equipment, furniture and inventory	other costs	Total		
1	2	3	4	5	6	7	8	9
1	1	Museum of Contemporary Art with Translucent Structures in Almaty	2254200	--	--	8451110000	38.082	2736.023
2		**Total**	2254200	--	--	**8451110000**	38.082	2736.023
3		Temporary buildings and structures	552452	--	--	552452	38.082	2736.023
4		Return of materials from temporary buildings and structures	551145	--	--	551145	38.082	2736.023
5		**Total**	552452	--	--	**552452**	38.082	2736.023
6		**Total**	2806652	--	--	**2806652**	38.082	2736.023
7		Additional costs in the production of work in the winter	33679.824	--	--	33679.824	38.082	2736.023
8		Seniority costs			28066.52	28066.52	38.082	2736.023
9		Additional vacation costs			11226.608	11226.608	38.082	2736.023
10		**Total**	**33679.824**		**39293.128**	**72972.952**	38.082	2736.023
11		**Total**	2840331.824		39293.128	2879624.952	38.082	2736.023
12		Including refundable amounts	551145		--	551145	38.082	2736.023
13		**Total according to the estimated calculation in the base prices of 2001.**	2840331.824		39293.128	2879624.952	38.082	2736.023
14		Total estimated at current prices in 2021.	9713934.838		134382.4978	9848317.336	38.082	2736.023
15		Including refundable amounts in current prices	1884915.9			1884915.9	38.082	2736.023
16		Taxes, fees, mandatory payments,			196966.3467	196966.3467	38.082	2736.023
17		Estimated cost at current price level	9713934.838		331348.8445	10045283.68	38.082	2736.023
18		НДС (12%)			1205434.042	1205434.042	38.082	2736.023
19		Construction cost	9713934.838		1536782.886	11250717.72	38.082	2736.023

Figure D.1- Objective estimation

Continuation of Appendix D

Estimated calculation of the cost of construction in the amount of 19r 7c	42700131.59 Thous.Tenge
including refundable amounts: 15r 7c	**59456.1039** Thous.Tenge
value added tax 18r7c	4575014.099 Thous.Tenge

ESTIMATE CALCULATION OF THE COST OF CONSTRUCTION

Compiled in prices for 01.1. 2001 y

№ п/п	No. of estimates and calculations	Name of works and costs	Estimated cost, Thous.Tenge			Total,Thous. Tenge
			construction and installation works	equipment, furniture and inventory	other costs	
1	2	3	4	5	6	7
1	1	Museum of Contemporary Art with Translucent Structures in Almaty	10536258	--	--	10536258
2		**Total=1 row**	10536258	--	--	**10536258**
3		Temporary buildings and structures 1,1%*2 row 7column	115898.838	--	--	115898.838
4		Return of materials from temporary buildings and structures 15%*3r7c	17384.8257	--	--	17384.8257
5		**Total=3 row**	115898.838	--	--	**115898.838**
6		**Total 2r+5r**	10652156.84	--	--	**10652156.84**
7		Additional costs in the production of work in the winter1,2%*6r7c	127825.8821	--	--	127825.8821
8		Seniority costs 1%*6r7c			106521.5684	106521.5684
9		Additional vacation costs 0,4%*6r7c			42608.62735	42608.62735
10		**Total 7r+8r+9r**	**127825.8821**		**149130.1957**	**276956.0778**
11		**Total 6r+10r**	10779982.72		149130.1957	10929112.92
12		Including refundable amounts=4r	17384.8257		--	17384.8257
13		**Total according to the estimated calculation in the base prices of 2001..=11r**	10779982.72		149130.1957	10929112.92
14		Total estimated at current prices in 2021. 13r*3,42	36867540.9		510025.2694	37377566.17
15		Including refundable amounts in current prices 12r7c*3,42	59456.10389			59456.10389
16		Taxes, fees, mandatory payments,2%*14r7c			747551.3234	747551.3234
17		Estimated cost at current price level 14r+16r	36867540.9		1257576.593	38125117.5
18		НДС (12%)*17r7c			4575014.099	4575014.099
19		Construction cost17r+18r	36867540.9		5832590.692	42700131.59

Figure D.2- calculation of the cost of the construction

Continuation of Appendix D

OBJECT ESTIMATE

Estimated Cost	**8451110000** Thous.Tenge
Normative Labor Intensity	**13.213** Thous.pers.h
Estimated Wages	**5495.41** Thous.Tenge

