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

Mina Ahmadzai

On the theme of “Multifunctional administrative complex using solar energy in Kyzylorda”

EXPLANATORT NOTE
To the diploma project

Specialty 5B072900 – Civil Engineering

Almaty 2021

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ALLOWED TO PROTECT

Head of Department
__________ N.V. Kozyukova
Master of technical science,
lecturer
«_1_»___6___2021 y.

EXPLANATORY NOTE
to the diploma project

On the theme of “Multifunctional administrative complex using solar energy in Kyzylorda”

5B072900 - "Civil Engeneering"

Prepared by Mina Ahmadzai

Scientific adviser: N.V. Kozyukova
Master of technical science, lecturer
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I APPROVE
Head of Department
_______N.V. Kozyukova
Master of technical science, lecturer
«__»_______2021 y.

ASSIGNMENT
Complete a diploma project

Student: Mina Ahmadzai
Topic « Multifunctional administrative complex using solar energy in Kyzylorda »
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, 2021.
Initial data for the diploma project: Kyzylorda
Structural schemes of the building - structures are made of monolithic reinforced concrete, skeleton structure of slab and column.
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 waffle slab.
c) Organizational and technological part: development of technological maps of formwork, construction schedule and construction plan;
d) Economic part: local estimate, object estimate, Cost of Construction estimate;
List of graphic material (with exact indication of required drawings):
1. Facade, standard floor plans, parts 1-1 and 2-2 - 6 sheets.
2. Slab and columns, specifications - 2 sheet.
3. Technical maps of formwork, calendar plan, construction site plan - 3 sheets.
15 slides of work presentation are provided.
Recommended main literature: SP PK 2.04-01-2017 "Construction climatology", CN PK 2.04-04-2013 "Construction heat engineering", SN RK 2.03-30-2017

"Construction in seismic zones", CN PK 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	N.V. Kozyukova Master of technical science, lecturer		
Calculation and design	N.V. Kozyukova Master of technical science, lecturer		
Organizational and technological	N.V. Kozyukova Master of technical science, lecturer		
Economic	N.V. Kozyukova Master of technical science, lecturer		
Norm controller	Bek.A.A Master of technical science, assistant		
Quality control	N.V. Kozyukova Master of technical science, lecturer		

Scientific adviser N.V. Kozyukova

The task was accepted for execution student Mina Ahmadzai

Date "__" ___ 2021 y.

АҢДАТПА

Дипломдық жұмыстың тақырыбы – « Қызылорда қаласында күн энергиясын пайдаланатын көпфункционалды әкімшілік кешені». Жұмыс келесі бөлімдерден тұрады: сәулет-құрылыс, есептік-конструктивтік, құрылыс өндірісінің технологиясы мен ұйымдастырылуы, экономикалық бөлім, тіршілік қауіпсіздігі және еңбекті қорғау.

Осы жұмысты құру кезінде бағдарламалық кешендердің келесі тізімі пайдаланылды:

1. AutoCAD 2020;
2. CSI-ETABS 2019;
3. Revit 2020.
4. CSI-CAFÉ 2016.

АННОТАЦИЯ

Тема данной дипломной работы – « Многофункциальный административный комплекс с использованием солнечной энергии в городе Кызылорда ».Работа состоит из следующих разделов: архитектурно-строительный, расчетно-конструктивный, технология и организация строительного производства, экономический раздел, безопасность жизнедеятельности и охрана труда.

При создании данной работы был использован следующий перечень программных комплексов:

1. AutoCAD 2020;
2. CSI-ETABS 2019;
3. Revit 2020.
4. CSI-CAFÉ 2016.

ANNOTATION

The topic of this thesis is “Multifunctional administrative complex using solar energy in Kyzylorda”. The work consists of the following sections: architectural and construction, design and construction, technology and organization of construction production, economic section, life safety and labor protection.

When creating this work, the following list of software systems was used:

1. AutoCAD 2020;
2. CSI-ETABS 2019;
3. Revit 2020.
4. CSI-CAFÉ 2016.

CONTENT

INTRODUCTION

The purpose of this diploma project is to design “Multifunctional administrative complex using solar energy in Kyzylorda”. The tasks are reflected in the assignment for design.

The Multifunctional Administrative complex is one of the newest construction and need in the today’s modern society. Today for each part and sections we need the administrative room or building which could control all the sub works.

Multifunctional Administrative construction in modern style will bring its zest to the architecture of the city, as well will be excellent conditions for operating and working. As well as in today modern society the usage of solar panels are very common and most economical in the electricity industry. Traditional electricity relies heavily on fossil fuels such as coal and natural gas, not only are they bad for the environment, but also they are so limited. That the usage of solar can cause a greater advantage to economy of country.

The Kyzylorda city has sunnier weather almost 50.4 percentage of the weather is sunny so the usage of solar panels for electricity is the greatest choice

This project includes offices for regular workers, main offices, meeting rooms, eating room, comfortable free area, as well as some primary needed premises.

The diploma project was carried out using software systems ETABS, AutoCAD, Revit, CSI SAFE.

The objective of this thesis project is the construction taking into account all the requirements for Administrative offices complex. The structural basis of a multi-story building is a spatial supporting system of column and slabs of reinforced concrete interconnected in an order that ensures the strength, stability and durability of the system as a whole, as well as its individual elements.

Their production is carried out on the basis of a developed network of highly mechanized and automated enterprises of monolithic concrete, specialized in the production of a certain range of products and structures.

The layout of the structural scheme includes the plan of building, the cross section of column. The layout is carried out taking into account the purpose of the structure, architectural and planning solutions, technical and economic indicators.

1 Architectural Part

1.1 General Information about the Area and Construction Site

Diploma project on the theme: "Multifunctional administrative complex using solar energy in Kyzylorda" executed in accordance with the assignment. The initial data are presented below**.**

Construction area - city of Kyzylorda

Absolute Minimum Air Temperature: minus 40 centigrade.

Average temperature of the coldest five-day week: -26 centigrade (security 0.98).

Average temperature of the coldest day: minus 30 centigrade.

Seismic - 6 points

Type of soil – Sandy loam, second class.

Material - Monolithic Reinforced Concrete

Structural Skeleton of column and slab

Snow Region I - 0.8 kilo Pascal.

Wind Region Iv - 0.77 kilo Pascal.

The structural basis of a multi-story building is a spatial supporting system of column and slabs of reinforced concrete interconnected in an order that ensures the strength, stability and durability of the system as a whole, as well as its individual elements.

Their production is carried out on the basis of a developed network of highly mechanized and automated enterprises of monolithic concrete, specialized in the production of a certain range of products and structures.

The layout of the structural scheme includes the plan of building, the cross section of column. The layout is carried out taking into account the purpose of the structure, architectural and planning solutions, technical and economic indicators.

The main parameters of the building - span, height, length - are assigned in accordance with operational and architectural requirements. Operational requirements, reflecting primarily the technological process, are formulated in the terms of reference.

The design is carried out in accordance with the current regulatory documents (Eurocode, and construction Norms of Kazakhstan), which constitute the technical and legal basis for design work and ensure the necessary reliability and efficiency of construction projects.

1.2 Natural and Climatic Condition

Kyzylorda has a desert climate. There is virtually no rainfall during the year. The average temperature is 10.2 centigrade. The coldest month is January which is minus 8 centigrade.

The average day and night temperature is shown in the figure 1, which we see that the sunny temperature reaches to almost 40 centigrade.

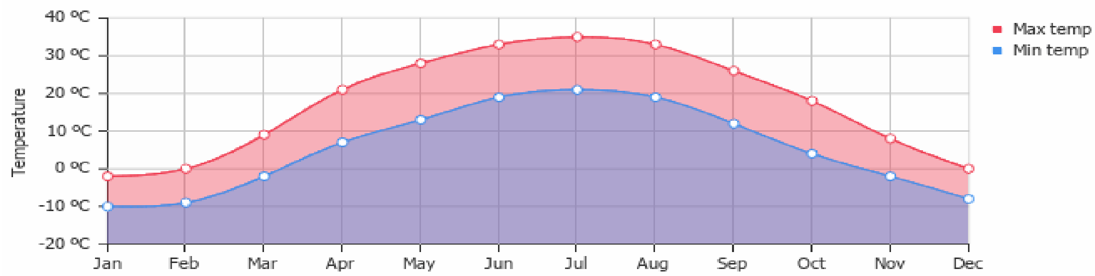


Figure 1- Average min and max temperature in Kyzylorda

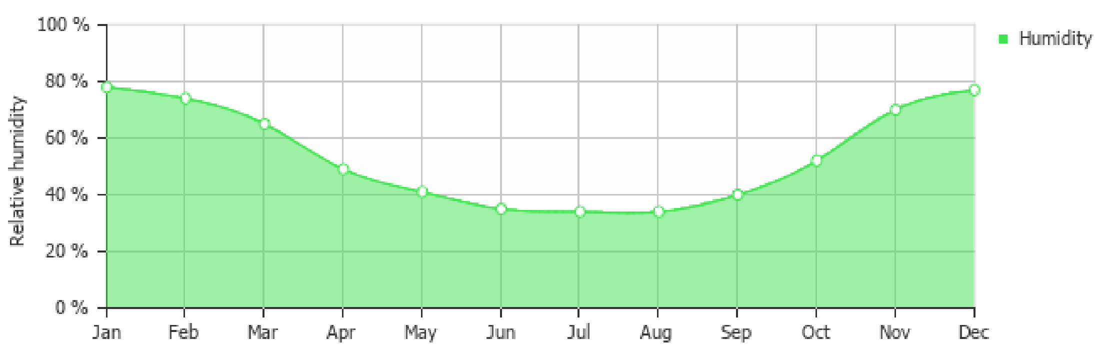


Figure 2- Average relative humidity in Kyzylorda

Wind Direction: The wind direction mostly is Northeast and east. Chance of precipitation during the year.

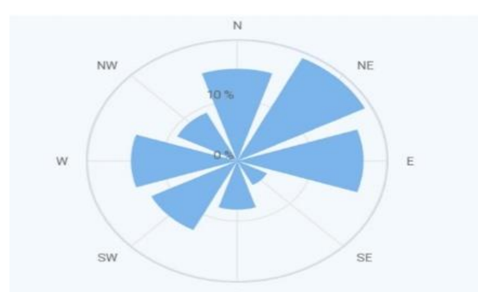


Figure 3- wind direction in Kyzylorda

1.3 The design of space planning

According to standards seismic zone we have 6 points with second type of soil (sandy loam), in this case our building dimensions are ok. [1]

As well requirement for the height of the building that we have monolith reinforcement structure. According to table the height of the building doesn't exceed from limited value: the height our structure is 12 meter.

We have monolithic slab in this case according to seismic points the thickness of slab shouldn't be less than 200 mile meter.

The Administrative building is considered with the length of 90.8 meter and width of 59.5 meter and height of 12 meter. The total area of Administrative building is 3436.9 meter square.

This administrative office create comfortable, back-up condition for work and stay in organization and institution. When designing buildings for consumer services it is necessary to provide for large steps span of load bearing structures. [2]

Engineering systems and Equipment: water supply systems, sewerage systems, drains, fire-prevention water supply systems should be provided for the offices and premises in accordance with the requirement of Kazakhstan standards.

1.4 The Usage of Solar Energy in Building

A solar panel is an assembly of photo-voltaic mounted in a framework for installation. These panels use sunlight as a source of energy and generate direct current electricity. In today modern society the usage of solar panels are very common and most economical in the electricity industry. Traditional electricity relies heavily on fossil fuels such as coal and natural gas, not only are they bad for the environment, but also they are so limited. That the usage of solar can cause a greater advantage to economy of country.

The Kyzylorda city has sunnier weather almost 50.4 percent of the weather is sunny so the usage of solar panels for electricity is the greatest choice.

The Administrative building as well need more electricity for different purposes so using solar energy can be more economical and sufficient.

I used monocrystalline type of solar panels which has high efficiency and performance and aesthetics. In general the efficiency of panel depends on the amount of sunlight it receives. Mostly this panel can produce 250 watt per hour.

These panels will be placed on the roof of third floor and the weight of these panels considered 0.18 kilo Newton per meter square.

1.5 Thermal technical calculation of the outer wall

According to the joint venture of the Republic of Kazakhstan [14 P7] and the joint venture of the Republic of Kazakhstan "Construction Heat Engineering".

Degree day of the heating period:

$$GOSP = (t_B - t_{cn})\ z_{nt} = (24+4.3)\ 181 = 5122.3$$

-The air temperature of the coldest five days centigrade: t_H = -30

-The air temperature inside the building t_B = 24 centigrade
-The duration of the heating period z_{nt} = 181
-The average temperature of the heating period: text = -4.3

<u>Determination of the thermal conductivity support enclosing structure:</u> where n equal to 1 and normalized temperature difference for administrative building $\Delta t_H = 4.5$°C, and heat transfer coefficient $\alpha_b = 7.6$.

$$R^0 = \frac{n\,(t_B - t_H)}{\Delta t_H \cdot \alpha b} = \frac{1(24+30)}{4.5 \cdot 7.6} = 1.57\ m^2°C/bm$$

Of two values we take the greatest value

4000 = 2.4

5122.3 = $R^{\circ mp}$

$R^{\circ mp}$= 3.07 so we take this value of R.

<u>Determine the desired thickness of the insulation</u>: The reduced heat transfer resistance of the enclosing structure is determined by the formula:

$$R^{\circ mp} = R^{\circ ycl} \cdot r$$

where the $R^{\circ ycl}$ is the resistance to heat transfer of the outer wall without taking in to account the influence of external corners, joints and ceiling, windows slopes and heat conducting inclusions. And r is the coefficient of heat engineering uniformity, depending on the wall design, determined according to table.

r= 0.90

$$R^{\circ ycl} = \frac{R^{\circ mp}}{r} = \frac{3.07}{0.9} = 3.41$$

$$R^{\circ ycl} = (1/\alpha_b + R_1 + R_2 + R_3 + R_4 + 1/\alpha_h)$$

$$R_1 = \frac{0.04}{0.015} = 2.6$$

$$R_2 = \frac{0.7}{0.02} = 35$$

$$R_3 = \frac{0.76}{0.24} = 3.1$$

$$R_4 = \frac{0.04}{0.075} = 0.53$$

$$\alpha_b = 7.6$$

$$\alpha_h = 12$$

$$R^{\circ ycl} = (1/7.6 + 2.6 + 35 + 3.1 + 0.53 + 1/12) = 41.44 m^2°C/bm$$

We check the condition:

$$R^0 = 1.57\ m^2°C/bm \le R^{\circ ycl} = 41.44 m^2°C/bm$$

The intended wall structure corresponds to the climatic condition in City of Kyzylorda.

2 Calculation and Design Part

The construction of the building begins with the drawing of the basic (overall) dimensions of the structural elements in the plane of the frame. The vertical dimensions are drawn to the floor level, taking it to be zero. The horizontal dimensions are tied to the longitudinal axes of the building. All dimensions are taken in accordance with the basic provisions for unification.

Floor slabs are made of precast slab that accepted as coffered or ribbed slabs. Structural layout includes selection of grid and column spacing, putting of coffered slab etc. The layout is carried out taking into account the purpose of the structure, architectural and planning solutions, technical and economic indicators, etc.

2.1 calculation of Loads

<u>Dead Load:</u> The below table 1 shows the dead load of structure elements.

Table 1 - Determination of Loads

Own weight of floors	Layer thickness, m density, kg/m^3	Characteristic load, kg/m2
For footing		
Expanded polystyrene	0.05 1400	70
Roofing materials 2 layers (insulation)	0.15 200	60
Reinforced cement-sand screeds	1.1 2400	2640
Total for foundation floor		2770=27.16 KN/m^2
Own weight typical floors		
Insulation	0.07 200	14
Plastering	0.005 2040	10.2
Reinforced cement-sand screeds(PCC)	0.37 2400	1258
Glue		1.2
Parquet board(flooring)	0.015 780	11.7
Total for a typical floor:		1295.1=12.7KN/m^2
Own weight of roof floor		

Continuation of table 1

Own weight of floors	Layer thickness, m density, kg/m^3	Characteristic load, kg/m2
Roof cladding	0.0012 7850	9.42
Vapor barrier		0.015
Insulation foam concrete	0.28 200	56
Reinforced cement-sand screeds(PCC)	0.44 2400	1056
Plastering	0.01 2040	20.4
Bituminous waterproofing bottom layer	0.001 100	0.1
Bituminous waterproofing top layer	0.001 100	0.1
Total for a flat roof		1142=11.2KN/m^2
Wall construction	Layer thickness, m density, kg/m^3	Characteristic load, kg/m2
External self-supporting curtain walls (wall height 4)		
Mullion Aluminum framed	0.2 2600	520
Glass thickness	0.03 2500	75
Air gap	0.001	0
Total for curtain walls		595=23.34KN/m
External concrete walls (wall height 4m)		
stucco	0.015 2040	30.6
Aerated concrete	0.24 2400	576
Polystyrene board insulation	0.075 80	6
Gypsum wallboard	0.02 724	14.48
Total for concrete wall		627.08=24.5KN/m
Partitions (height 4m)		
Dry wall	0.105 2400	252

Continuation of table 1

Partitions (height 4m)		
Sound insulation	0.08	1.12
	14	
Plasterboard	0.015	30.6
	2040	
Total for partitions		283.72=11KN/m
Load of Solar Panels	No	
250 watt with 60 cell with the size of 1 · 1.6m	1	$19kg/m^2$
Total		$0.18\ KN/m^2$

Temporary Load: For the temporary load we take from [3 chapter 6 table 6.1 and 6.2.]

First for slab equal to 2 kilo Newton per meter square, for stairs 2 kilo newton per meter square and for balcony 2.5 kilo Newton per meter square.

Calculation of Snow Load**:** Snow loads on the coatings should be determined as follow: I region according to snow.[4]

$$S = \mu_i \cdot C_e \cdot C_t \cdot S_k \quad (1)$$

where S_K-calculation value of the extreme snow load on the ground for specific area equal to 0.8 kilo Pascal.

Ce is the environmental coefficient or exposure factor if protected equal to 1.2.

Ct is the temperature coefficient if heated equal to 1.

μ_i is coefficient of snow load form for general buildings equal to 0.8.

$$S = 0.8 \cdot 1.2 \cdot 1 \cdot 0.8 = 0.76kpa$$

Calculation of Wind Load: The wind load act on the building from the windward (active pressure) and windward (suction) sides. The dimensions of the 90.8 · 59.5 · 12 meter, wind region Iv. [5]

The division of the building in height into zones corresponding to the base height for external pressure ze equal to12 meter from method of 7.2.2[5] where b=59.5meter >h =12 meter.

Figure 4- Zone of the building

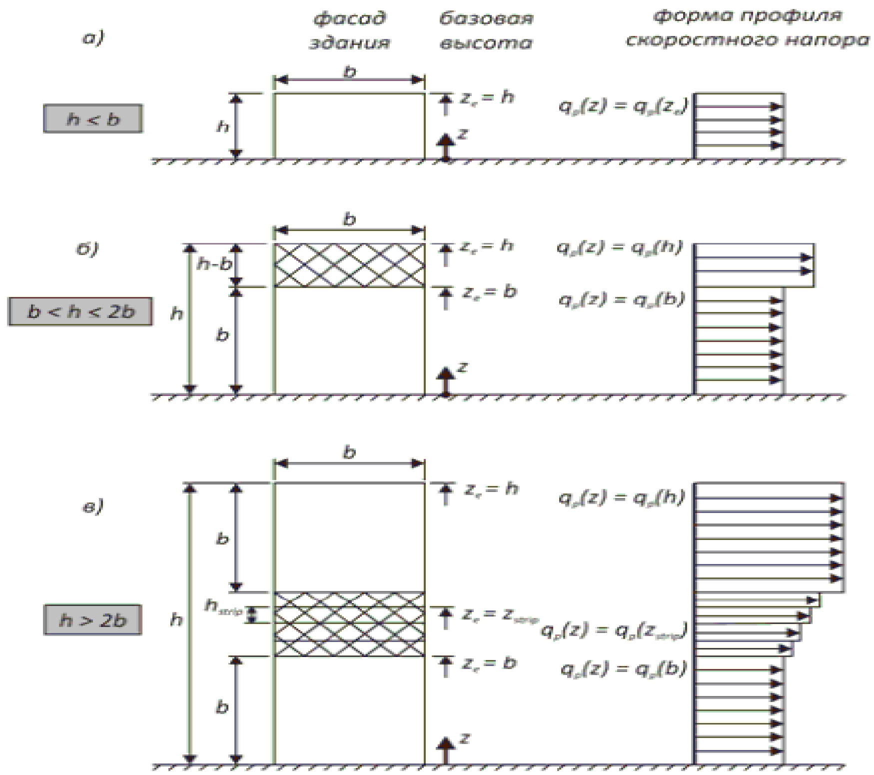


Figure 5- Reference height, Z_e, depending on h and b, and corresponding velocity pressure profile.

Wind pressure according to formula w_e:

$$W_e = q_p(z_e) \cdot c_{pe} \qquad (2)$$

where $q_p(ze)$ is the peak value of the velocity wind pressure $q_p(ze) = c_e(z) \cdot q_b$.[5]

Z_e is the base height for external pressure according to section 7 [5].

C_{pe}-aerodynamic coefficient of external pressure according to table 7.1[5]. Where h/d=5 and c_{pe} equal to 1.2.

Basic speed wind pressure for wind region q_b=0.77 kilo Pascal.

The wind pressure:

Ze=12m

Ce(12) =1.7

$$W_e = 1.7 \cdot 770 \cdot 1.2 = 1570.8 pa = 1.5708 KN/m^2$$

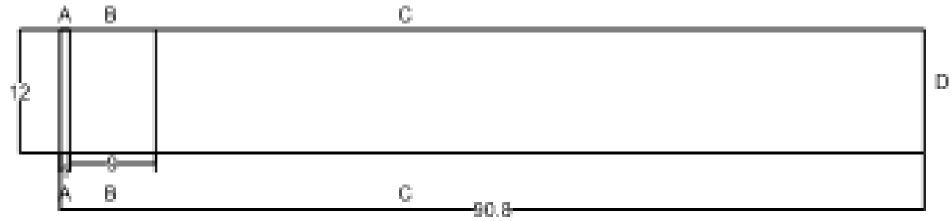


Figure 6-scheme of side area breakdown.

Table 2 - Wind pressure w_e.

A	$c_{pe} = -1.2$	Ce(12)=1.7	We=1.7 · 770 · (-1.2)= -1570.8pa =-1.5708KN/m^2
B	$c_{pe} = -0.8$	Ce(12)=1.7	We=1.7 · 770 · (-0.8)= -1047.2pa =-1.0472 KN/m^2
C	$c_{pe} = -0.5$	Ce(12)=1.7	We=1.7 · 770 · (-0.5)= -654.5pa=- 0.654.5KN/m^2
D	$c_{pe} = -0.5$	Ce(12)=1.7	We=1.7 · 770 · (-1)= -1309pa =- 1.309KN/m^2

Table 3 - External pressure coefficient for vertical rectangular walls in plan of building.

zone	A		B		C		D		E	
h/d	C_{pe},10	C_{pe},1	C_{pe},10	C_{pe},1	C_{pe},10	C_{pe},1	C_{pe},10	C_{pe},1	C_{pe},10	C_{pe},1
5	-1.2	-1.4	0.8	-1.1	-0.5		+0.8	+0.1	-0.7	
1	-1.2	-1.4	-0.8	-1.1	-0.5		+0.8	+0.1	-0.5	
≤0.25	-1.2	-1.4	-0.8	-1.1	-0.5		+0.7	+0.1	-0.5	

Wind loads are applied at the floor level:

At the wall level we first take into account half of first floor (2000)mile meter and foundation (0.800). For the windward side, one zone 4000 (from second floor till 3 floor.

Table 4 - Wind load on levels

	1 floor
E	1.5708×2.8=4.39KN/m
A	-1.5708×2.8= -4.39KN/m
B	-1.0472×2.8= -2.93KN/m
C	-0.654×2.8= -1.83KN/m
D	-1.309×2.8= -3.66KN/m
	Typical floor(roof level) 2-3
E	1.508×4=6.032KN/m
A	-1.5708×4= -6.032KN/m
B	-1.047×4= -4.18KN/m
C	-0.654×4= -2.61KN/m
D	-1.309×4= -5.2KN/m

2.2 Combination of Actions

The combination of effects of actions to be considered should be based on the design value of the leading variable action, and the design combination values of accompanying variable actions.

We can have the following formula:[6]

$$\sum\gamma_{G,J}G_{K,J} + \gamma_P P + \gamma_{Q,1}Q_{K,1} + \sum\gamma_{Q,i}\,\psi_{0,i}Q_{k,i} \tag{2}$$

where for permanent ($\gamma_{G,J}$) we have 1.35 for variable(floor $\gamma_{Q,1}$) we have 1.5 and for $\gamma_{Q,I}$ we have 1.5 · 0.5=0.75.

2.3 Manual Calculation of Coffered or Waffle Slab

The coffered slab is a ribbed structure with reinforced ribs, perpendicular to each other.

Generally the use of ribbed shape slab reduce the use of concrete for the construction of the floor and the load on the vertical load-bearing walls, which reduce the cost of the building.

The rib height is determined in two sections: first is located in the middle of the most loaded rib, the second section is the place where the ribs are adjacent to the vertical support.

For calculation of monolithic coffered slab I considered the plate with L_1=L_2=7 meter.

The column diameter is 0.7 meter. According to distance of columns I select the coffered slab standard size which the slab total thickness is 460 mile meter, from it 60 mile meter is the thickness of flat shell. The rib has 180 mile meter width with height of 400 mile meter.[8]

Aspect ratio K_1 equal to 0.62.[7]

I haves used caissons with the dimension of 1.8meter and the caissons have from column 150 mile meter each side and external wall distance of 200 mile meter.

The design resistance of concrete to axial compression is determined by the formula 3 [9]:

$$f_{cd} = a_{cc} \cdot \frac{f_{ck}}{\gamma_c} \tag{3}$$

Characteristic resistance of concrete class Concrete C30/37 to axial compression f_{ck} = 30 Mega Pascal. Partial safety factor for concrete γ_c =1.5.

$$f_{cd} = 0.85 \cdot \frac{30}{1.5} = 17\ MPa$$

Characteristic tensile strength of working reinforcement class S400 f_{yk} equal to 400 Mega Pascal. The design tensile strength of the working reinforcement is determined by the formula 4 [3]:

$$f_{yd} = \frac{f_{yk}}{\gamma_s} \quad (4)$$

$$f_{yd} = \frac{400}{1.15} = 348\ MPa$$

Estimated rib length:

Lr=1.045 · 7 =7.32m

Estimated slab span:

$$a= \frac{7.32}{4} =1.83m$$

Arc Length:

$$\frac{85^0}{360^0}(2 \cdot 3.14 \cdot 7)=10.379m \cong 10.4m$$

For the calculation of coffered slab we need to find the loads acting in 1meter square of slab as bellow.

Table 5 - Standard and design loads per 1 meter square of floor

Load	Standard load, kN/m²	Load safety factor	Design load, kN/m²
Constant: Plastering and insulation 5mm+70mm=75mm; the same layer of cement mortar, δ = 360mm (ρ = 2400 kg / m3); the same parquet loads, δ = 20mm (ρ =780 kg / m3);	 0.2 8.46 1.52	 1.1 1.3 1.1	 0.264 11 1.68
Total Temporary Including: long short-term	10.22 2.33 1.57 0.76	 1.2 1.2 1.2	12.7 2.8 1.884 0.912
Full load Including constant and long-term short-term	12.55	-	15.5

Collection of loads. Calculation of loads per 1 meter square of flooring is given in accordance with table 1.

Design load per 1 meter with a slab width of 1.83 meter, taking into account the safety factor for the purpose of the building $\gamma_n = 0.95$:

Constant g=12.7 · 1.83 · 0.95=15.48 kN /m

Complete g+υ =15.5 · 1.83 · 0.95=27kN /m
Standard load per 1 meter:
Constant g=10.22 · 1.83· 0.95=17.76kN /m
Complete g+υ=12.55 · 1.83 · 0.95=21.81 kN /m

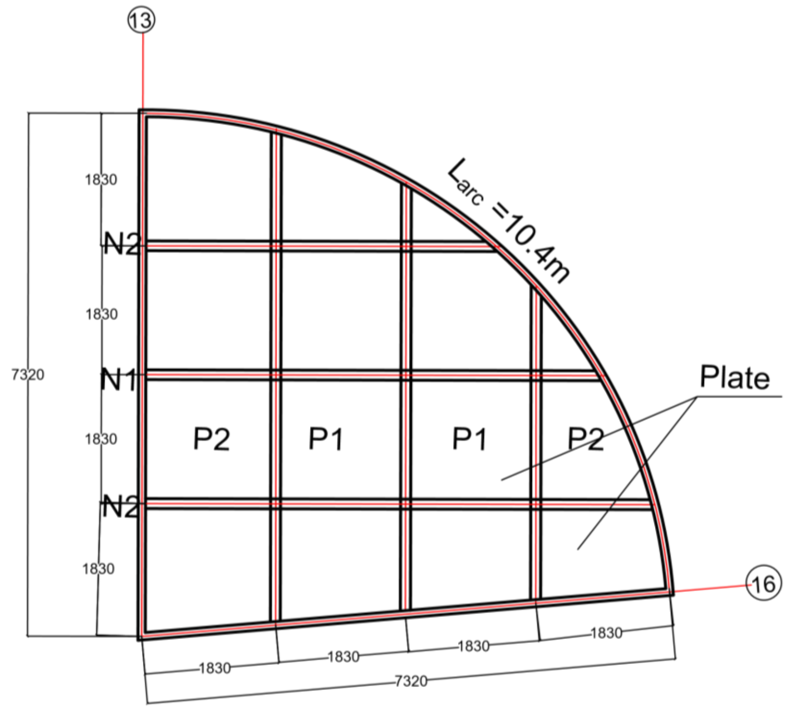


Figure 7 – View of Monolithic Waffle Slab in Plan.

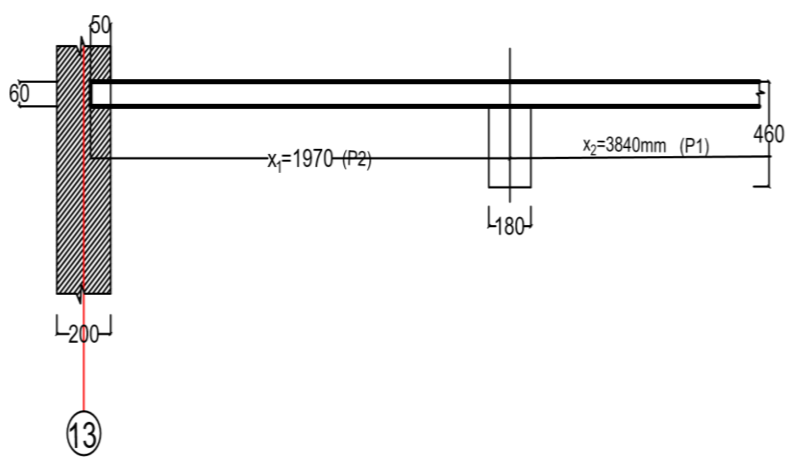


Figure 8 – View of Monolithic Waffle Slab in Section.

The bending moment of the design load is determined by the formula below [9]:

$$M_1=M_2=(g+\upsilon)\cdot\frac{l_0^2}{8}=27\cdot\frac{7.32^2}{8}=180.8\ kN\cdot m$$

The shear force is determined by formula [9]:

$$Q_1=Q_2=(g+\upsilon)\cdot\frac{l_0}{2}=27\cdot\frac{7.32}{2}=98.8\ kN$$

According to ETABS results we have the bellow moment and shear force that we can take the ETABS results.

Mmax=669 kNm

Q=216.5KN/m

Side beams have less deflections and experience less bending moments. If we assume approximately that the bending moment of the spaced from the edge of the floor at a distance x of the beam is proportional to its deflection [7], then:

$$M_{1x} = k_1 \cdot M_1 \quad (5)$$

where k1 are coefficients that are calculated through the dividing the deflection which we can take as 0.62.[7]

For P2 where k equal to 0.62:

$$M= 0.62 \cdot 669=414.8\ KNm$$

The shear force is determined by the formula:

$$Q= k_1 \cdot Q_1=0.62 \cdot 216.5=134.3\ KN$$

A system of beams used as ribs for a monolithic coffered floor, we will designate brands P2, which will reinforced with volumetric frames, K1, respectively. [8]

To simplify the understanding of the calculation, we divide the slab into several structural elements in the form of N1, N2, since due to the arising in them efforts to be reinforced and they will work in different ways. We could reinforce them according to the highest stresses, but based on the type structure, as well as reducing the overall percentage of reinforcement, thereby making the construction easier, we will perform a detailed calculation. [7]

Table 6 - Determination of the coefficients required for the calculation this coffered floor slab.

Slab grade	Coefficient value
N1	L1=L2=1.63, L1/L2=1 (c = 0,5, φ = 55,74, φ = 55,74)
N2	L1=L2=1.8, L1/L2=1 (c = 0,5, φ = 37,15, φ = 37,15)

Table 7- Determination of the moments required for further calculation of the coffered floor.

N1	M1 = M2 =$q \cdot l^2/\varphi$= 1,3kNm, MoN1 = MoN2 = $ql^2/12$ = 6.05 KNm
N2	M1 = M2 =$q \cdot l^2/\varphi$= 2.35kNm, MoN1 = MoN2 = $ql^2/12$ = 7.3 KNm

Top reinforcement.

Determination of the required area and the amount of tensile reinforcement for N1: In here the slab has the height of h=60mm.

The working height of the section is determined by the formula [9]:

$$h_0=h-c_1 = 6-2= 4cm$$

$$\alpha_m = \frac{M_x}{\gamma_1 \cdot R_b \cdot b \cdot {h_0}^2} = \frac{605}{0.9 \cdot 17.5 \cdot 163 \cdot 4^2} = 0.014$$

$$\xi = 1 - \sqrt{1 - \alpha_m} = 0.007$$

$$A_s = \frac{\gamma_{b1} \cdot R_b \cdot b \cdot \xi \cdot h_0}{R_s} = \frac{0.9 \cdot 17.5 \cdot 163 \cdot 0.007 \cdot 4}{35.5} = 2.024cm^2$$

According to table we take the reinforcement – diameter 8 Reinforcement of A400 type (a) with span 200mm, A_s = 2,51 cm2/m. [9]

Distribution fittings are accepted diameter 4 with a pitch of 350 mile meter.

Determination of the required area and the amount of tensile reinforcement for N2:

$$\alpha_m = \frac{730}{0.9 \cdot 17.5 \cdot 180 \cdot 4^2} = 0.016$$

$$\xi = 1 - \sqrt{1 - \alpha_m} = 0.008$$

$$A_s = \frac{\gamma_{b1} \cdot R_b \cdot b \cdot \xi \cdot h_0}{R_s} = \frac{0.9 \cdot 17.5 \cdot 180 \cdot 0.008 \cdot 4}{35.5} = 2.55cm^2$$

According to table we take the reinforcement - Ø10 A400 (a) with span 150 mile meter, A_s = 3.93 cm^2/m. [9]

Distribution fittings are accepted diameter 5 with a pitch of 350 mile meter.

Bottom Reinforcement:

Determination of the required area and the amount of tensile reinforcement for N1:

$$\alpha_m = \frac{605}{0.9 \cdot 17.5 \cdot 163 \cdot 4^2} = 0.014$$

$$\xi = 0.014$$

$$A_s = \frac{\gamma_{b1} \cdot R_b \cdot b \cdot \xi \cdot h_0}{R_s} = \frac{0.9 \cdot 17.5 \cdot 163 \cdot 0.014 \cdot 4}{35.5} = 4.05cm^2$$

According to table we take the reinforcement – Ø12 A400 (a) with span 200 mile meter, A_s = 5.65 cm2/m. [9]

Distribution fittings are accepted diameter 6 with a pitch of 350 mile meter.

Determination of the required area and the amount of tensile reinforcement for N2:

$$\alpha_m = \frac{730}{0.9 \cdot 17.5 \cdot 180 \cdot 4^2} = 0.016$$

$$\xi = 0.016$$

$$A_s = \frac{\gamma_{b1} \cdot R_b \cdot b \cdot \xi \cdot h_0}{R_s} = \frac{0.9 \cdot 17.5 \cdot 180 \cdot 0.016 \cdot 4}{35.5} = 5.11cm^2$$

According to table we take the reinforcement - Ø12 A400 (a) with span 200 mile meter, A_s = 5.65 cm^2/m. [9]

Distribution fittings are accepted diameter 6 with a pitch of 350 mile meter.

Reinforcement of the distribution beam system of the coffered slab.

For rib P2 M= 0.62 · 669=414.8 KNm, Q=0.62 · 216.5=134.3 KN.

$$h_0=40\text{-}2=3800$$

$$\alpha_m = \frac{M_x}{\gamma_1 \cdot R_b \cdot b \cdot h_0{}^2} = \frac{41480}{0.9 \cdot 17.5 \cdot 18 \cdot 38^2} = 0.1$$

$$\eta = 0,5 \cdot (1 + \sqrt{1 - 2\alpha_m}) = 0,5 \cdot (1 + \sqrt{1 - 2 \cdot 0.022}) = 0.94$$

$$A_{STP} = \frac{M}{R_s \cdot h0 \cdot \eta} = \frac{41480}{35.5 \cdot 38 \cdot 094} = 32.7cm^2$$

According to table we take the diameter of reinforcement - 4Ø32 A400, A_s = 32.8 cm^2/m. [9]

We use the upper belt constructively 4 bars with diameter 30 (b).

For rib P1 M=669 KNm, Q=216.5KN.

$$h_0=40\text{-}2=38mm$$

$$\alpha_m = \frac{66900}{0.9 \cdot 17.5 \cdot 18 \cdot 38^2} = 0.16$$

$$\eta = 0,5 \cdot (1 + \sqrt{1 - 2 \cdot 0.036}) = 0.91$$

$$A_{STP} = \frac{M}{R_s \cdot h0 \cdot \eta} = \frac{66900}{35.5 \cdot 38 \cdot 091} = 54cm^2$$

According to table we take the diameter of reinforcement - 6Ø36 A400, A_s = 61.08 cm^2/m. [9]. We use the upper belt constructively 6Ø32 (b).

Table 8 - Specification of Reinforcement

Mark	Point	Diameter, Class of reinforcement	Length, mm	Quantity	Mass of one reinforcement, kg/m	Mass, kg
KP-1	1	6Ø36 A400	3660	6	7.515	27.5
	2	6Ø32 A400	3660	6	6.313	23.1
	3	Ø10 BP-1	150	15	0.1	0.015
KP-2	4	4Ø32 A400	3660	4	6.313	23.1
	5	4Ø30 A400	3660	4	4.32	15.8
	6	Ø10 BP-1	15	15	0.1	0.015
C-1	7	Ø8 A400	1630	8	0.395	0.643
	8	Ø4 A400	1630	6	0.09	0.146
C-2	9	Ø10 A400	1800	13	0.617	1.11
	10	Ø5 A400	1800	7	0.154	0.277
C-3	11	Ø12 A400	1630	8	0.888	1.447
	12	Ø6 A400	1630	6	0.222	0.361
C-4	13	Ø12 A400	1800	10	0.888	1.6
	14	Ø6 A400	1800	7	0.222	0.4

2.4 Manual Calculation of Circular Columns

For the calculation of column we need to find the force which we have on column: Then the main system is sequentially loaded with constant and temporary loads (N, M, H, p), which cause corresponding reactions and bending moments in the racks.

According to my calculation in ETABS Software the moment is equal to M=770kilo Newton multiple to meter and the shear force N=-526.3 kilo Newton.

2.4.1 Determination of Longitudinal forces From Design Loads

First we need to find the length of column:

$$lc = h_f - h_{sl} = 4000 - 60 = 3940mm$$

Area of Column:

$$d=0.7m$$

$$A=\pi \left(\frac{d}{2}\right)^2 = 3.14 \left(\frac{0.7}{2}\right)^2 = 0.3846m^2$$

Load area of the middle column with a grid of columns $12 \cdot 5.7 = 68.4\ m^2$.

Constant load: -from overlapping according to the formula from 6 [9]:

$$N_1 = \gamma_n \cdot g \cdot A_{гр} \quad (6)$$

where g – floor Design load,

$A_{гр}$–middle column cargo area

$$N_1 = 0.95 \cdot 9.885 \cdot 68.4 = 642.3 \text{ kN}$$

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

$$N_3 = \gamma_n \cdot \gamma_f \cdot A_C \cdot H_{эт} \cdot \rho = 0.95 \cdot 1.1 \cdot 0.3846 \cdot 4 \cdot 25 = 40.2 \text{ kN}$$

From the coating is determined by the formula from 7 [9]:

$$N_4 = \gamma_n \cdot \gamma_f \cdot g_{покр} \cdot A_{гр} \quad (7)$$

where $g_{покр}$–temporary load from the coating.

$$N_4 = 0.95 \cdot 1.1 \cdot 0.36 \cdot 68.4 = 217 \text{ kN}$$

The total constant load is:

$$N_{пост} = (642.3 + 40.2) \cdot 2 + 40.2 \cdot 3 + 217 = 1365+120.6+217 = 1702.6 \text{ kN}$$

Live load: -from the overlap is determined by the formula from 8 [9]:

$$N_5 = \gamma_n \cdot \gamma_f \cdot \vartheta \cdot A_{гр} \cdot n_{перекр} \quad (8)$$

where ϑ – temporary design load

$$N_5 = 0.95 \cdot 1.2 \cdot 3.036 \cdot 68.4 \cdot 3 = 710.2 \text{ kN}$$

From snow is determined by the formula below [1]:

$$N_6 = \gamma_n \cdot \gamma_f \cdot p \cdot A_{гр} = 0.95 \cdot 1.4 \cdot 0.96 \cdot 68.4 = 87.3 \text{ kN}$$

Longitudinal force acting on the column:

$$N = V_{Ed} = N_{пост} + N_{врем} = -2500.1 \text{ kN} .$$

Shear Force according to ETABS software:

N=-526.3KN

M=770KNm

2.4.2 Selection of Section and Calculation of the Sectional Area of Reinforcement

Effective length of column:

$$l_0 = 0.7 \cdot l = 0.7 \cdot 3940 = 2758 mm$$

Calculate the eccentricity of column [10]

$$e_0 = \frac{l_c}{400} = \frac{2758}{400} = 9.5 mm$$

$$M_{Ed} = e_0 \cdot N = 0.0095 \cdot 2500.1 = 23.75 kNm$$

Calculate the slenderness value:

$$\lambda = \frac{4 \cdot l_0}{d} = \frac{4 \cdot 2758}{700} = 15.76$$

Design shear force caused by the load on column:

$$V_{Ed} = \frac{N_{Ed}}{(Acf_{cd})} = \frac{-2500100}{3846 \cdot 17} = -38.2$$

$$V_{Ed} = \frac{-526300}{3846 \cdot 17} = -8.05$$

$$a_{Eds} = \frac{M_{Ed}}{(Ac\, h\, f_{cd})} = \frac{77000000}{384600 \cdot 700 \cdot 17} = 0.168$$

$$\omega_{tot} = 0.5$$

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

$$A_{s,tot} = \frac{\omega_{tot} \cdot Ac}{\frac{f_{yd}}{f_{cd}}} = \frac{0.5 \cdot 38400}{25.6} = 7511.7\ mm^2$$

$A_{s1} = A_{s2} = 3755.85\ mm^2$, accept 8Ø36 S800 ($A_s = 8144\ mm^2$).

The step is taken based on the conditions: No more than 500 mile meter; No more than the minimum side of the section; No more $20d_{min}$.

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). its in spiral form.

Pitch of spiral bar is considered as 150mm. Length of spiral bar:

$$L = n\sqrt{c^2 + p^2} = 12\sqrt{1.884^2 + 0.15^2} = 22.93m$$

Where C is the circumference = πd =3.14 · 600=1884mm

The calculation for the limiting states of the first group consists in: Checking for load-bearing capacity and stability:

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

$$N \leq \varphi(R_b Ac + R_{sc} A_{s,tot}) \quad (9)$$

where R_b is the concrete resistance,

Ac is the cross section area of column

φ is the buckling Factor. Determine the value of the buckling factor φ (according to Table 6.1) [5]:

$$\frac{l}{h} = \frac{3940}{700} = 5.6 \Rightarrow \varphi = 0.88$$

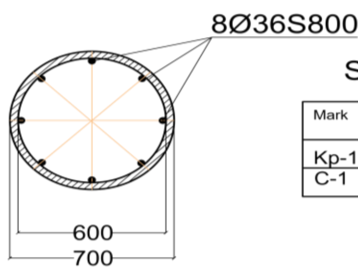
$$2500 \leq 0{,}88 \cdot (17 \cdot 10^6 \cdot 0{,}3846 + 695 \cdot 10^6 \cdot 8144 \cdot 10^{-6})$$

$$2500\ KN \leq 49808KN$$

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

$$\sigma = \frac{N}{\varphi \cdot A} \leq Rb \cdot \gamma c = \frac{526.3}{0.88 \cdot 0.3846} \leq 17 \cdot 1.5 = 1.55MPa \leq 25.5MPa$$

Condition is met. Column reinforcement is shown in accordance with Figure 9.