Compiled in prices for 01.1. 2001 y

№ п/п	No. of estimates and calculations	Name of works and costs	Estimated Cost, Thous. Tenge				Normative Labor Intensity	Estimated Wages
			construction and installation works	equipment, furniture and inventory	other costs	Total		
1	2	3	4	5	6	7	8	9
1	1	Museum of Contemporary Art with Translucent Structures in Almaty	145200	--	--	8451110000	38.082	2736.023
2		**Total**	145200	--	--	**8451110000**	38.082	2736.023
3		Temporary buildings and structures	12550	--	--	12550	38.082	2736.023
4		Return of materials from temporary buildings and structures	551145	--	--	551145	38.082	2736.023
5		**Total**	12550	--	--	**12550**	38.082	2736.023
6		**Total**	157750	--	--	**157750**	38.082	2736.023
7		Additional costs in the production of work in the winter	1893	--	--	1893	38.082	2736.023
8		Seniority costs			1577.5	1577.5	38.082	2736.023
9		Additional vacation costs			631	631	38.082	2736.023
10		**Total**	**1893**		**2208.5**	**4101.5**	38.082	2736.023
11		**Total**	159643		2208.5	161851.5	38.082	2736.023
12		Including refundable amounts	551145		--	551145	38.082	2736.023
13		**Total according to the estimated calculation in the base prices of 2001.**	159643		2208.5	161851.5	38.082	2736.023
14		Total estimated at current prices in 2021.	545979.06		7553.07	553532.13	38.082	2736.023
15		Including refundable amounts in current prices	1884915.9			1884915.9	38.082	2736.023
16		Taxes, fees, mandatory payments,			11070.6426	11070.6426	38.082	2736.023
17		Estimated cost at current price level	545979.06		18623.7126	564602.7726	38.082	2736.023
18		НДС (12%)			67752.33271	67752.33271	38.082	2736.023
19		Construction cost	545979.06		86376.04531	632355.1053	38.082	2736.023

Figure D.3 – objective estimate

RESPONSE
OF THE SUPERVISOR
for the graduation project

___________*Ahmadi Wali Ahmad*________
5B072900–"Civil Engineering"

Topic: «Museum of contemporary art with translucent structures in Almaty in Almaty».

Wali Ahmad started the implementation of the diploma project on the above-mentioned topic according to a preliminary schedule and completed all its sections on time.

During the implementation of the diploma project, Wali Ahmad showed himself only on good terms, was a solid fighter. He competently mastered the knowledge gained during his studies.

It is worth noting the completeness and high quality of the diploma project. It is worth noting the completeness of all sections of the diploma project, especially the accounting and design section. In this section, the performer calculated the frame of the building using a computer program. I calculated and assembled the mainstay and beam from the reinforced concrete compressed from the middle. He used new quantitative and reference literature (Eurocodes).

There are the following comments on the diploma project::

- the explanatory note contains errors in translations;
- in some drawings, the axes are not marked.

The student independently solved many problems of the diploma project. Taking into account all this, I believe that the diploma project performed by Wali Ahmad, which was evaluated by 93% (excellent) and recognized by its author as a fully formed specialist, deserves an degree "Bachelor of technics and technology».

Supervisor
Candidate of technical sciences, associate professor

______________________ Nashiraliyev Zh. T.

« 30 » may 2021 yr.

Протокол анализа Отчета подобия Научным руководителем

Заявляю, что я ознакомился(-ась) с Полным отчетом подобия, который был сгенерирован Системой выявления и предотвращения плагиата в отношении работы:

Автор: Ахмади Вали АХМАД

Название: Museum of contemporary art with translucent structures in Almaty

Координатор:Жангельди Наширалиев

Коэффициент подобия 1:1.9

Коэффициент подобия 2:0.5

Замена букв:87

Интервалы:0

Микропробелы:101

Белые знаки: 0

После анализа Отчета подобия констатирую следующее:

- ☐ обнаруженные в работе заимствования являются добросовестными и не обладают признаками плагиата. В связи с чем, признаю работу самостоятельной и допускаю ее к защите;
- ☐ обнаруженные в работе заимствования не обладают признаками плагиата, но их чрезмерное количество вызывает сомнения в отношении ценности работы по существу и отсутствием самостоятельности ее автора. В связи с чем, работа должна быть вновь отредактирована с целью ограничения заимствований;
- ☐ обнаруженные в работе заимствования являются недобросовестными и обладают признаками плагиата, или в ней содержатся преднамеренные искажения текста, указывающие на попытки сокрытия недобросовестных заимствований. В связи с чем, не допускаю работу к защите.

Обоснование:

……

……………………… ……………………………………

Дата *Подпись Научного руководителя*

Протокол анализа Отчета подобия

заведующего кафедрой / начальника структурного подразделения

Заведующий кафедрой / начальник структурного подразделения заявляет, что ознакомился(-ась) с Полным отчетом подобия, который был сгенерирован Системой выявления и предотвращения плагиата в отношении работы:

Автор: Ахмади Вали АХМАД

Название: Museum of contemporary art with translucent structures in Almaty

Координатор: Жангельди Наширалиев

Коэффициент подобия 1:1.9

Коэффициент подобия 2:0.5

Замена букв:87

Интервалы:0

Микропробелы:101

Белые знаки:0

После анализа отчета подобия заведующий кафедрой / начальник структурного подразделения констатирует следующее:

☐ обнаруженные в работе заимствования являются добросовестными и не обладают признаками плагиата. В связи с чем, работа признается самостоятельной и допускается к защите;
☐ обнаруженные в работе заимствования не обладают признаками плагиата, но их чрезмерное количество вызывает сомнения в отношении ценности работы по существу и отсутствием самостоятельности ее автора. В связи с чем, работа должна быть вновь отредактирована с целью ограничения заимствований;
☐ обнаруженные в работе заимствования являются недобросовестными и обладают признаками плагиата, или в ней содержатся преднамеренные искажения текста, указывающие на попытки сокрытия недобросовестных заимствований. В связи с чем, работа не допускается к защите.

Обоснование:

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Дата *Подпись заведующего кафедрой / начальника структурного подразделения*

Окончательное решение в отношении допуска к защите, включая обоснование:

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Дата *Подпись заведующего кафедрой / начальника структурного подразделения*