Specification of Reinforcement

Mark	NO	Diameter, class reinforcement	length mm	Number	Mass 1 Kg/m	Mass Total,Kg
Kp-1	1	8Ø36S800	3840	8	7.515	28.8
C-1	2	Ø10 A-1	22.93	1	0.617	14

Figure 9- Column reinforcement

2.5 Determination of geometric dimensions of Foundation

The standard load on the foundation is determined by the formula from 10 [3]:

$$N_n = \frac{N}{\gamma_f} \quad (10)$$

where γ_f –average load factor for the reliability,

N – Longitudinal force on a column

$$N_n = \frac{526.3}{1.15} = 457.6 \text{ кN}$$

The depth of the foundation is determined by the formula from 11 [3]:

$$d = d_\theta \sqrt{\sum_{i=1}^{n} M_i} \qquad (11)$$

where d_θ – depends on the type of soil, equal to 0.28 m for sandy loam,

$\sum_{i=1}^{n} M_i$–average annual sum of negative temperatures

$$d = 0.28\sqrt{8.6 + 7.3 + 4.3 + 3.3} = 1.3 \text{ m}$$

The area of the base of the foundation according to the formula from 29 [3]:

$$\text{A} = \frac{N_n}{R - \gamma_m d} \qquad (12)$$

where R – design soil resistance equal to 0.025 kN /cm^2,

γ_m – The average load from the weight of 1 m^3 of the foundation soil and the soil on its ledges, equal to $33.698 \cdot 10^{-6}$ kN /cm^3

$$\text{A} = \frac{457.6}{0.025 - 33.698 \cdot 10^{-6} \cdot 130} = 22192\ cm^2 \approx 22200$$

The length and width of the basement base are taken, in accordance with the unification condition, in multiples of 30 centimeter equal to 110 centimeter.

3 Technological and Organizational Part

3.1 Arrangement of Earthworks

Removal of top soil: As the foundation is column footing and there is need of trench digging, During trench excavation, removal of the top soil To be implemented at the area (only for the trench).[11]

$$Sa = (10+l1)\cdot(10+l2) = Sa = (10+90.8)\cdot(10+59.5) = 7005.6m^2$$

The total volume of top soil removal is calculated by the Formula:

$$V_{sr} = S_{1(a)}\cdot 0{,}15m = V_{sr} = 7005.6\cdot 0{,}15m = 1050.84m^3$$

Soil excavation in the trench access: Calculation of the trench volume (V_{tr}) is carried out on the basis of longitudinal profiles and cross–sections of the separate sections.

The volume of each trench section can be determined by the formula: [11]

$$V_{tr} = \sum L_1 \cdot F_a \tag{13}$$

where L_1 – full length of the trench per the scheme, m; F_a– the average cross–sectional area of the trench, m^2

$$F_a = \frac{(L_{2s.b} + L_{2s.t})h_{tr}}{2}$$

Where m – slope factor, h_{tr}–depth of trench in meter.

$$L_{2s.b} = L_2 + (0.8\cdot 2)m = 59.5 + 1.6 = 61.1m$$

$$L_{2s.t} = L_{2s.b} + 2mh_{tr} = 61.1 + 2(0.67)(-1.3) = 59.3m$$

$$L_{1s.b} = L_1 + (0.8\cdot 2)m = 90.8 + 1.6 = 92.4m$$

$$L_{1s.t} = L_{1s.b} + 2mh_{tr} = 92.4 + 2(0.67)(-1.3) = 90.6m$$

$$F_a = \frac{(61.1+59.3)\cdot(-1.3)}{2} = 78.26m$$

$$V_{tr} = \sum L_1 \cdot F_a = 90.8\cdot 78.26 = 7106m^2$$

Backfilling: The volume of soil to be backfilled in the trench gaps, in structures without basement, is calculated by the formula: [11]

$$V_{bf} = \frac{V_{tr} - V_{c/f}}{1+K_{rl}}, m^3 \tag{14}$$

where V_{tr} =7106m^3 volume of the trench.

K_{rl}=1.03 Index of residual soil loosening,

$V_{c/f}$ =39.039m^3 Volume of all columnar footings,

$$V_{bf} = \frac{7106-39.039}{1+1.03} = 3481.2m^3$$

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 (for the trench) [11]

$$V_{comp} = \frac{V_{bf}}{h_c}, m^2 \rightarrow = \frac{3481.2m^3}{0.4m} = 8703m^2$$

Vbf = 5326.7m^3, backfilling volume.

hc– compacted layer thickness, 0, 2-0, 4 m.

3.2 Specification of Formwork

The quantity of formworks is equal to the area of the surfaces form. It is necessary to count the area of side faces of the member of structure and trapezoidal inner glass surfaces. For better working we selected steel formwork for slab and column as well timber formwork for wall and foundation.

Unite of form work is meter square or meter cubic. And its coefficient is 0.3.

- The thickness of the timber boards will be equal t 3 centimeter.
- The diameter of theses formwork equal to 10 centimeter generally.
- Wastes on the formwork board equal to 0.013m^3/m^2.
- One worker can do 3.22 meter square of formwork in a day.

Table 9 - Specification of formwork

Type of shield	Sizes.mm		Weight, kg	Code in shields
	length	width		
Linear and universal board	3000	1200	25kg	LB-2
Angular board	3000	600	16kg	AB-1

Linear board Are intended for the device of a formwork at erection of direct monolithic walls of the base. Universal and interchangeable. Mounted in both horizontal and vertical position. Opposite shields are attached with the help of tightening screws with nuts, next standing shields are connected through locks.

Angular board They are used to form the internal right angles of the building wall. Angular articulated angles serve to form the indirect corners of the building walls from 60 to 135 degrees.

3.2.1 Foundation Formwork

The foundation of the structure is columnar footing, in the case that it would have square shape the formwork will count as bellow:

The quantity of formwork is equal to the area of the surfaces form.

Area= $1.1 \cdot 0.3 = 0.33m^2$

Formwork for one foundation, (R.R.C work):

Volume of footing $= 0.33\text{m}^2 \cdot 1.3 = 0.429m^3$

Shuttering stands for a temporary structure formed to retain wet concrete that is poured in it to produce the structure that we want. It supports the liquid concrete until it achieves the required strength and shape. Shuttering area for rectangular footing:

Perimeter of rectangular=$4 \cdot 1.1$=4.1m

Total shuttering area for one footing=$4.1 \cdot 1.3$ =5.33m^2

When we want to find the volume of one wooden formwork (timber):

$$V_{timber} = \text{area of footing} \cdot 0.015\text{m}^3/\text{m}^2 = 5.33\text{m}^2 \cdot 0.015\text{m}^3/\text{m}^2 = 0.0799\text{m}^3$$

$$\text{Volume of all footing} = 0.429 \cdot 91 = 39.039m^3(\text{n})$$

$$\text{Total number of formwork} = \frac{volume\ of\ cloumn}{volume\ of\ timber} \quad (15)$$

$$\text{Total number of formwork} = \frac{39.039}{0.0799} = 488.6 \approx 489$$

3.2.2 Column Formwork

In general we only need the formwork quantity for first floor then we can reuse it in two other floors. The quantity of formworks is equal to the area of the surfaces form.

Table 10 - Specification of formwork for all columns

Name of floor	Height	Sides	Number of columns	Number of formwork	Shuttering Area of 1 column, m^2	Shuttering Area of all column, m^2
First floor	4	2	91	182	8.792	800.072
Second floor	4	2	91	182	8.792	800.072
Third floor	4	2	51	102	8.792	448.4

Diameter of column d=0.7m.

$$\text{Area of column} = A = \pi\left(\frac{d}{2}\right)^2 = 3.14\left(\frac{0.7}{2}\right)^2 = 0.3846\text{m}^2$$

$$\text{Volume of column} = 0.3846\text{m}^2 \cdot 4 = 1.538m^3$$

Shuttering stands for a temporary structure formed to retain wet concrete that is poured in it to produce the structure that we want. It supports the liquid concrete until it achieves the required strength and shape. Shuttering area for circular columns:

Perimeter of circle =2 · 3.14 · 0.35=2.198m

Total shuttering area for one column =2.198 ·4 , =8.792m^2

The all formwork specification is shown in table 10 above.

3.2.3 Slab Formwork

The formwork of waffle slab made up of many elements: waffle pods, horizontal supports, vertical supports, cube junctions, hole plates and steel bars. First the supports are built, then the pods are arranged in place and finally the concrete is poured. The type of formwork is combined. The inserts are installed on plywood or plank flooring (fig.10). The advantage of this formwork is that fewer posts and beams are required compared to other, but plywood or plank flooring is required. [8]

Figure 10- General view of slab formwork

1 Telescopic racks are placed under the ends and joints of the supporting formwork beams (girders). In this case, the racks are fixed in an upright position with tripods.

Length of building =90.8m

Height of vertical element= 3540m

$$\frac{Length\ of\ the\ building}{distance\ of\ ledger}=\frac{90.8}{1.8}$$ =50.44 ≈51 stands we need.

Width of First block of building =59.5m

Height of vertical element= 3540m

$$\frac{Length\ of\ the\ building}{distance\ of\ ledger}=\frac{59.5}{1.8}$$ =33 stands we need.

Width of Second block of building =35m

Height of vertical element= 3540m

$$\frac{Length\ of\ the\ building}{distance\ of\ ledger} = \frac{35}{1.8}$$ =19.44 stands we need.

2 The load-bearing formwork beams (girders) are placed in the telescopic props heads. The design of the head allows for the joint of the beams along the length "in the joint". The beams are laid in the heads with forks (Figure 10), so the number of beams will equal to the number of racks.

3. On the top of the supporting beams (girders), plank flooring is laid formwork;

Area of slab = 3437m^2

Volume of slab= 3437 · 0.46=1581.02 m^3

Area of plank flooring=3437m^2

4. Install volumetric formwork elements: it will equal to the:

Area of volumetric formwork=1.8 · 1.8= 3.24m^2

Volume of plank flooring=3.24 · 0.4=1.3 m^3

Number of longitudinal plank flooring of building=50 m^2

3.2.4 Formwork for internal wall

Note I considered the wall between two columns at axis number 13.

Table 11 - Specification of formwork for longitudinal walls.

Size	Area one, m^2	Volume, m^3	Number	Area of All	Volume of all
6×0.2	1.2	4.8	5	6	24
14.1×0.2	2.82	11.28	4	11.28	45.12
11×0.2	2.2	8.8	8	17.6	70.4
15.9×0.2	3.18	12.72	5	15.9	63.6
8×0.2	1.6	6.4	4	6.4	25.6

Volume of wall (longitudinal) = 6 · 0.2 · 4 = 4.8 m^3

Area of wall = L · B =6 · 0.2 =1.2m^2

Volume of timber without waste (V_{timber}) =4.8 · 0.015 =0.072 m^3

($V_{timber\ wastages}$) =4.8 · 0.0095 =0.0456 m^3

($V_{timber\ with\ wastages}$) =0.0456 · 0.072 =0.00328 m^3

If we consider the thickness of timber to 10mm and the height 4 meter, so we can find the timber if timer according to its volume as follow:

V_{timber} = b · h · L= V_{timber} =0.01 · 6 · 4=0.24m^3

Now we can find the volume of formwork planks as follow:

(V_{plank}) =1.2 · 0.03 =0.036 m^3

Volume of plank wastage:

$$(V_{wastages}) = 1.2 \cdot 0.013 = 0.0156 m^3$$
$$(V_{plank\ with\ wastages}) = 0.036 \cdot 0.477 = 0.017\ m^3$$

Specification of formwork for longitudinal walls are shown in table 11.

3.3 Calculation of the turnover of scaffolding

When the height above floor level exceeds about 1.5m, a temporary structure, usually of timber, is erected close to the work to provide safe working platform for the workers and to provide a limited space for the storage of plant and building material. This temporary formwork is known as a scaffolding. It is useful in construction, demolition, maintenance or repair work. We define the formwork by the following formula:

$$z = \frac{\sum_{1}^{a} m}{n - 1 + \frac{A \cdot t_{б}}{K}} \qquad (16)$$

z=0.5

where $\sum_{1}^{a} m$ total number of seizures on all tiers constructions;

n is the number of simple processes=3,

A the number of shifts per day=2,

t_b time of aging of concrete in the formwork (1-6 days)=6;

K-the duration of the formwork installation on one clamp (K = 1 is assumed).

Calculation of scaffolding material:

We have the length of building 90.8 meter. And the height of 12 meter.

Standard size of vertical element= 3m

$$\frac{Lb}{\text{distance of ledger}} = \frac{90.8}{1.5} = 60.5 \text{ stands we need.}$$

Then for inside as weal, 60.5 · 2 =121

Base jack= 121

3.4 Reinforcement and concrete works

Volume of concrete for footing: Concrete quantity in the foundations is determined by geometry formulas with the use of plan and foundation section drawn earlier.

$$V_{c/f} = V_f \cdot a, m^3 \qquad (17)$$

where $V c/_f$ Volume of all columnar footings meter cubic.

V_f – Volume of concrete for 1 footing meter cubic.

a– Number of foundations in the plan.

$$vf = 1.3 \cdot 1.1 \cdot 1.1 = 1.573m^3$$
$$V\ c/_f = 1.573 \cdot 91 = 143.14m^3$$

<u>Volume of concrete for wall</u>

$$\text{Volume of concrete for wall} = 6 \cdot 0.12 \cdot 3.54 = 2.5488\ m^3$$
$$\text{Area of wall} = L \cdot B = 6 \cdot 0.12 = 0.72m^2$$

Table 12 - Volume of concrete for longitudinal walls.

Size	Area one, m^2	Volume, m^3	Number	Area of All	Volume of all
6×0.12	0.72	2.55	5	3.6	12.75
14.1×0.12	1.7	5.99	4	10.2	23.9
11×0.12	1.32	4.67	8	10.56	37.36
15.9×0.12	1.9	6.75	5	9.5	33.75
8×0.12	0.96	3.4	4	3.84	13.6

<u>Volume of concrete for Column:</u>

$$Ac = A = \pi(\frac{d}{2})^2 = 3.14\ (\frac{0.7}{2})^2 = 0.3846m^2$$

Volume of concrete for one column $= 0.3846m^2 \cdot 4 = 1.538m^3$

Volume of concrete for Third Floor column= $1.538 \cdot 51 = 78.438m^3$

Volume of concrete for First Floor column= $1.538 \cdot 91 = 139.95m^3$

<u>Volume of concrete for slab:</u>

$$\text{Area of slab} = 3437\ m^2$$
$$\text{Volume of concrete for slab} = 3437 \cdot 0.37 = 1271.7\ m^3$$

Table 13 - Volume of concrete for Floor Slab

Floor	Area of slab, m^2	Volume of concrete, m^3
First	3437	1271.7
Second	3437	1271.7
Third	1383.7	512

<u>Foundation Reinforcement</u>: In foundation for 1 meter cubic of concrete it consumes 40 kilogram per meter cubic reinforcement. Reinforcement consumption for the columnar foundation:

$$vf = 1.3 \cdot 1.1 \cdot 1.1 = 1.573m^3$$
$$V\ c/_f = 1.573 \cdot 91 = 143.14m^3$$

$$G = 143.14 \cdot 40 = 5725.6 \text{ kg}$$

Slab Reinforcement: The consumption of reinforcement for floor slabs are 65 kilogram per meter cubic.

Volume of Slab= 1271.7m^3

$$G = 1271.7 \cdot 65 = 82660.5Kg$$

Column Reinforcement: the consumption of reinforcement for floor columns are 80 kilogram per meter cubic.

Volume of one floor columns= 1.538 · 91=139.95m^3

$$G = 139.95 \cdot 80 = 11196kg$$

Total length of bars= Bar N_o · hc · No of Columns

Total length= 8 · 3.54 ·91=2577.12

Weigh of one Bar = $((\frac{dia\ of\ bar^2}{162kg/m3}) \cdot$ Length of bar = $((\frac{36^2}{162}) \cdot$ 11.76m=94.08kg

3.5 Selection of excavator, bulldozer, vehicles and machines

Selection of the excavator: Selection of excavator depends on the soil volume in the trench. Kind of excavator (E-153) → (ZE -1514)new, capacity of excavator=0.15).

To be determined the specific capital investments for the development of 1m^3 of soil in the (trench) for each type of excavators: [11]

$$c_{sp(1,2)} = \frac{1.07c_{i.e}}{p_{shf.}} \tag{18}$$

where, C$i.e$. Inventory estimated cost of excavator equal to 5.35.

Pshf, 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.

$$c_{sp(1,2)} => \frac{1.07 \cdot 5.35}{350} = 0.01$$

Selection of the bulldozer: Maximum efficiency is achieved when moving soil at the distances: for bulldozer on the basis of tractors T–180, DET250, T–330 – up to 150 m. it has higher Productivity 1400m^3/h.

Selecting Soil Compaction Machine: Depending on the lack of space of works performance conditions, can be used: -motor rollers with smooth rolls – for cohesive soil (T–100M). Shift operating performance of rollers is calculated by the formula:[11]

$$P_{sh.o} = \frac{(B-b) \cdot V \cdot 1000 \cdot h \cdot T}{m} 0.85 \tag{19}$$

where B– width of compaction line (annex. №1. table. 4 = 2.5 [11]);

b– width of overlap of adjacent lines (0,1–0,2 m =0.5);

ν– average speed (4–6 km / h 3km);

h– width of the condensed layer, m =2.5,

m– Required number of blows or passes= 9.

$$P_{sh.o} = \frac{(2.5 - 0.15) \cdot 5 \cdot 1000 \cdot 2.5 \cdot 8}{9} 0.85 = 22194$$

Selection of Crane: In the cranes selection for installation of column foundations need to be used self–propelled jib cranes (DEK-161) and height of rise of 15.5m. Crane hook radius Lcr, is calculated by the formula:

$$Lcr = l1 + l2 + l3 = Lcr = 3.5+2 +29.75=33.25\text{m}$$

where Lcr– mounting radius $l1$ – the distance from the pivot axis to the mount joint of crane boom (3÷3,5), m;

$l2$ – 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

$l3$ – the distance the structure outer surface or its protruding part crane hook axis, to be taken as equal to the half of the structure width $l2/2$. 59.5/2=29.75.

3.6 Calculate the method of transporting, and compacting the concrete mix

Delivery of concrete to the construction site is carried out in specialized vehicles – mixer trucks.

Methods of concrete supply into the concrete blocks directly by mixer truck into the formwork through the inclined tray or vibration gutter.

Choosing a concrete pump as a paving machine, should take into account the relative placement of the concrete pump and concreted foundations – the desired range. Specifications for the concrete truck are given in.

For compacting the concrete of the coffered floor, it is recommended to use a needle vibrator with a diameter of no more than 45 mm. The latter is immersed in the compacted layer vertically or with a slight slope. The tip should be immersed quickly, after which it, vibrating, remains motionless for 10 - 15 seconds, and then slowly pulled out of the concrete mixture in order to ensure that the released space is filled with the mixture.

Type of bunker (BP -0.5): Weight of bin with concrete mix M:[11]

$$M = Me + \text{E} \cdot \gamma_{dc} = 360 +1.8 \cdot 2.4=364.32$$

where Me mass of the empty bunker, (annex.1, tab. 18=360 [11]) t;

E – hopper capacity, (annex.1, tab. 18=1.8 [11]) $m3$.

γ_{dc} -density of concrete mix = 2,4 t/$m3$

Features of rotated bins and not rotated bins for feeding the concrete mix by valves are given in (annex №1. tab. 18 tub bunker rotaryBP-0.5).

Table 14 - List of mechanisms, equipment and devices

Name(mark)	appointment	Basic parameters	Required code in
T–100M	Soil compactor	Mass=13.6t	T-100M
DET250	Bulldozer	4.5 ·1.4m	Productivity 1400m^3/h
ZE -1514	Excavator	Capacity 0.15	
(ABN-75/32)	Concrete pump	Range of concrete mixer(28)	ABN-170,1)
KaMAZ53212	Basic car	10.3 · 2.5 · 3.8m	53212
Sb-211	Concrete mixer	Volume of concrete drum(90m^3)	SB-211
KaMAZ	Basic car	11.8 · 2.5 · 3.55m	54112
BP-0.5	Bunkers for supply	1636 · 1636 · 2485mm	1,8
GAZ-93A	Dump truck	(Speed of the movement on dirt roads, km/h)=24	93-A
DEK-161	crane	loading capacity of 16t	161
steel	sling	Slings with inventory lifters	--

3.7 Preparation of work schedule

The planned schedule of works specifies sequence of the processes and the duration of their mutual coordination. The data in columns are transferred from the calculation of labor input and machine input.

Labor costs of processes in man– hours are determined by the formula:[11]

$$Q_{m-hour}. = V \cdot \text{Ntr.}=7005.6 \cdot 0.56=3923.13$$

where, V– volume of work;

Ntr – Standard time.

And in man–days defined as:

$$Qm{-}day = \frac{\text{Qm−hour}}{8.2} = \frac{3923.13}{8.2} = 478.4$$

Duration of manual processes is:[1]

$$P\text{p}=\frac{Q}{n \cdot A} = \frac{478}{20 \cdot 2} = 12\text{d}$$

where, Q–labor costs ,(human – day);

n– number of workers per shift.

A - number of shifts take depending on the method of manufacture of works.

During mechanized method their implementation using machinery number of shifts take at least two, and the processes performed without applying machines are usually one shift.

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

$$Ku = \frac{n_{max}}{n_{av}} = \frac{20}{15.22} = 1.31$$

where, n_{max}– the maximum number of workers at the facility;

n_{av} – the average number of worker:

$$nav = \frac{\sum Q}{p_{total}} = \frac{5710.91}{375} = 15.22$$

where, Q – total labor input (labor costs);

P_{Total}– total duration determined by the schedule of work.

Ratio $Ku \leq 1.5$, and if it is large, the schedule should be adjusted due to a more uniform distribution of the individual processes. Sometimes it is possible to lengthen the periods of time–consuming work, reducing the number of workers, as well as move the timing of these works without changing the number of workers.

The Work Schedules are in Appendix B.

3.8 Calculation of Electrical Supply

It is designed as dead-end networks with one power source, since in the event of a short circuit in one section of the network, the remaining sections will continue to operate.

Two-wire at 220 voltage is mainly used for electric lighting. Type of transformer is typical mobile transformer KPTP – 320.

The calculation of the required power of transformers is made according to the formula:

$$P_C = 1,05 \cdot \left(\frac{\lambda 1 \Sigma PH}{\cos\varphi} + \Sigma P_{\Pi} + \lambda_2 \Sigma P_{OB} + \lambda_3 \Sigma P_{OH} + \lambda_4 \Sigma P_{CB}\right) \qquad (20)$$

where 1.05 -coefficient taking into account power losses in the low-voltage network;

ΣP_H - the sum of the rated powers of all installed electric motors, Kw

ΣP_{Π} -power consumption for production needs (soil thawing, concrete electric heating, etc.), kW;

ΣP_{OB} -total power of indoor lighting fixtures, kW; ΣP_{OH} - the same for outdoor lighting, kW;

ΣP_{CB} -the sum of the rated powers of all installed welding transformers, kW;

cosφ -power factor equal to 0.8;

λ_1 - coefficient of simultaneity of work (with the number of consumers: 6 equals 0.6 from 5 to 8-0.5; more than 8-0.4);

λ_2 - coefficient of simultaneity for indoor electric lighting, equal to 0.8;

λ_3 - coefficient of simultaneity for outdoor lighting, equal to 0.9;

λ_4- coefficient of simultaneous operation of welding transformers with numbers: 3= 0.8; 3 - 5 = 0.6; 5 - 8 = 0.5 and over 8 = 0.4.

$$P_0 = 1{,}05\left(\frac{0{,}4\cdot 86.8}{0{,}8} + 135 + 0{,}8\cdot 32 + 0{,}9\cdot 40 + 0{,}6\cdot 196.2\right) = 375.6\text{ kW}$$

Table 15 - Power Consumption

Electricity consumers	Power consumption, kW
Welding machines T-22 - 6 pcs	196.2
Concrete mixer- 3 pcs	15
Vibrator -4 pcs	6
Lifts - 4 pcs.	28,0
Plastering station	7,0
Compressors - 7 pcs.	30.8
Bitumen cooker - 1pc.	7.5
Installation for heating concrete - 3pc.	120
Electric heater - 1pc.	7.5
Outdoor lighting devices	40
Lighting devices for permanent and auxiliary buildings	50,0
Other consumers	32,0 (10%)
Total	540,0

3.9 Calculation of Site Requirements for Temporary Buildings

Additional area is determined:

$$STP = SH \cdot N = 0.75 \times 30 = 22.5 m^2$$

Where SH is the normative indicator of the area of 1 person equal to 0.75; N - the number of those working in the most numerous shift (engineers, employees) , while it is assumed that the line personnel of engineering and technical personnel and employees make up 50 Percent of their number. The control room area is determined according to the same formulas, with a standard area indicator for 1 person. - 7 m^2.

The area of the restroom is determined by the formula [11]

$$STP = (0.7 \cdot N \cdot 0.1) \cdot 0.7 + (1.4 \cdot N \cdot 0.1) \cdot 0.3 \quad (21)$$

where 0.7 and 1.4 are the standard area indicators, respectively, for men and women (per 10 people);

0.7 And 0.3 are coefficients that take into account the number of men and women, respectively;

N is the number of employees in the most numerous shift.

$$STP = (0.7 \cdot 30 \cdot 0.1) \cdot 0.7 + (1.4 \cdot 30 \cdot 0.1) \cdot 0.3 = 2.73 m^2$$

Warehouses for Formwork: We consider the 3750 meter square work in 11 months so the area of three floors of the building equal to 8255.7 meter square and it will be equal to 24.22 months.

$$T = 24.22 \cdot 26 = 630 days$$

We consider the 50 percent of the durability of work so:

$$T = \frac{630 \cdot 50}{100} = 315 days$$

Volume of formwork for slab:

$$\text{Volume of slab} = 3437 \cdot 0.46 = 1581.02\ m^3$$

Durability of formwork is 20 percent and durability of concreting according to norms, therefore the maximum daily consumption is equal to:

$$q_{cp} = \frac{Q \cdot K1 \cdot K2}{T} = \frac{1581.02 \cdot 1.1 \cdot 1.3}{315 \cdot 0.2} = 35.88\ m^3/days$$

where K_1 is the coefficient of irregular transport of material to construction site is equal to 1.1.

Q is the volume of work considered in planed days.

k_2 is the coefficient of irregular work performance is equal to 1.3.

Consumption for usage of stored material time: 10days

$$Q_{cr} = 35.88\ m^3/days \cdot 10 days = 358.8 m^3$$

So we can consider two warehouses with the size of (10 · 15)m.

4 Safety Measures at the Construction Site

Formwork developed after the concrete has reached the specified strength with the permission of the foreman.

The preparation and processing of the reinforcement carried out in specially designated places for this purpose.

The given reinforcing mesh is lowered over the place of its laying not lower than by 80 cm and only then the reinforcement workers direct it to the design position.

Walking on reinforcing elements is allowed only on the gangways of a width of 30-40 cm.

At an altitude of at least 2.5 m from the ground, the electrical wires enclosed in cords or boxes. When working with an open electric arc, electric welders are provided with a helmet-mask or a shield with protective glass filters for protecting the face and eyes, and all those working in the electric welding zone - glasses with protective glasses. The electric welder is obliged to warn the people around him about starting work.

When preparing a concrete mixture with the use of chemical additives, measures should be taken to prevent skin burns and damage to the eyes of workers.[11]

Installation, dismantling and repair of concrete trucks, as well as removal of delayed concrete from them is allowed only after reducing the pressure to atmospheric.

Workers with electric vibrators are allowed to work only after medical conclusion. Medical re-examination is carried out regularly and on time. Concrete workers are provided with overalls, including shoes and vibration-proof dielectric gloves.

After every 30-35 minutes of operation, the vibrators are switched off for 5-7 minutes for cooling.

5 Economic Section

As in every industry, construction also has an economic aspect. This is related to its design, organization, and costs of materials and labor of worker, sanitary and household, security costs.

The calculation of the estimate can be carried out both manually and using various software. The total area of the building is 3437 meter square. Estimated cost - the sum of all cash costs necessary for the implementation of construction on project materials. The estimated cost is the basis for the dimensional determination of capital investments, financing the construction process, creating contract prices for construction products, settlements for contract work (construction and others).

The cost of building buildings and structures of the main and additional purpose is calculated on the basis of Structure Norms of Republic of Kazakhstan. Stage of calculating the cost of construction. The cost of a unit of measurement is taken according to the data of design and construction organizations or according to aggregated indicators, taking into account the correction factor adopted in accordance with the construction area. The cost of preparing the construction site includes the cost of land allotment, determined on the basis of the price list for the payment of land allotment work; funds for the breakdown of the main axes of a building and structures, determined by calculation on the basis of a collection of prices for design and survey works; funds associated with the demolition of buildings and structures in the amount of the carrying amount of demolished buildings and structures.

Investment costs of construction include all the costs of the customer for the project and are compiled in the form of a consolidated estimate of the cost of construction. The following cost items are additionally included in the consolidated estimated cost of construction: The cost of engineer services; Training of operational personnel; the cost of design and survey work; the cost of the examination of design estimates;

The cost of design and survey work is determined in accordance with the general provisions on determining the cost of design work for construction in the Republic of Kazakhstan.

Calculation of Local estimation is presented in Appendix C, Calculation of cost of construction estimation is presented in Appendix D and Calculation of object estimation is presented in Appendix E which are based on the calculation of labor costs from Appendix A Table A.2 and bill of quantities Table A.1.

CONCLUSION

Based on the given task, a graduation project was carried out on the topic of a Multifunctional Administrative Complex using Solar Energy located at ‘Kyzylorda’.

In the architectural and constructive part of the diploma, space-planning as well as structural solutions were considered, geological and climatic conditions were presented and reviewed, the compositions and methods of work, and also the materials necessary for the construction and decoration of the complex were clarified. The heat and electrical engineering calculation was carried out in accordance with the applicable standards and conditions of the building construction site.

In the design section, work was performed in the ETABS 2019 program and the sections and materials were selected, as well as the efforts in the building were shown. Then, based on these data, the slab and Column was calculated. The calculation of the slab is made according to modern norms and rules. The design of these elements using the fittings selected according to the results of calculations was carried out, its required quantity was calculated.

In the section of technology and organization of construction production, Most of works were considered and specifically work related to the Formwork of the building was calculated - earthworks and concrete, appropriate and cost-effective machine mechanisms were selected, a calculation was made, based on which a schedule was developed.

The economic performance of the building was calculated using the National Estimation codes of Kazakhstan, which greatly simplifies this process. The economic side of construction was reflected in local, volume and summary estimates.

In the section of life safety and labor protection, the necessary conditions and rules for conducting construction work, as well as ways to reduce the negative impact of work on the environment are considered.

LIST OF REFERENCE

1 CN RK 2.03-30-2017 "Construction in seismic zones."

2 CN RK 3.02-28-2013 (Basics of Architectural part)

3 Eurocode 1991: Actions on structures - Part 1-4: General actions chapter 6

4 EN 1991-1-1 (Actions on structures)

5 RTG RK 01-01-3.1 (4.1)-2017 (Load and Impacts On Tasks)

6 EN1990-6 (Basis of structural design)

7 Пецольд Т.М., Рак Н.А., Даниленко И.В., Смех В.И. Проектирование монолитных железобетонных конструкций многоэтажного здания – Минск, 2017 С. 34–40

8 Лоскутов И.С. Монолитные железобетонные кессонные перекрытия Москва, 2015 – С. 8–11

9 Байков В. Н., Сигалов Э. Е. “Железобетонные конструкции (Общий курс)” Учеб. для вузов. — 5-е изд., перераб. и доп. М.: Стройиздат, 1991. — 767 с.: ил.

10 проектирование бетонных и железобетонных конструкций из тяжелых бетонов без предварительного напряжения арматуры.(RTG RK 02-01-1.6-2013)

11 Design of building processes during construction of substructure (Book)

12 CN RK 1.03-05-2011 "Labor protection and safety in construction."

13 Design of Reinforced concrete ‘Russell H. Brown Clemson University’

14 CN RK 2.04-01-2017 “Construction Climatology”

Appendixes

Appendix A

Table A.1 – Details of First Floor Plan

Name	Mark	Area	Name	Mark	Area
Portico	1	115.4	Medical care room	24	79.7
Open area	2	965.4	Premises	25	27.3
Portico	3	58.8	Meeting room	26	108.4
Office	4	21.	Meeting room	27	108.4
Office	5	17.4	Main worker room	28	50.7
Office	6	21.3	Main worker room	29	56.7
Office	7	19.36	Office	30	38.1
Office	8	17.4	Office	31	38.1
Office	9	19.36	Manager room	32	36
Main worker room	10	18.2	Master toilet	33	5.3
Archives	11	6.05	Worker rooms	34	27.3
Archives	12	5.5	Archives	35	27.3
Meeting room	13	187	Worker rooms	36	32.7
Office	14	19.3	Worker rooms	37	12.6
Office	15	17.4	Electrical care room	38	36
Office	16	19.3	Manager room	39	36
Meeting room	17	23.2	Manager room	40	36
Meeting room	18	25.1	Manager room	41	36
Premises	19	35.3	Manager room	42	36
Premises	20	29.4	Manager room	43	36
Smoking room	21	6.2	Exit room	44	12.6
Toilet	22	164.4	Room	45	19.6
Smoking room	23	6.2	Room	46	38.4

Continuation of Appendix A

Table A.2 – Details of Second Floor Plan

Name	Mark	Area	Name	Mark	Area
Portico	1	115.4	Medical care room	24	79.7
Open area	2	965.4	Premises	25	27.3
Portico	3	58.8	Meeting room	26	108.4
Office	4	21.	Meeting room	27	108.4
Office	5	17.4	Main worker room	28	50.7
Office	6	21.3	Main worker room	29	56.7
Office	7	19.36	Office	30	38.1
Office	8	17.4	Office	31	38.1
Office	9	19.36	Manager room	32	36
Main worker room	10	18.2	Master toilet	33	5.3
Archives	11	6.05	Worker rooms	34	27.3
Archives	12	5.5	Archives	35	27.3
Meeting room	13	187	Worker rooms	36	32.7
Office	14	19.3	Worker rooms	37	12.6
Office	15	17.4	Electrical care room	38	36
Office	16	19.3	Manager room	39	36
Meeting room	17	23.2	Manager room	40	36
Meeting room	18	25.1	Manager room	41	36
Premises	19	35.3	Manager room	42	36
Premises	20	29.4	Manager room	43	36
Smoking room	21	6.2	Room	44	19.6
Toilet	22	164.4	Room	45	38.4
Smoking room	23	6.2			

Continuation of Appendix A

Table A.3 – Details of Third Floor Plan

Name	Mark	Area
Room	47	19.6
Portico	48	287.7
Portico	49	58.8
Portico	50	212.3
Portico	51	77
Room	52	38.4
Premises	53	38.4
Women Toilet	54	27
Eating room	55	518.6
Men toilet	56	32.4

Design Results of ETABS

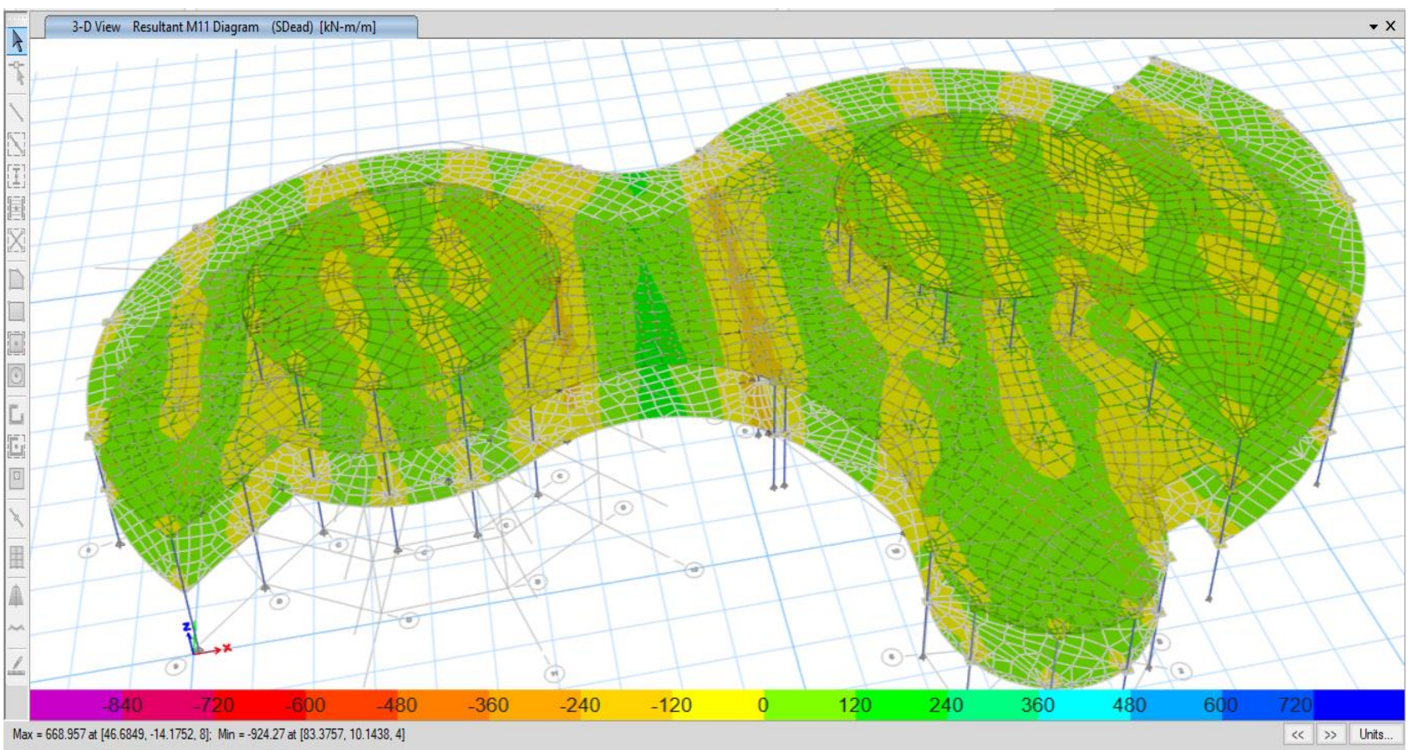


Figure A.1- Maximum moment of slab M_{max}=668.96KNm, Minimum moment of slab M_{min}= -924.27KNm.

Continuation of Appendix A

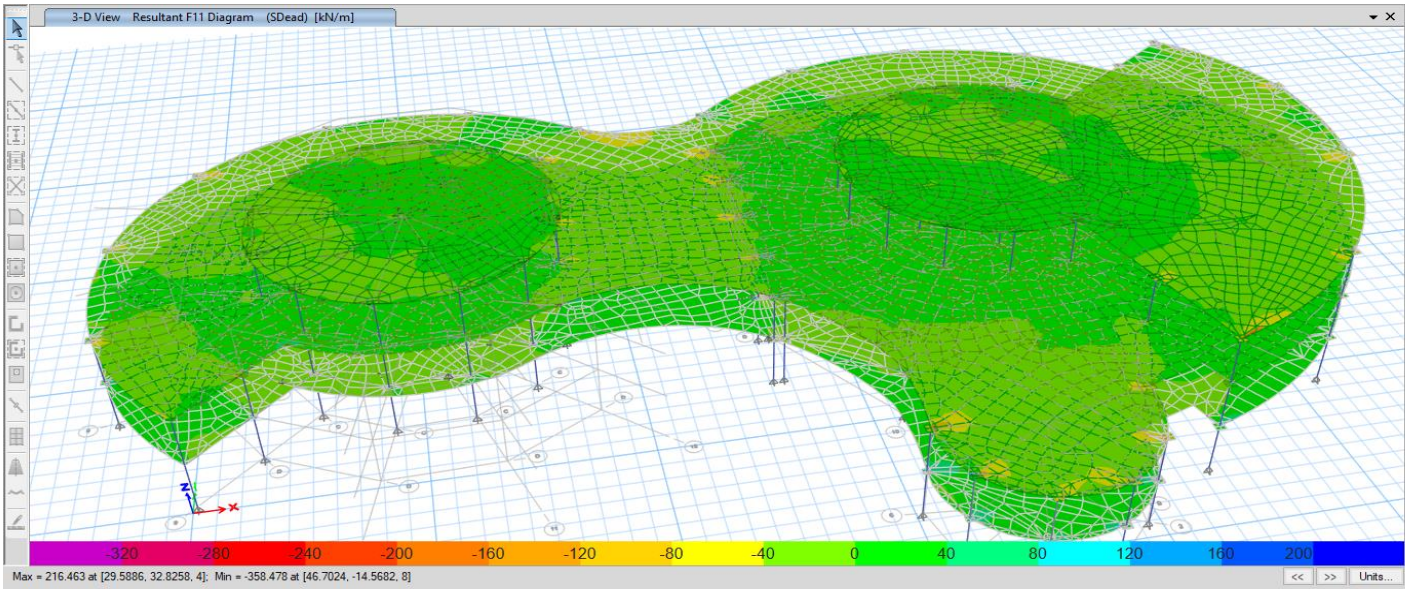


Figure A.2- Maximum shear force of slab Q_{max}=216.5KN/m, Minimum sheer force of slab Q_{min}= -358.4KN/m.

The ultimate deformation for our building type is civil multi-storey building with full reinforced concrete frame, maximum draft is $S_{max,u}$ = 10 cm. According to the displacement diagram, the maximum draft in our building is 3.44 mm, it is being tested.

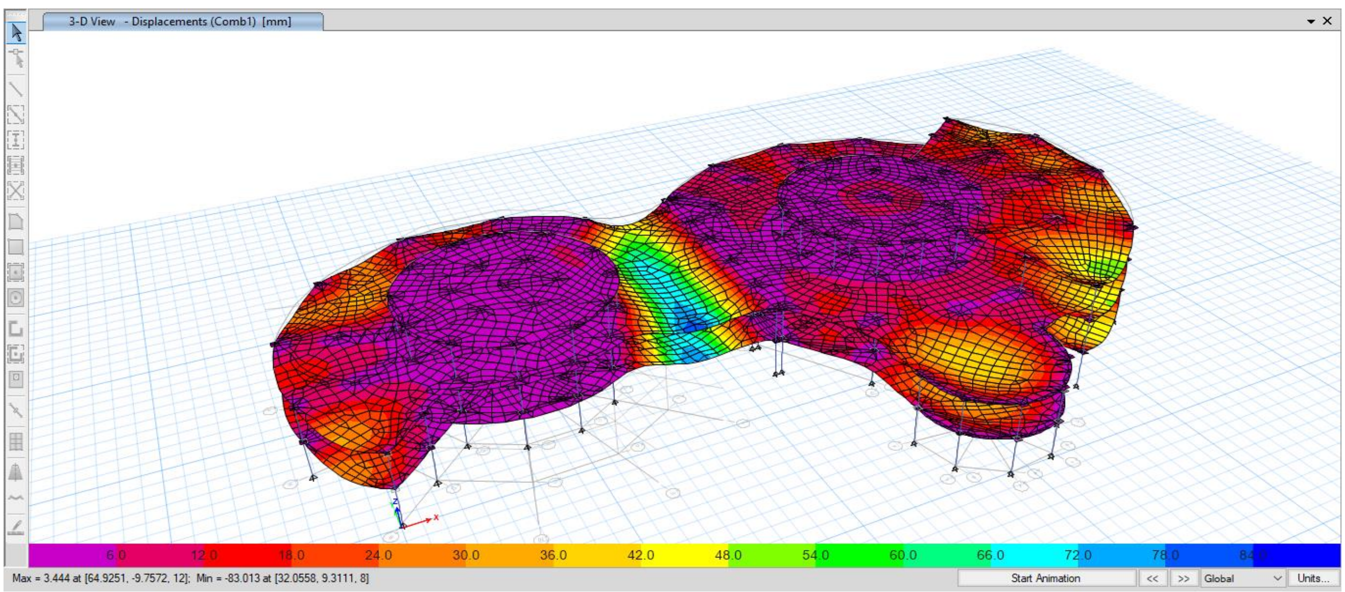


Figure A.3- Resultant displacement of S_{max}=3.44mm, S_{min}= -83.03KN/m.

When checking the deflections, we use a quasi-constant combination, select the overlap of the 3th floor, cut out 1 span and check for deflection.

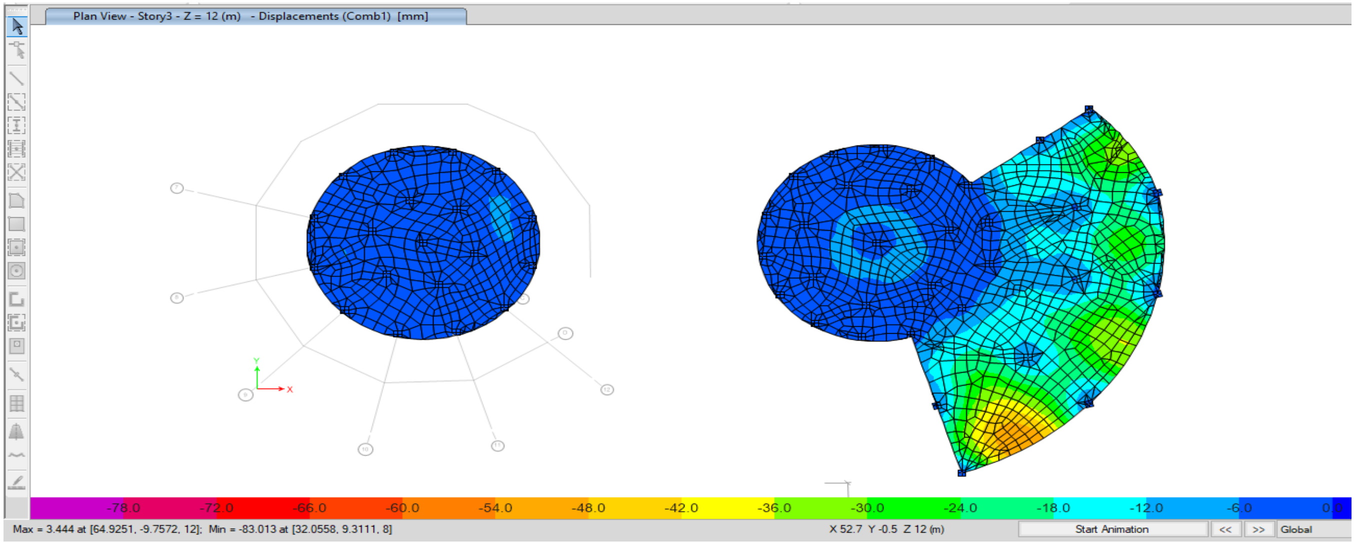


Figure A.4- Resultant displacement According to UZ S_{max}=3.44mm, S_{min}= -83.03KN/m.

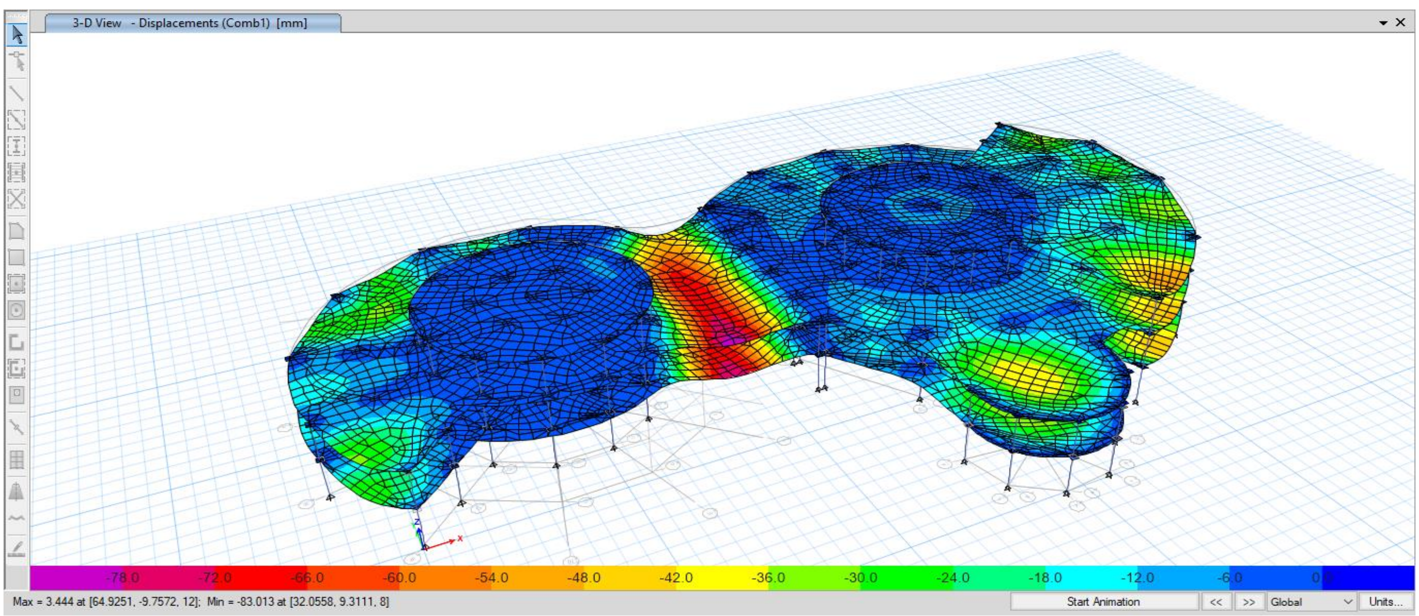


Figure A.5- Resultant displacement According to UZ S_{max}=3.44mm, S_{min}= -83.03KN/m.

Checking the overlap, the relative displacement is 83.03 - 78 =5.03 mm. The maximum span is L=12000mm.

$$\frac{L}{250} = 48 \text{ mm}$$

The condition met.

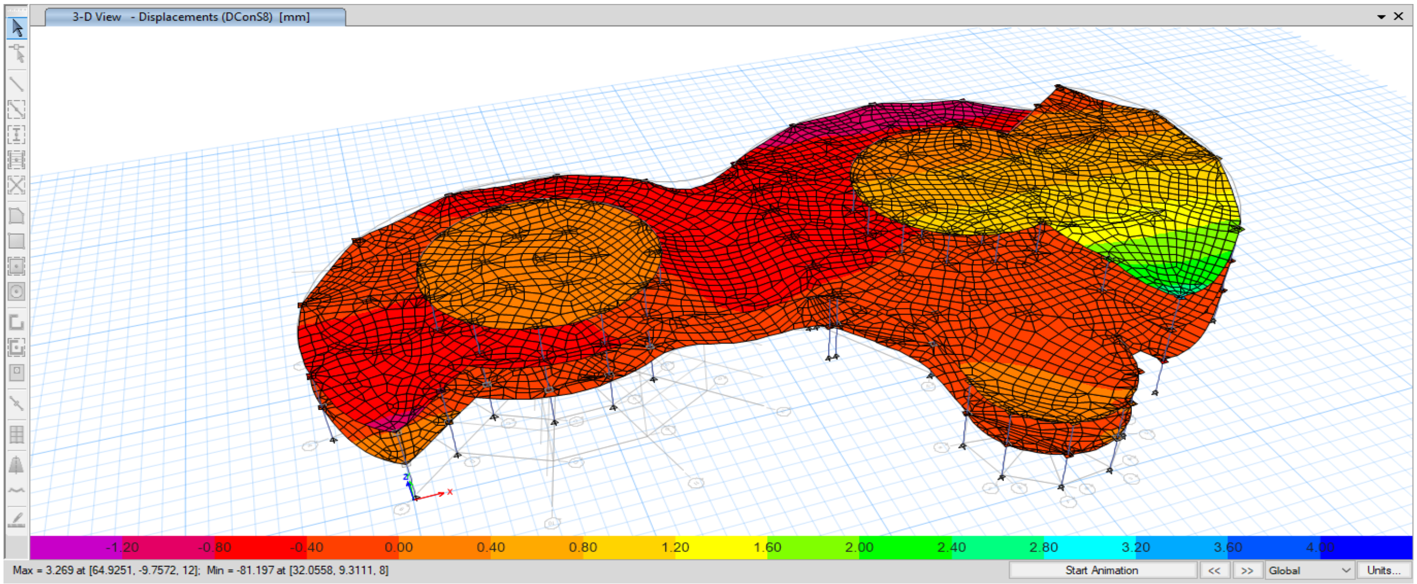


Figure A.6 Diagram of the x displacement of the building frame from the wind, S_{max}=3.26mm, S_{min}= -81.2mm.

Building height h = 12 m,

$$\frac{h}{500} = 24 \text{ mm.}$$

The condition met.

Basic Detail of working in ETABS

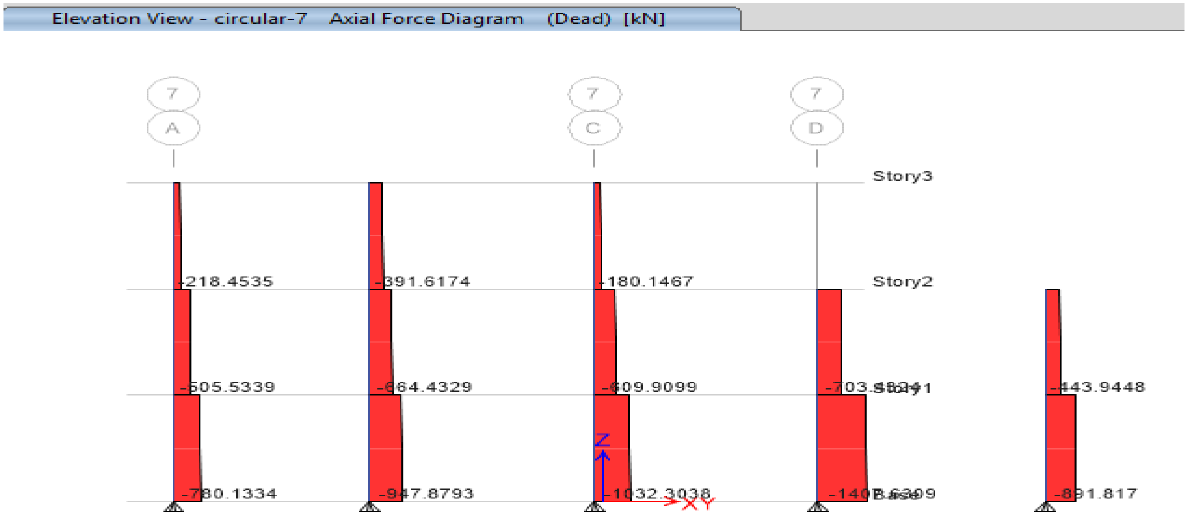
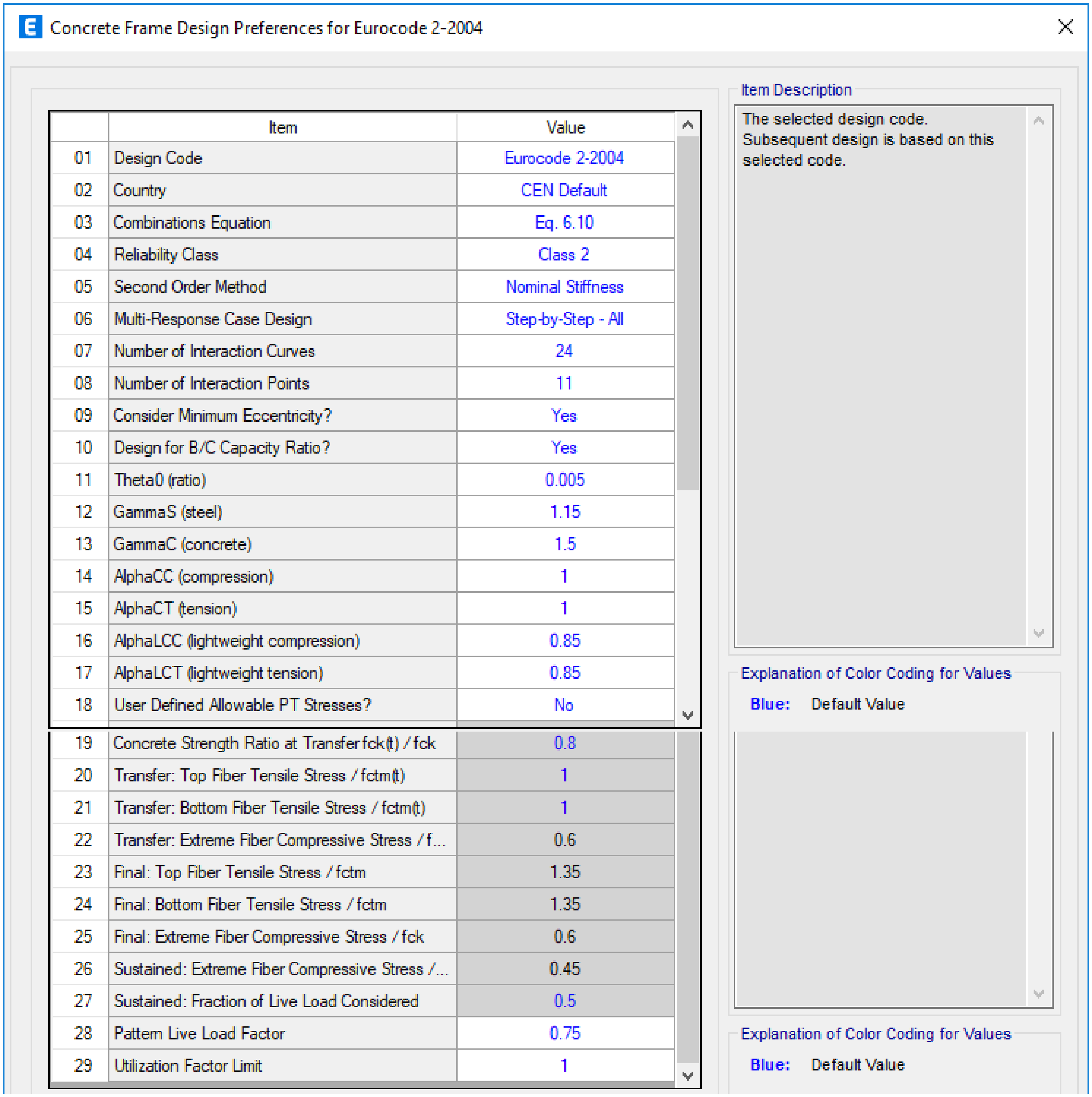


Figure A.7- Axial Forces Diagrams on Elevation View

Continuation of Appendix A



Concrete Frame Design Preferences for Eurocode 2-2004

	Item	Value
01	Design Code	Eurocode 2-2004
02	Country	CEN Default
03	Combinations Equation	Eq. 6.10
04	Reliability Class	Class 2
05	Second Order Method	Nominal Stiffness
06	Multi-Response Case Design	Step-by-Step - All
07	Number of Interaction Curves	24
08	Number of Interaction Points	11
09	Consider Minimum Eccentricity?	Yes
10	Design for B/C Capacity Ratio?	Yes
11	Theta0 (ratio)	0.005
12	GammaS (steel)	1.15
13	GammaC (concrete)	1.5
14	AlphaCC (compression)	1
15	AlphaCT (tension)	1
16	AlphaLCC (lightweight compression)	0.85
17	AlphaLCT (lightweight tension)	0.85
18	User Defined Allowable PT Stresses?	No
19	Concrete Strength Ratio at Transfer fck(t) / fck	0.8
20	Transfer: Top Fiber Tensile Stress / fctm(t)	1
21	Transfer: Bottom Fiber Tensile Stress / fctm(t)	1
22	Transfer: Extreme Fiber Compressive Stress / f...	0.6
23	Final: Top Fiber Tensile Stress / fctm	1.35
24	Final: Bottom Fiber Tensile Stress / fctm	1.35
25	Final: Extreme Fiber Compressive Stress / fck	0.6
26	Sustained: Extreme Fiber Compressive Stress /...	0.45
27	Sustained: Fraction of Live Load Considered	0.5
28	Pattern Live Load Factor	0.75
29	Utilization Factor Limit	1

Item Description

The selected design code. Subsequent design is based on this selected code.

Explanation of Color Coding for Values

Blue: Default Value

Explanation of Color Coding for Values

Blue: Default Value

Figure A.8- Concrete Frame Design Preference For Eurocode.

Continuation of Appendix A

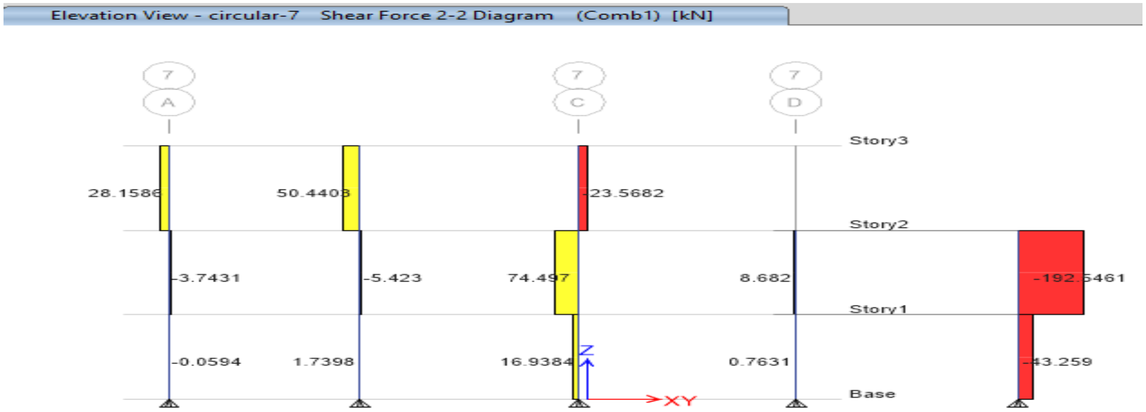


Figure A.9- Shear forces 2-2 Diagrams on Elevation View

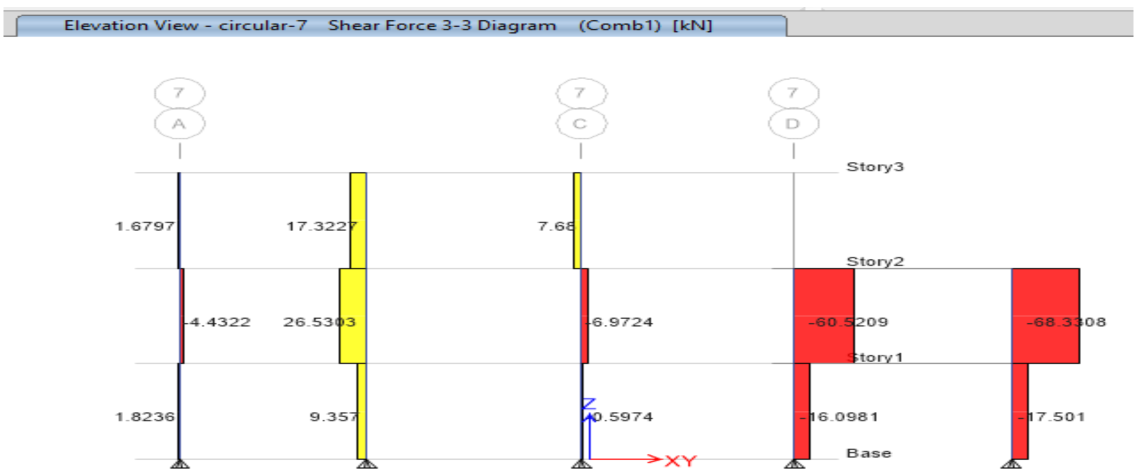


Figure A.10- Shear forces 3-3 Diagrams on Elevation View

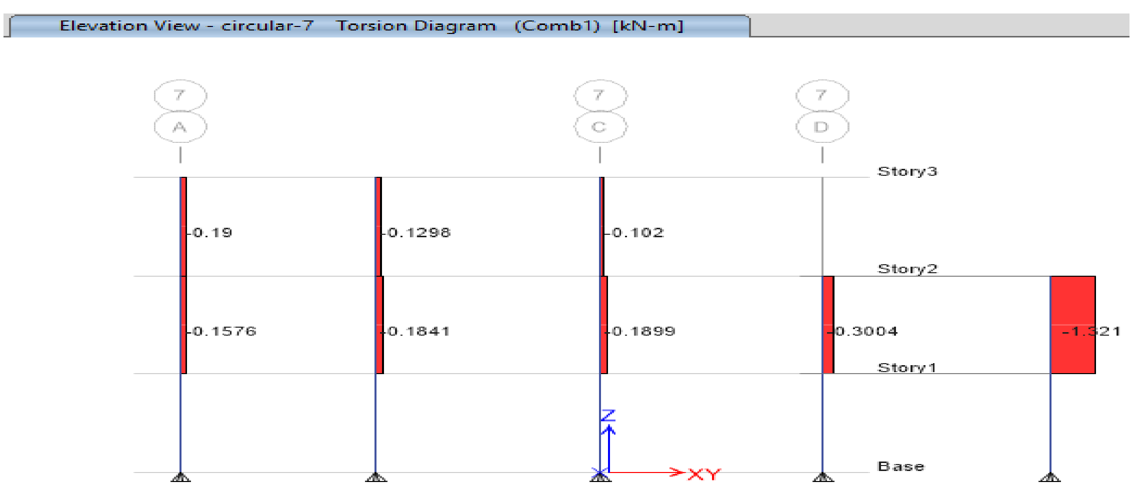


Figure A.11- Torsion Diagrams on Elevation View

Continuation of Appendix A

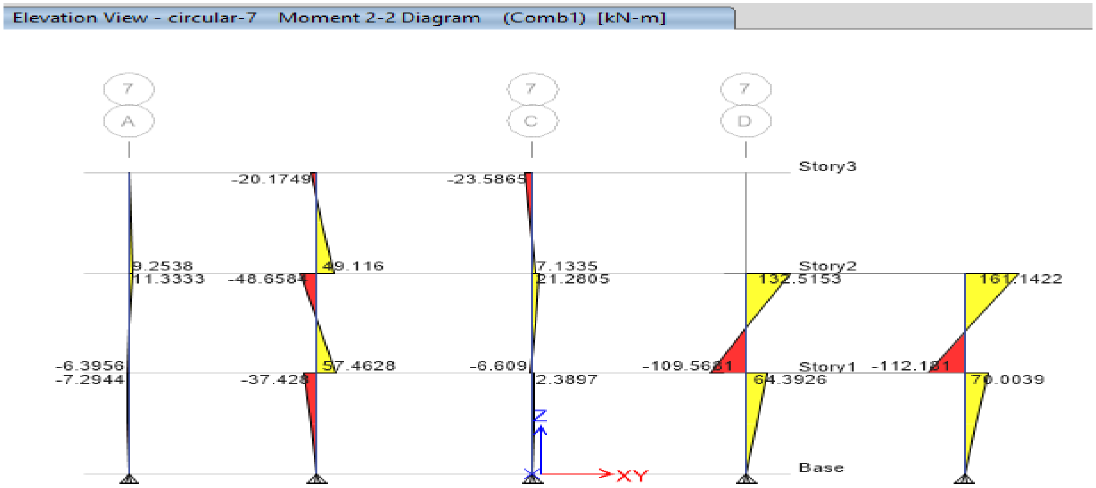


Figure A.12- Moment 2-2 Diagrams on Elevation View

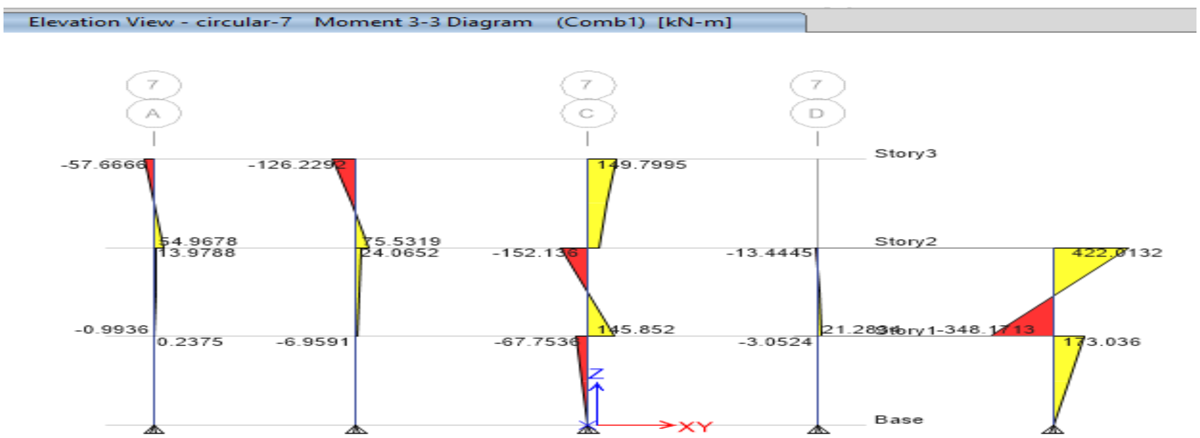


Figure A.13- Moment 3-3 Diagrams on Elevation View

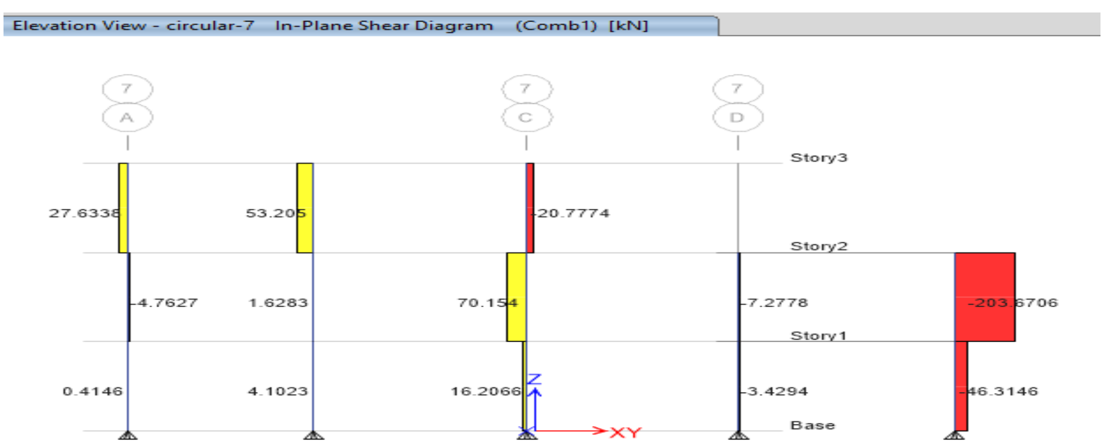


Figure A.14- In-plane Shear Diagrams on Elevation View

Continuation of Appendix A

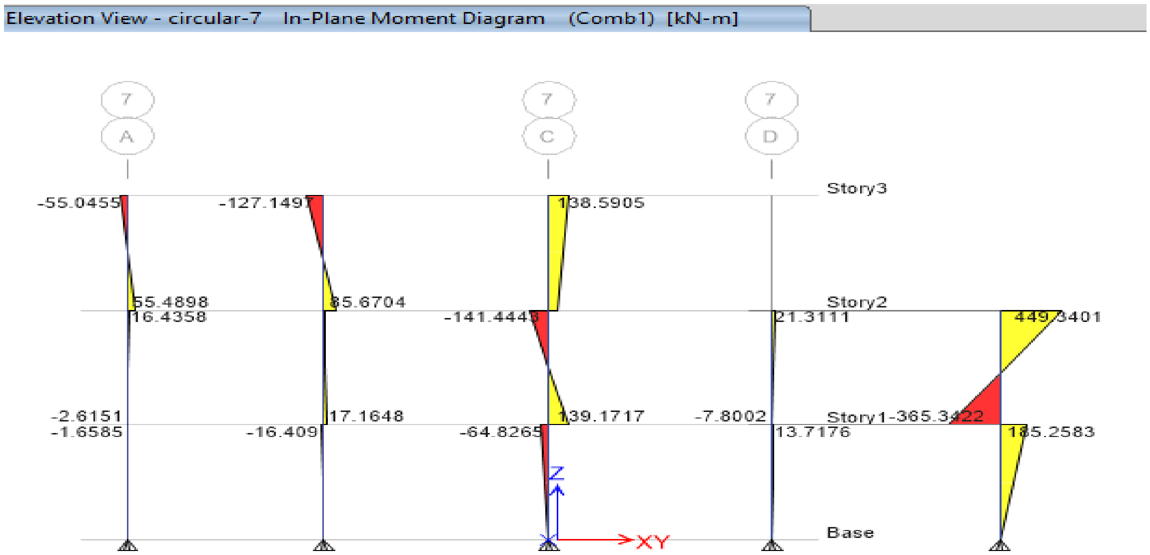


Figure A.15- In-plane Moment Diagrams on Elevation View

Table A.4- Design Forces of Columns on ETABS

Story	Column	UniqueName	Combo	P,Kn	V2,Kn	V3,kN	M2,kNm	M3,kNm
Story1	C1	424	DConS1-1	-1251.6	45.7	-19.9	0	0
Story1	C1	424	DConS1-1	-1225.7	45.7	-19.9	39.84	-91.41
Story1	C1	424	DConS1-1	-1199.7	45.7	-19.9	79.68	-182.8
Story1	C1	424	DConS2-1	-1309.9	49	-21.2	0	0
Story1	C1	424	DConS2-1	-1284	49	-21.2	42.31	-98.02
Story1	C1	424	DConS2-1	-1258	49	-21.2	84.62	-196
Story1	C1	424	DConS2-2	-1309.9	49	-21.2	0	0
Story1	C1	424	DConS2-2	-1284	49	-21.2	42.31	-98.02
Story1	C1	424	DConS2-2	-1258	49	-21.2	84.62	-196
Story1	C1	424	DConS3-1	-1309.9	49	-21.2	0	0

Continuation of Appendix A

Continuation of Table A.4

Story	Column	UniqueName	Combo	P,Kn	V2,Kn	V3,kN	M2,kNm	M3,kN
Story1	C1	424	DConS3-1	-1258	49	-21.2	84.62	-196
Story1	C1	424	DConS4-1	-1309.9	49	-21.2	0	0
Story1	C1	424	DConS4-1	-1284	49	-21.2	42.31	-98.02
Story1	C1	424	DConS4-1	-1258	49	-21.2	84.62	-196
Story1	C1	424	DConS5-1	-1309.9	49	-21.2	0	0
Story1	C1	424	DConS5-1	-1284	49	-21.2	42.31	-98.02
Story1	C1	424	DConS5-1	-1258	49	-21.2	84.62	-196
Story1	C1	424	DConS6-1	-1309.9	49	-21.2	0	0
Story1	C1	424	DConS6-1	-1284	49	-21.2	42.31	-98.02
Story1	C1	424	DConS6-1	-1258	49	-21.2	84.62	-196
Story1	C1	424	DConS7-1	-1292.4	48	-20.8	0	0
Story1	C1	424	DConS7-1	-1266.5	48	-20.8	41.57	-96.04
Story1	C1	424	DConS7-1	-1240.5	48	-20.8	83.14	-192.1
Story1	C1	424	DConS8-1	-1292.4	48	-20.8	0	0
Story1	C1	424	DConS8-1	-1266.5	48	-20.8	41.57	-96.04
Story1	C1	424	DConS8-1	-1240.5	48	-20.8	83.14	-192.1
Story1	C1	424	DConS9-1	-1292.4	48	-20.8	0	0
Story1	C1	424	DConS9-1	-1266.5	48	-20.8	41.57	-96.04
Story1	C1	424	DConS9-1	-1240.5	48	-20.8	83.14	-192.1
Story1	C1	424	DConS10-1	-1266.5	48	-20.8	41.57	-96.04
Story1	C1	424	DConS10-1	-1240.5	48	-20.8	83.14	-192.1
Story1	C1	424	DConS11-1	-1251.6	45.7	-19.9	0	0
Story1	C1	424	DConS11-1	-1225.7	45.7	-19.9	39.84	-91.41
Story1	C1	424	DConS11-1	-1199.7	45.7	-19.9	79.68	-182.8
Story1	C1	424	DConS12-1	-1251.6	45.7	-19.9	0	0
Story1	C1	424	DConS12-1	-1225.7	45.7	-19.9	39.84	-91.41
Story1	C1	424	DConS12-1	-1199.7	45.7	-19.9	79.68	-182.8
Story1	C1	424	DConS13-1	-1251.6	45.7	-19.9	0	0

Continuation of Appendix A

Continuation of Table A.4

Story	Column	Unique Name	Combo	P,Kn	V2,Kn	V3,kN	M2,kNm	M3,kNm
Story1	C1	424	DConS13-1	-1225.7	45.7	-19.9	39.84	-91.41
Story1	C1	424	DConS13-1	-1199.7	45.7	-19.9	79.68	-182.8
Story1	C1	424	DConS14-1	-1251.6	45.7	-19.9	0	0
Story1	C1	424	DConS14-1	-1225.7	45.7	-19.9	39.84	-91.41
Story1	C1	424	DConS14-1	-1199.7	45.7	-19.9	79.68	-182.8
Story1	C1	424	DConS15-1	-927.14	33.9	-14.8	0	0
Story1	C1	424	DConS15-1	-907.9	33.9	-14.8	29.51	-67.71
Story1	C1	424	DConS15-1	-888.67	33.9	-14.8	59.02	-135.4
Story1	C1	424	DConS16-1	-927.14	33.9	-14.8	0	0
Story1	C1	424	DConS16-1	-907.9	33.9	-14.8	29.51	-67.71
Story1	C1	424	DConS16-1	-888.67	33.9	-14.8	59.02	-135.4
Story1	C1	424	DConS17-1	-927.14	33.9	-14.8	0	0
Story1	C1	424	DConS17-1	-907.9	33.9	-14.8	29.51	-67.71
Story1	C1	424	DConS17-1	-888.67	33.9	-14.8	59.02	-135.4
Story1	C1	424	DConS18-1	-927.14	33.9	-14.8	0	0
Story1	C1	424	DConS18-1	-907.9	33.9	-14.8	29.51	-67.71
Story1	C1	424	DConS18-1	-888.67	33.9	-14.8	59.02	-135.4

Continuation of Appendix A

Continuation of Table A.4

Story	Column	Unique Name	Combo	P,Kn	V2,Kn	V3,kN	M2,kNm	M3,kNm
Story2	C1	150	DConS1-1	-631.62	137	-97.7	-155	230.1
Story2	C1	150	DConS1-1	-605.65	137	-97.7	40.43	-43.63
Story2	C1	150	DConS1-1	-579.68	137	-97.7	235.9	-317.4
Story2	C1	150	DConS2-1	-661.16	147	-104	-164	246.88
Story2	C1	150	DConS2-1	-635.19	147	-104	42.98	-46.87
Story2	C1	150	DConS2-1	-609.22	147	-104	250.1	-340.6
Story2	C1	150	DConS2-2	-635.19	147	-104	42.98	-46.87
Story2	C1	150	DConS2-2	-609.22	147	-104	250.1	-340.6
Story2	C1	150	DConS3-1	-661.16	147	-104	-164	246.88
Story2	C1	150	DConS3-1	-635.19	147	-104	42.98	-46.87
Story2	C1	150	DConS3-1	-609.22	147	-104	250.1	-340.6
Story2	C1	150	DConS4-1	-661.16	147	-104	-164	246.88
Story2	C1	150	DConS4-1	-635.19	147	-104	42.98	-46.87
Story2	C1	150	DConS4-1	-609.22	147	-104	250.1	-340.6
Story2	C1	150	DConS5-1	-661.16	147	-104	-164	246.88
Story2	C1	150	DConS5-1	-635.19	147	-104	42.98	-46.87
Story2	C1	150	DConS5-1	-609.22	147	-104	250.1	-340.6
Story2	C1	150	DConS6-1	-661.16	147	-104	-164	246.88
Story2	C1	150	DConS6-1	-635.19	147	-104	42.98	-46.87
Story2	C1	150	DConS6-1	-609.22	147	-104	250.1	-340.6
Story2	C1	150	DConS7-1	-652.29	144	-102	-161	241.85
Story2	C1	150	DConS7-1	-626.33	144	-102	42.22	-45.9
Story2	C1	150	DConS7-1	-600.36	144	-102	245.8	-333.6
Story2	C1	150	DConS8-1	-652.29	144	-102	-161	241.85
Story2	C1	150	DConS8-1	-626.33	144	-102	42.22	-45.9
Story2	C1	150	DConS8-1	-600.36	144	-102	245.8	-333.6
Story2	C1	150	DConS9-1	-652.29	144	-102	-161	241.85
Story2	C1	150	DConS9-1	-626.33	144	-102	42.22	-45.9
Story2	C1	150	DConS9-1	-600.36	144	-102	245.8	-333.6

Continuation of Appendix A

Continuation of Table A.4

Story	Column	Unique Name	Combo	P,Kn	V2,Kn	V3,kN	M2,kNm	M3,kNm
Story2	C1	150	DConS10-1	-652.29	144	-102	-161	241.85
Story2	C1	150	DConS10-1	-626.33	144	-102	42.22	-45.9
Story2	C1	150	DConS10-1	-600.36	144	-102	245.8	-333.6
Story2	C1	150	DConS11-1	-631.62	137	-97.7	-155	230.1
Story2	C1	150	DConS11-1	-605.65	137	-97.7	40.43	-43.63
Story2	C1	150	DConS11-1	-579.68	137	-97.7	235.9	-317.4
Story2	C1	150	DConS12-1	-631.62	137	-97.7	-155	230.1
Story2	C1	150	DConS12-1	-605.65	137	-97.7	40.43	-43.63
Story2	C1	150	DConS12-1	-579.68	137	-97.7	235.9	-317.4
Story2	C1	150	DConS13-1	-605.65	137	-97.7	40.43	-43.63
Story2	C1	150	DConS13-1	-579.68	137	-97.7	235.9	-317.4
Story2	C1	150	DConS14-1	-631.62	137	-97.7	-155	230.1
Story2	C1	150	DConS14-1	-605.65	137	-97.7	40.43	-43.63
Story2	C1	150	DConS14-1	-579.68	137	-97.7	235.9	-317.4
Story2	C1	150	DConS15-1	-467.86	101	-72.4	-115	170.45
Story2	C1	150	DConS15-1	-448.63	101	-72.4	29.95	-32.32

Continuation of Appendix A

Continuation of Table A.4

Story	Column	Unique Name	Combo	P,Kn	V2,Kn	V3,kN	M2,kNm	M3,kNm
Story2	C1	150	DConS15-1	-429.39	101	-72.4	174.7	-235.1
Story2	C1	150	DConS16-1	-467.86	101	-72.4	-115	170.45
Story2	C1	150	DConS16-1	-448.63	101	-72.4	29.95	-32.32
Story2	C1	150	DConS16-1	-429.39	101	-72.4	174.7	-235.1
Story2	C1	150	DConS17-1	-467.86	101	-72.4	-115	170.45
Story2	C1	150	DConS17-1	-448.63	101	-72.4	29.95	-32.32
Story2	C1	150	DConS17-1	-429.39	101	-72.4	174.7	-235.1
Story2	C1	150	DConS18-1	-467.86	101	-72.4	-115	170.45
Story2	C1	150	DConS18-1	-448.63	101	-72.4	29.95	-32.32
Story2	C1	150	DConS18-1	-429.39	101	-72.4	174.7	-235.1

Appendix B

Table B.1. Bill of Quantities

Name of processes	Unit of measure	Volume of Work	
		On one base	In total
Removal of top soil	$1000m^2$		7005.6
Soil excavation in the trench access	$100m^2$		7106
Backfilling	m^3		3481.2
Soil compaction	m^2		8703
Reinforcement installation for footing	t		5.725
Installation of Footing formwork	m^3		39.039
Concreting of footing	m^3	1.573	143.14
Footing Formwork removal	m^3		39.039
Reinforcement installation of First Floor column	t		11.19
formwork Installation of first floor columns	m^2		800.1
volume of concrete for first floor columns	m^3	1.538	139.95
First Floor Column formwork removal	m^2		800.1
Reinforcement installation of first floor slab	t		82.66
Installation of first floor slab formwork	m^2		3437
First floor Slab concreting	m^3	1271.7	1271.7
uninstallation of First Floor slab formwork	m^2		3437
Installation of formwork for 1 floor walls	m^2		228.72
Volume of concrete for first floor wall	m^3		121.36
uninstalling of formwork of first floor walls	m^2		228.72

Continuation of Appendix B

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

(Name of processes)	Unit of measure	Volume Of work	Standard time		Quantity		Labor costs		Salary	
			Worker h-h	machine	worker	machine	Working m-d	Drivers Of m-cm	worker	drivers
Removal of top soil	1000 m^2	7005.6	-	0.56	-	0.6	478.4	-	-	4203.3
Soil excavation in the trench access	$100m^2$	7106	2.8	3.56	1.48	1.7	2426	3085	10516.8	12080.2
Backfilling	m^3	3481.2	-	0.39	-	1.58	-	118	-	5500.3
Soil compaction	m^2	8703	-	0.92	-	0.26	-	976	-	2262.7
Reinforcement installation for footing	t	5.7256	22.71	–	15	–	15.86	-	85.88	-
Installation of Footing formwork	m^3	39.039	0.36	0.12	0.35	0.17	2	1	13.66	6.63
Concreting of footing	m^3	143.14	1.2	0.89	0.34	0.31	21	15	48.66	44.37
Footing Formwork removal	m^3	39.039	0.31	-	0.08	-	2	-	3.123	-
Reinforcement installation of First Floor column	t	11.196	2.41	0.12	9	0.17	3.3	1	100.764	2
formwork Installation of first floor columns	m^2	800.1	0.4	0.1	10	0.05	39.1	10	8001	40.0
volume of concrete for first floor columns	m^3	139.95	1.5	0.28	1.07	2	26	5	699.75	279.9
First Floor Column formwork removal	m^2	800.1	0.4	0.1	5	0.05	39.1	10	4000.5	40
Reinforcement installation of first floor slab	t	82.7	2.41	0.12	9	0.17	24.5	1.5	744.3	14.05
Installation of first floor slab formwork	m^2	3437	1.1	0.28	0.77	0.29	461	117	2646.5	996.73
First floor Slab concreting	m^3	1271.7	1.5	1.1	0.4	0.35	232.6	170.6	508.68	445.1
uninstallation of First Floor slab formwork	m^2	3437	0.9	-	0.1	-	377	-	343.7	-
Installation of formwork for 1 floor walls	m^3	228.72	0.46	-	0.32	-	13	-	73.2	-
Volume of concrete for first floor wall	m^3	121.36	0.79	0.28	0.56	2	12	4	67.9	242.72
uninstalling of formwork of first floor walls	m^3	228.72	0.25	-	0.16	-	7	-	36.6	-

Continuation of Appendix B

Continuation of Table B.2

(Name of processes)	Unit of measure	Volume Of work	Standard time		Quantity		Labor costs		Salary	
			Worker h-h	machine	worker	machine	Working m-d	Drivers Of m-cm	worker	drivers
formwork Installation of Second floor columns	m^2	800.1	0.4	0.1	10	0.05	39.1	10	8001	40.0
volume of concrete for Second floor columns	m^3	139.95	1.5	0.28	1.07	2	26	5	699.75	279.9
Second Floor Column formwork removal	m^2	800.1	0.4	0.1	5	0.05	39.1	10	4000.5	40
Reinforcement installation of Second floor slab	t	82.7	2.41	0.12	9	0.17	24.5	1.5	744.3	14.05
Installation of Second floor slab formwork	m^2	3437	1.1	0.28	0.77	0.29	461	117	2646.5	996.73
Second floor Slab concreting	m^3	1271.7	1.5	1.1	0.4	0.35	232.6	170.6	508.68	445.1
uninstallation of Second Floor slab formwork	m^2	3437	0.9	-	0.1	-	377	-	343.7	-
Installation of formwork for 2 floor walls	m^3	228.72	0.46	-	0.32	-	13	-	73.2	-
Volume of concrete for Second floor wall	m^3	121.36	0.79	0.28	0.56	2	12	4	67.9	242.72
uninstalling of formwork of Second floor walls	m^3	228.72	0.25	-	0.16	-	7	-	36.6	-
Reinforcement installation of Third Floor column	t	6.275	2.41	0.12	9	0.17	2	1	56	1.1
formwork Installation of Third floor columns	m^2	448.4	0.4	0.1	10	0.05	22	6	4484	22.42
volume of concrete for Third floor columns	m^3	78.438	1.5	0.28	1.07	2	14.5	3	84	157
Third Floor Column formwork removal	m^2	448.4	0.4	0.1	5	0.05	22	6	2242	22.42
Reinforcement installation of Third floor slab	t	33.28	2.41	0.12	9	0.17	10	1	299.52	6
Installation of Third floor slab formwork	m^2	1383.7	1.1	0.28	0.77	0.29	182.61	47.3	1065.5	401.3
Third floor Slab concreting	m^3	512	1.5	1.1	0.4	0.35	94	69	204.8	179.2
uninstallation of Third Floor slab formwork	m^2	1383.7	0.9	-	0.1	-	152	-	138.37	-

Continuation of Appendix B

Table B.3- Planned schedule of work

(Name of processes)	(Volume of work)	Labour cost, h–d	(The required cars)		(Duration of, days(P))	Number of changes (A))	Duration of time, h	(Number of workers in change)	(Working schedule)									
			Req.car	Num.shift					1	2	3	4	5	6	7	8	9	10
Removal of top soil	7005.6	478.4	2	2	24	2	6	10	20									
Soil excavation in the trench access	7106	2426	3	2	155	2	6	10		20								
Backfilling	3481.2	5	2	1	2	1	6	5			5							
Soil compaction	8703	5	3	1	2	1	6	5				5						
Reinforcement installation	5.725	15.86	2	2	2	2	6	5				10						
Installation of Footing formwork	39.039	5	2	1	1	1	6	5					5					
Concreting of footing	143.14	21	4	2	3	2	6	8						16				
Footing Formwork removal	39.039	5	1	1	1	1	6	5						5				
Reinforcement installation of First Floor. column	11.196	10	2	1	2	1	6	5						5				
formwork of First Floor columns	800.1	39.1	2	2	3	2	6	8							16			
volume of concrete of First Floor column	139.95	26	3	2	2	2	6	8							16			
First Floor Column formwork removal	800.1	39.1	1	1	5	1	6	8								16		
First Floor Slab Reinforcement	82.7	24.5	2	2	3	2	6	8								16		
Installation of First Floor slab formwork	3437	461	2	2	24	2	6	10								20		
First Floor Slab concreting	1271.7	232.6	3	2	12	2	6	10								20		
uninstallation of First Floor slab formwork	3437	377	1	2	19	2	6	10									20	

Continuation of Appendix B

Continuation of Table B.3

(Name of processes)	(Volume of work)	Labour cost, h–d	(The required cars)		(Duration of, days (P))	Number of changes (A))	Duration of time, h	(Number of workers in change)	(Number of workers in change)	(Working schedule)									
			Req.car	Num. shift						1	2	3	4	5	6	7	8	9	10
Volume of concrete for First Floor wall	121.36	12	3	3	2	2	2	6	5										10
uninstalling of formwork of First Floor walls	228.72	7	3	2	1	2	1	6	5										5
Reinforcement installation of Second Floor. column	11.196	10	2	1	1	2	1	6	5						5				
formwork of Second Floor columns	800.1	39.1	2	2	2	3	2	6	8							16			
volume of concrete of Second Floor column	139.95	26	3	2	2	2	2	6	8							16			
Second Floor Column formwork removal	800.1	39.1	1	1	1	5	1	6	8								16		
Second Floor Slab Reinforcement	82.7	24.5	2	2	2	3	2	6	8								16		
Installation of Second Floor slab formwork	3437	461	2	2	2	24	2	6	10								20		
Second Floor Slab concreting	1271.7	232.6	3	2	2	12	2	6	10								20		
uninstallation of Second Floor slab formwork	3437	377	1	2	2	19	2	6	10									20	
Installation of formwork for	228.72	13	2	2	1	2	1	6	10									10	

Continuation of Appendix B

Continuation of Table B.3

(Name of processes)	(Volume of work)	Labor cost	Require car		(Duration of, days(P))	Number of changes (A))	Duration of time, h	(Number of workers in change)	(Working schedule)										
			Req. C	Shift					1	2	3	4	5	6	7	8	9	10	11
Volume of concrete for Second Floor wall	121.36	12	3	2	2	2	6	5											10
uninstalling of formwork of Second Floor walls	228.72	7	1	1	1	2	1	8											8
Reinforcement installation of Third Floor. column	6.275	2	2	1	1	1	6	5				8							
formwork of Third Floor columns	448.4	22	2	2	2	2	6	6				12							
volume of concrete of Third Floor column	78.438	14.5	3	2	2	2	6	6				12							
Third Floor Column formwork removal	448.4	22	1	1	4	1	6	6					12						
Third Floor Slab Reinforcement	33.28	10	2	1	1	1	6	6					12						
Installation of Third Floor slab formwork	1383.7	182.61	2	2	10	2	6	10							20				
Third Floor Slab concreting	512	94	3	2	5	2	6	10								20			
uninstallation of Third Floor slab formwork	1383.7	152	1	2	8	2	6	10									20		

Appendix C

Table C.1- Local Estimation

Name of Object - Multifunctional Administrative Building Using Solar Energy in Kyzlorda

Name of the Building - Multifunctional Administrative Building Using Solar Energy in Kyzlorda

Object Number -

LOCAL ESTIMATE No № 2-1-1
(Calculation of Local Estimation)

on the Multifunctional Administrative Building Using Solar Energy in Kyzlorda

Basics

Estimated Cost	126166.56	thous.Tenge
Normative Labor Intensity	38082	pers.-h
Estimated Wages	2736.0225	thous.Tenge

Compiled in prices for 01.1. 2001 y

N п/п	Code and No position of the standard	Name of Works and Costs, Unit of Measures	Quantity	unit Cost(1), Tenge		Total Cost, Tenge		overhead costs	Labor costs, per,h, construction workers	
				Total	opera. Machines	Total	opera. Machines			
				Salary of construction workers	Salary of drivers	Salary of construction workers	Salary of drivers	Tenge	workers, serving machines	
								%	in one	Total
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
		SECTION 1 Earthworks								
1	**E0101-30-3**	**Planning of areas with bulldozers up to 132 (to 180) kBT**	**7005.6**	**0.26**	**0.26**	**1821.46**	**1821.46**	**339.77**	_	_
		m2		_	**0.05**	_	**350**	**97**	_	_

Continuation of Table C.1

2	E0101-11-14	**Development of soil of group 2 with loading on dump trucks excavators with bucket with a capacity of 1.25 m3**	7106	25.99	25.16	184685	178787	56176.48	0.01	71
		m2		0.78	7.37	5543	52371	97	0.03	213
3	E0101-27-2	**Backfilling of trenches and pits bulldozers with a capacity of 79(108) kW (hp) at movement of soils of group 2 up to 5 m**	3481.2	3.35	3.35	11662	11662	3917	--	--
		м3		--	1.16	--	4038	97	_	
4	E0101-130-1	**Soil compaction trailed pneumatic rollers running, 25 t, for the first pass one track at a thickness layer 25 cm**	8703	14.01	14.01	121929	121929	40521.168	-	-
		m2		-	4.80		41774	97	0.02	174
		TOTAL SECTION 1 DIRECT COSTS	**Tenge**			320097	314199	100954		71
			Tenge			5543	98534			387
	The cost of installation work -		Tenge			320097				
	Materials -		Tenge							
	Total salary -		Tenge				104077			
	The cost of materials and structures -		Tenge							
		Overhead costs -	Tenge			100954				
		Normative labor intensity in H.P. -	pers.-h							23
		Estimated wages in H.P. -	Tenge				15143			
		Irregular and unforeseen costs -	Tenge				326155			
	TOTAL, the cost of installation work -		Tenge				747207			
		Standard labor intensity -	pers.-h							481
		Estimated salary -	Tenge				113677			
		TOTAL SECTION 1	Tenge				747207			
		Standard labor intensity -	pers.-h							481
		Estimated salary -	Tenge				113677			
		SECTION 2 FOUNDATION								
1	E0106-50-2	**Installation of Formwork**	39.039	799.97	235.22	31230	9183	6069	0.56	22
		м2		74.25	73.80	2899	2881	105	0.15	6

Continuation of Appendix C

Continuation of Table C.1

2	**E0106-57-1**	**Reinforcement Installation**	**57.25**	**4604.04**	**289.29**	**263581**	**16562**	**253978**	**25.90**	**1483**
		t		**4146.75**	**78.30**	**237401**	**4483**	**105**	**0.30**	**17**
3	**E0108-4-7**	**Side coating bituminous waterproofing in 2 slots on the leveled surface of rubble masonry brick, concrete walls, foundations**	**535**	**245.44**	**3.82**	**131310**	**2044**	**24488**	**0.21**	**112**
		м2		**37.35**	**1.44**	**19982**	**770**	**118**	**0.01**	**5**
4	**E0106-1-15**	**Construction of concrete footing foundations**	**143.14**	**6490.82**	**100.65**	**929096**	**14407**	**27697**	**0.97**	**139**
		m3		**146.25**	**38.03**	**20934**	**5444**	**105**	**0.19**	**27**
5	**C12041-4**	**Uninstallation of formwork**	**39.039**	**799.97**	**235.22**	**31230**	**9183**	**6069**	**0.56**	**22**
		m2		**74.25**	**73.80**	**2899**	**2881**	**105**	**0.15**	**6**
		TOTAL SECTION 2 DIRECT COSTS	**Tenge**			**1386448**	**51378**	**318301**		**1778**
			Tenge			**284115**	**16459**			**61**
	The cost of installation work -		Tenge			**1386448**				
	Materials -		Tenge							
	Total salary -		Tenge				**300574**			
	The cost of materials and structures -		Tenge							
		Overhead costs -	Tenge			**318301**				
		Normative labor intensity in H.P. -	pers.-h							**92**
		Estimated wages in H.P. -	Tenge				**47745**			
		Irregular and unforeseen costs -	Tenge				**1405546**			
	TOTAL, the cost of installation work -		Tenge				**3110294**			
		Standard labor intensity -	pers.-h							**1931**
		Estimated salary -	Tenge				**64204**			
		TOTAL SECTION 2	Tenge				**3110294**			
		Standard labor intensity -	pers.-h							**1931**
		Estimated salary -	Tenge				**64204**			

SECTION 3. COLUMN

Continuation of Appendix C

Continuation of Table C.1

1	**E0106-15-1**	**Arrangement of columns in wooden formwork up to 4 m high,**	**2048.5**	**965.37**	**760.62**	**1977560**	**1558130**	**918165**	**1.42**	**2909**
		м2		**204.75**	**222.12**	**419430**	**455013**	**105**	**0.45**	**922**
2	**C12041-28**	**Reinforcement blanks not assembled into frames and meshes: steel of periodic profile of class A-III, d 32-40 mm**	**111.94**	**7207.00**	**148.00**	**806752**	**16567**	**24043**	**38.00**	**4254**
		т		**200.35**	**38.30**	**22427**	**4287**	**90**	**0.22**	**25**
3	**E0106-1-15**	**Concreting of Column**	**139.95**	**6490.82**	**100.65**	**908390**	**14086**	**27079**	**0.97**	**136**
		т		**146.25**	**38.03**	**20468**	**5322**	**105**	**0.19**	**27**
4	**E0106-15-1**	**uninstallation of columns in wooden formwork up to 4 m high,**	**2048.5**	**965.37**	**760.62**	**1977560**	**1558130**	**918165**	**1.42**	**2909**
		т		**204.75**	**222.12**	**419430**	**455013**	**105**	**0.45**	**922**
		TOTAL SECTION 3 DIRECT COSTS	**Tenge**			**5670263**	**3146913**	**1887453**		**10207**
			Tenge			**881756**	**919635**			**1895**
	The cost of installation work -		Tenge			**5670263**				
	Materials -		Tenge							
	Total salary -		Tenge				**1801391**			
	The cost of materials and structures -		Tenge							
		Overhead costs -	Tenge			**1887453**				
		Normative labor intensity in H.P. -	pers.-h							**605**
		Estimated wages in H.P. -	Tenge				**283118**			
		Irregular and unforeseen costs -	Tenge				**5783510**			
	TOTAL, the cost of installation work -		Tenge				**13341226**			
		Standard labor intensity -	pers.-h							**12707**
		Estimated salary -	Tenge				**1202753**			
		TOTAL SECTION 3	Tenge				**13341226**			
		Standard labor intensity -	pers.-h							**12707**
		Estimated salary -	Tenge				**1202753**			

Continuation of Appendix C

Continuation of Table C.1

		SECTION 4. WALLS								
1	**E0106-50-1**	**Installation and dismantling of large-panel wall formwork**	**228.72**	**965.37**	**760.62**	**220799**	**173969**	**102515**	**1.42**	**325**
		m3		**204.75**	**222.12**	**46830**	**50803**	**105**	**0.45**	**103**
2	**E0108-6-7**	**Construction of reinforced concrete walls up to 4 m high,**	**121.36**	**10182.71**	**5.80**	**1235774**	**704**	**201273**	**9.96**	**1209**
		m3		**1579.50**	**--**	**191688**	**--**	**105**	**1.63**	**198**
3	**E0108-4-5**	**Side waterproofing gluing on the leveled surface of rubble masonry, brick and concrete in 2 layers of walls, foundations**	**1114**	**665.48**	**8.23**	**741345**	**9168**	**111418.715 2**	**0.47**	**524**
		m2		**81.68**	**3.08**	**90992**	**3431**	**118**	**0.02**	**22**
4	**E0106-5-1**	**dismantling of large-panel wall formwork**	**228.72**	**965.37**	**760.62**	**220799**	**173969**	**102515**	**1.42**	**325**
		m3		**204.75**	**222.12**	**46830**	**50803**	**105**	**0.45**	**103**
5	**E0115-14-1**	**External cladding on a concrete surface individual ceramic tiles on polymer-cement mastic of walls**	**9307**	**2621.30**	**3.76**	**24396439**	**34994**	**1854498.86**	**1.04**	**9679**
		m2		**188.33**	**1.44**	**1752787**	**13402**	**105**	**-**	**-**
		TOTAL SECTION 4 DIRECT COSTS	**Tenge**			**26815156**	**392804**	**2372221**		**12061**
			Tenge			**2129128**	**118440**			**426**
	The cost of installation work -		Tenge			**26815156**				
	Materials -		Tenge							
	Total salary -		Tenge				**2247568**			
	The cost of materials and structures -		Tenge							
		Overhead costs -	Tenge			**2372221**				
		Normative labor intensity in H.P. -	pers.-h							**624**
		Estimated wages in H.P. -	Tenge				**355833**			
		Irregular and unforeseen costs -	Tenge				**1751243**			
	TOTAL, the cost of installation work -		Tenge				**30938620**			
		Standard labor intensity -	pers.-h							**13111**
		Estimated salary -	Tenge				**474273**			
		TOTAL SECTION 4	Tenge				**30938620**			

Continuation of Appendix C

Continuation of Table C.1

		Standard labor intensity -	pers.-h							**13111**
		Estimated salary -	Tenge				**474273**			
		Standard labor intensity -	pers.-h							**13111**
		SECTION 5. SLAB								
1	**E0106-50-2**	**Installation and of large-panel slab formwork**	**3437**	**799.97**	**235.22**	**2749496.89**	**808451.14**	**534290.2425**	**0.56**	**1924.72**
		m2		**74.25**	**73.8**	**255197.25**	**253650.6**	**105**	**0.15**	**515.55**
2	**E0106-1-15**	**Construction of Slab concrete**	**3055.7**	**6490.82**	**100.65**	**19833999**	**307556**	**591260**	**0.97**	**2964**
		м3		**146.25**	**38.03**	**446896**	**116208**	**105**	**0.19**	**581**
3	**E0106-62-1**	**Installation of reinforcement in small-panel formwork slabs**	**82.66**					**--**		
				2404.72	**385.72**	**198774**	**31884**		**11.58**	**957**
		т		**1683**	**104.40**	**--**	**8630**	**105**	**0.20**	**--**
4	**E0106-50-2**	**dismantling of large-panel slab formwork**	**3437**	**799.97**	**235**	**2749497**	**808451**	**534290**	**0.56**	**1925**
		m2		**74.25**	**73.80**	**255197**	**253651**	**105**	**0.15**	**516**
		TOTAL SECTION 5 DIRECT COSTS	**Tenge**			**25531767**	**1956342**	**1659840**		**7771**
			Tenge			**957291**	**632139**			**1612**
	The cost of installation work -		Tenge			**25531767**				
	Materials -		Tenge							
	Total salary -		Tenge				**1589430**			
	The cost of materials and structures -		Tenge							
		Overhead costs -	Tenge			**1659840**				
		Normative labor intensity in H.P. -	pers.-h							**469**
		Estimated wages in H.P. -	Tenge				**248976**			
		Irregular and unforeseen costs -	Tenge				**25631357**			
	TOTAL, the cost of installation work -		Tenge				**52822964**			
		Standard labor intensity -	pers.-h							**9851**
		Estimated salary -	Tenge				**881115**			
		TOTAL SECTION 5	Tenge				**52822964**			

Continuation of Appendix C

Continuation of Table C.1

Standard labor intensity -	pers.-h							**9851**
Estimated salary -	Tenge				**881115**			
Standard labor intensity -	pers.-h							**9851**
TOTAL DIRECT COSTS BY ESTIMATE:	**Тенге**			**59723731**	**5861637**	**6338769**		**31888**
	Tenge			**4257832**	**1785207**			**4381**
The cost of installation work -	Tenge			**59723731**				
Materials -	Tenge							
Total salary -	Tenge				**6043039**			
The cost of materials and structures -	Tenge							
Overhead costs -	Tenge			**6338769**				
Normative labor intensity in H.P. -	pers.-h							**1813**
Estimated wages in H.P. -	Tenge				**950815**			
Irregular and unforeseen costs -	Tenge				**60104057**			
TOTAL, the cost of installation work -	Tenge				**126166557**			
Standard labor intensity -	pers.-h							**38082**
Estimated salary -	Tenge				**2736023**			
Стоимость общестроительных работ -	Tenge							
Всего заработная плата -	Tenge							
Overhead costs -	Tenge							
Estimated wages in H.P. -	Tenge							
Irregular and unforeseen costs -	Tenge							
ВСЕГО, Стоимость общестроительных работ -	Tenge							
Estimated salary -	Tenge							
ИТОГО ПО СМЕТЕ:	Tenge				**126166557**			
Standard labor intensity -	pers.-h							**38082**
Estimated salary -	Tenge				**2736023**			
Recalculation of totals into prices for 1.05.2021 г.								
Total direct costs				**59723731**				

Continuation of Appendix C

Continuation of Table C.1

	Overheads Costs	**6338769**							
	Irregular and unforeseen costs	**6010405**							
	TOTAL in prices for1.01.2001 г.				**126166557**				
	Total with the cost of seniority	**1261666**	**127428222.74**						
	Total with the cost of additional leave	**504666**	**127932888.97**						
	Total in current prices for 1.05.2021	**4.4E+08**							
	Total with taxes, fees and obligations. Payments	**8750610**	**446281089.87**						
	Value added tax(НДС)	**12 %**	**53553730.78**						
	Total with value added tax (НДС)				**499834821**				

Made up ____________________ Ahmadzai Mina

Appendix D

Table D.1 - Estimate of Cost of Calculation

Estimated calculation of the cost of construction in the amount of 19r 7c	511313.4495	Thous.Tenge
including refundable amounts: 15r 7c	**711.958124**	Thous.Tenge
value added tax 18r7c	54783.58388	Thous.Tenge

ESTIMATE CALCULATION OF THE COST OF CONSTRUCTION

Compiled in prices for 01.1. 2001 y

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	
2	3	4	5	6	7
1	Administrative Building	126166.6	--	--	126166.6
	Total=1 row	126166.6	--	--	**126166.6**
	Temporary buildings and structures 1,1 percentage multiple to 2 row 7column	1387.8326	--	--	1387.8326
	Return of materials from temporary buildings and structures 15 percentage multiple to 3r7c	208.17489	--	--	208.17489
	Total=3 row	1387.8326	--	**--**	**1387.8326**
	Total 2r+5r	127554.4326	--	**--**	**127554.4326**
	Additional costs in the production of work in the winter1,2%*6r7c	1530.653191	--	**--**	1530.653191
	Seniority costs 1%*6r7c			1275.544326	1275.544326
	Additional vacation costs 0,4%*6r7c			510.2177304	510.2177304
	Total 7r+8r+9r	**1530.653191**		**1785.762056**	**3316.415248**
	Total 6r+10r	129085.0858		1785.762056	130870.8478
	Including refundable amounts=4r	208.17489		--	208.17489
	Total according to the estimated calculation in the base prices of 2001..=11r	129085.0858		1785.762056	130870.8478
	Total estimated at current prices in 2021. 13r*3,42	441470.9934		6107.306233	447578.2996
	Including refundable amounts in current prices 12r7c*3,42	711.9581238			711.9581238
	Taxes, fees, mandatory payments,2%*14r7c			8951.565993	8951.565993
	Estimated cost at current price level 14r+16r	441470.9934		15058.87223	456529.8656
	НДС (12%)*17r7c			54783.58388	54783.58388
	Construction cost17r+18r	441470.9934		69842.4561	511313.4495

Appendix E

Table E.1 – Object Estimation

OBJECT ESTIMATE

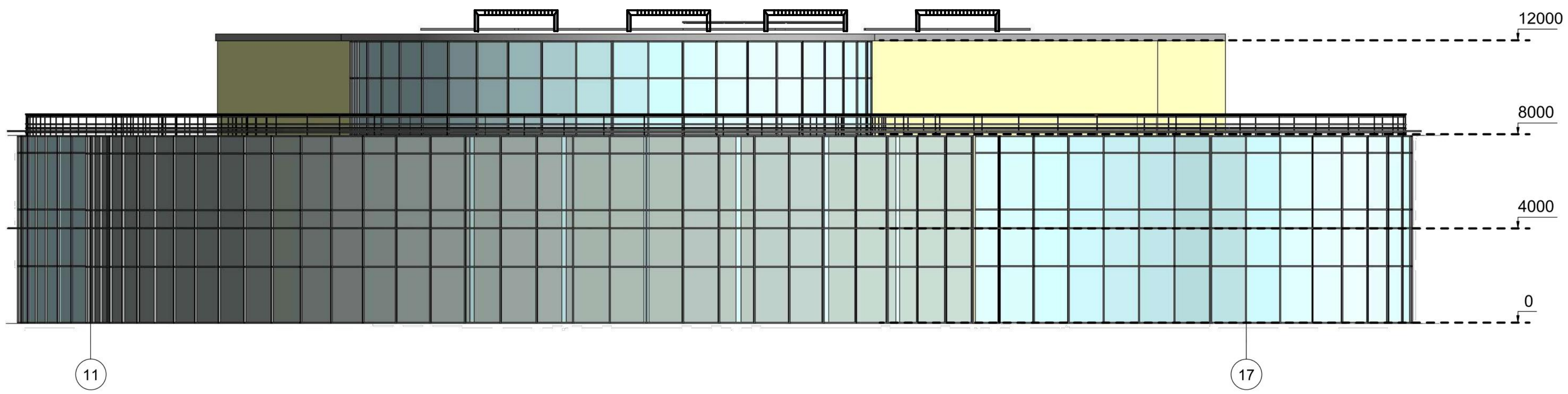
Multifunctional Administrative Building Using Solar Energy in Kyzlorda

Estimated Cost	126166.6	Thous.Tenge
Normative Labor Intensity	38.082	Thous.pers.h
Estimated Wages	2736.023	Thous.Tenge

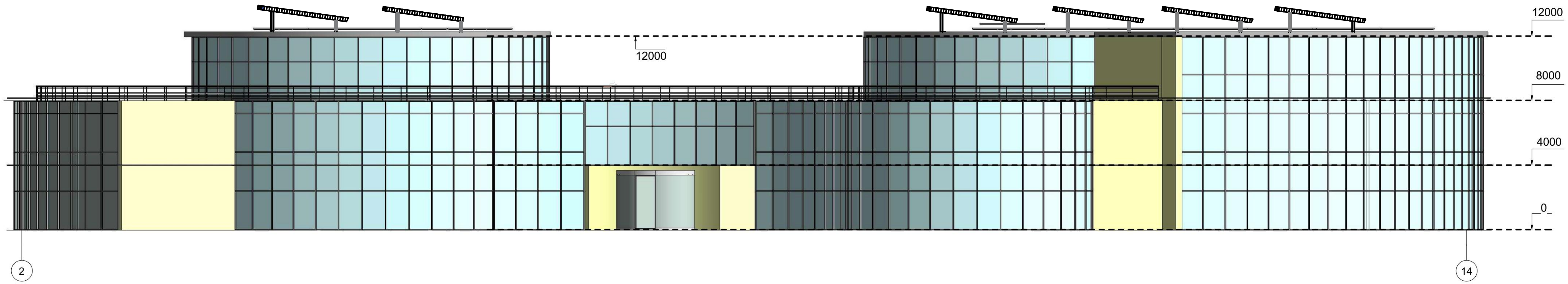
Compiled in prices for 01.1. 2001 y

№ 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	Administrative Building	126166.6	--	--	126166.6	38.082	2736.023
2		Total	126166.6	--	--	126166.6	38.082	2736.023
3		Temporary buildings and structures	1387.8326	--	--	1387.8326	38.082	2736.023
4		Return of materials from temporary buildings and structures	208.17489	--	--	208.17489	38.082	2736.023
5		Total	1387.8326	--	--	1387.8326	38.082	2736.023
6		Total	127554.4326	--	--	127554.4326	38.082	2736.023
7		Additional costs in the production of work in the winter	1530.653191	--	--	1530.653191	38.082	2736.023
8		Seniority costs			1275.544326	1275.544326	38.082	2736.023
9		Additional vacation costs			510.2177304	510.2177304	38.082	2736.023
10		Total	1530.653191		1785.762056	3316.415248	38.082	2736.023
11		Total	129085.0858		1785.762056	130870.8478	38.082	2736.023
12		Including refundable amounts	208.17489		--	208.17489	38.082	2736.023
13		Total according to the estimated calculation in the base prices of 2001.	129085.0858		1785.762056	130870.8478	38.082	2736.023
14		Total estimated at current prices in 2021.	441470.9934		6107.306233	447578.2996	38.082	2736.023
15		Including refundable amounts in current prices	711.9581238			711.9581238	38.082	2736.023
16		Taxes, fees, mandatory payments,			8951.565993	8951.565993	38.082	2736.023
17		Estimated cost at current price level	441470.9934		15058.87223	456529.8656	38.082	2736.023
18		НДС (12%)			54783.58388	54783.58388	38.082	2736.023
19		Construction cost	441470.9934		69842.4561	511313.4495	38.082	2736.023

Side Elevation 1:100

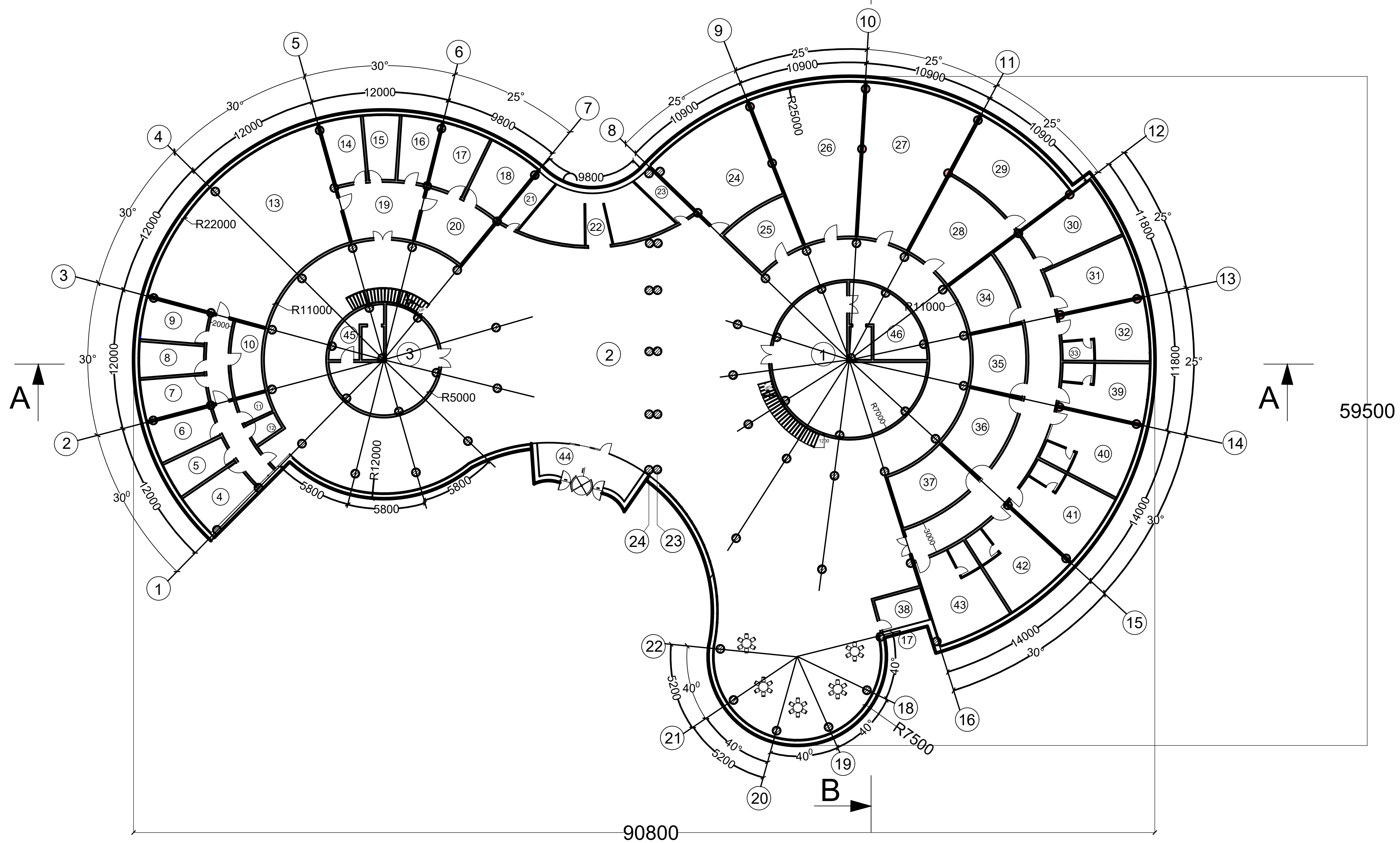


Front Elevation 1:100



					KazNITU-5B072900-Civil Engeneering-03.08.03-2021-DP
cha	Num.par.list	№ doc	sign	Date	Multifunctional Administrative Complex Using Solar Energy in Kyzylorda
H. Department		Kozyukova.N.V			Architecture and Analytical Part
Supervisor		Kozyukova.N.V			stage: DP; List: 1; Lists: 11
Consultant		Kozyukova.N.V			
N. Controller		Bek.A.A			Side and Front Elevation
Created by		Ahmadzai Mina			Civil Engineering and Building Material Department

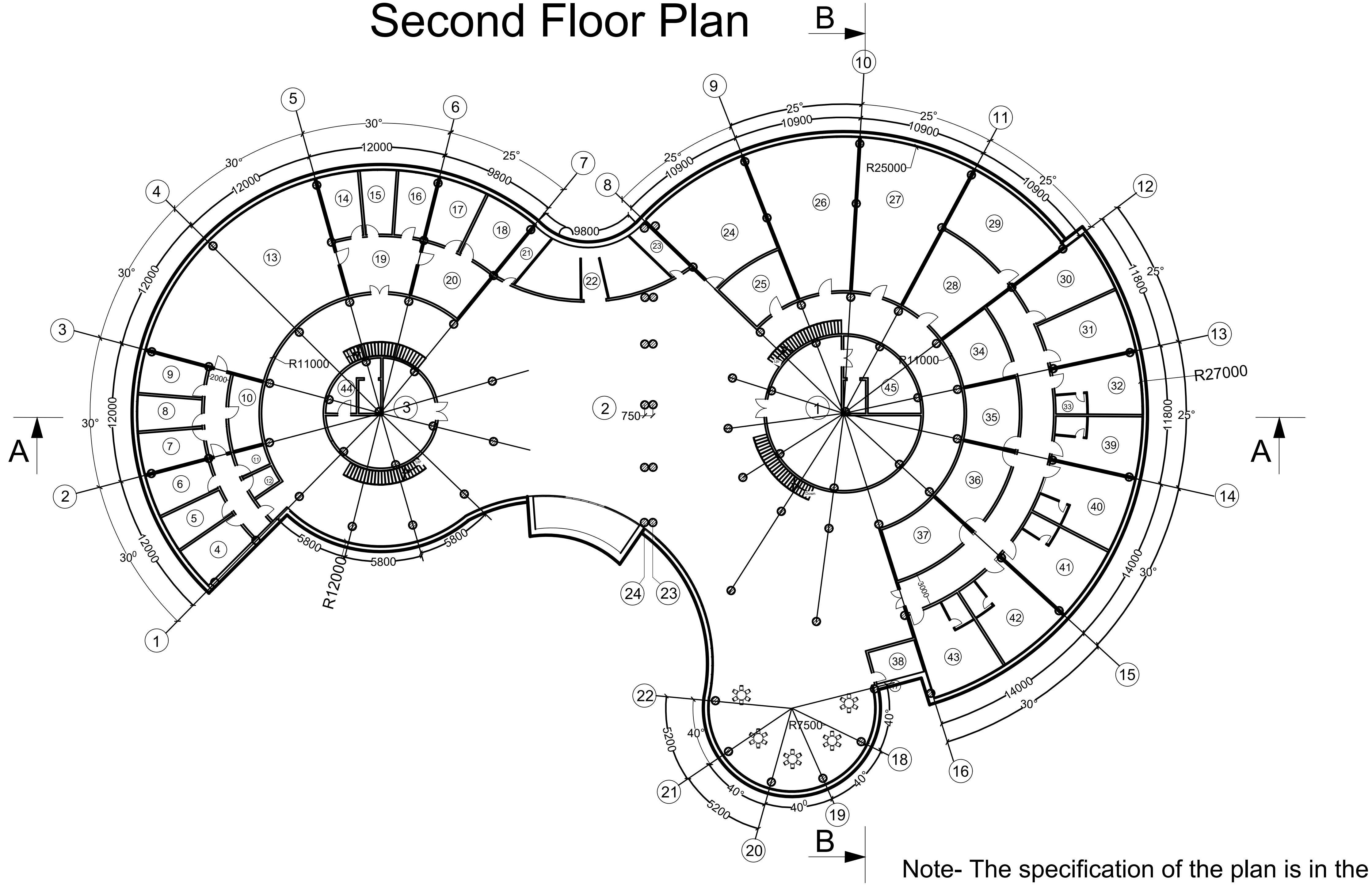
First Floor Plan



Note- The specification of the plan is in the Appendix A, Table A.1.

					KazNITU-5B072900-Civil Engeneering-03.08.03-2021-DP			
					Multifunctional Administrative Complex Using Solar Energy in Kyzylorda			
cha	Num.par.list	№ doc	sign	Date				
H. Department		Kozyukova.N.V			Architecture and Analytical Part	stage	List	Lists
Supervisor		Kozyukova.N.V				DP	2	11
Consultant		Kozyukova.N.V						
N. Controller		Bek.A.A			First Floor Plan	Civil Engineering and Building Material Department		
Created by		Ahmadzai Mina						

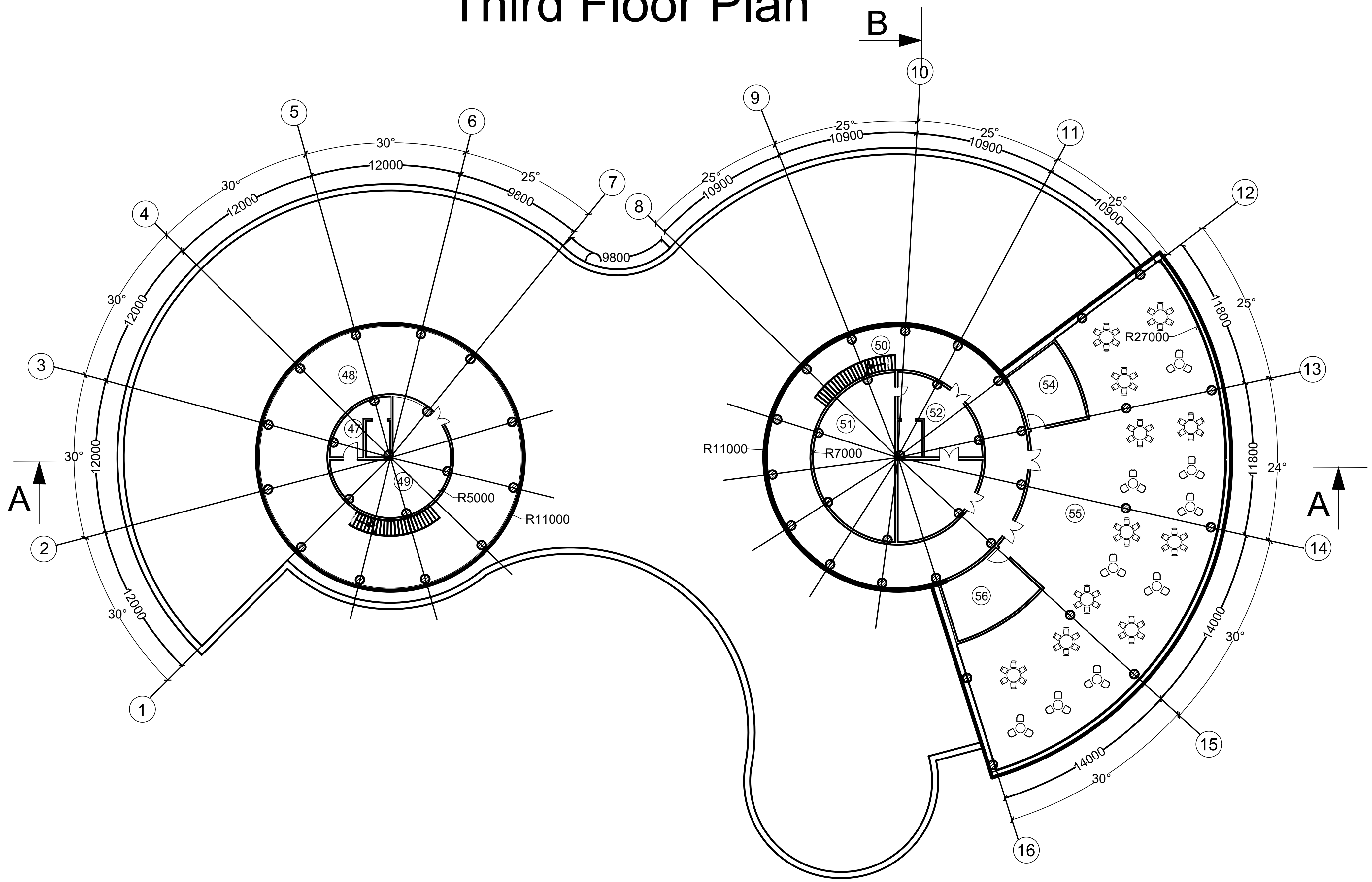
Second Floor Plan



Note- The specification of the plan is in the Appendix A, Table A . 2.

					KazNITU-5B072900-Civil Engeneering-03.08.03-2021-DP			
					Multifunctional Administrative Complex Using Solar Energy in Kyzylorda			
cha	Num.par.list	№ doc	sign	Date				
H. Department		Kozyukova.N.V			Architecture and Analytical Part	stage	List	Lists
Supervisor		Kozyukova.N.V				DP	3	11
Consultant		Kozyukova.N.V						
N. Controller		Bek.A.A			Second Floor Plan	Civil Engineering and Building Material Department		
Created by		Ahmadzai Mina						

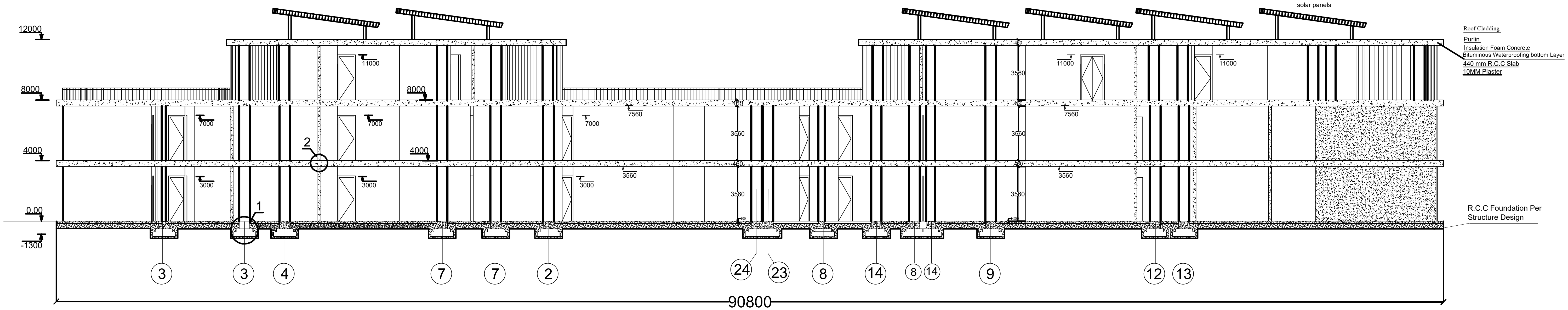
Third Floor Plan



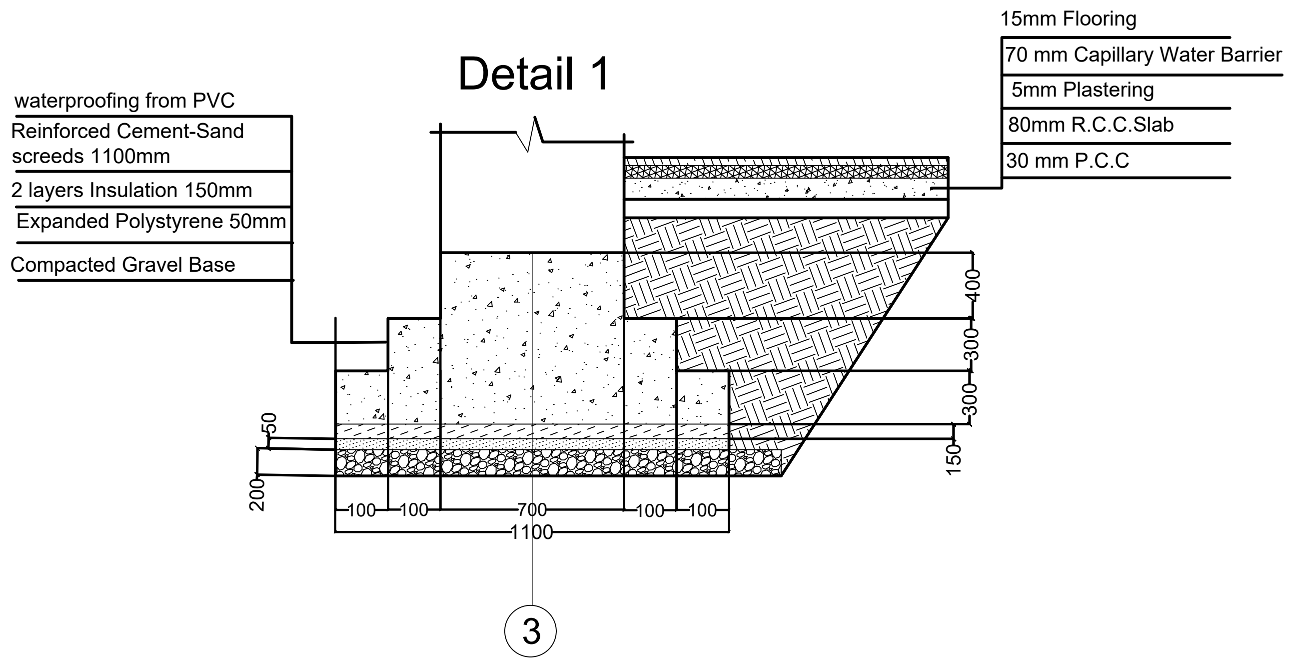
Note- The specification of the plan is in the Appendix A, Table A.3.

					KazNITU-5B072900-Civil Engeneering-03.08.03-2021-DP
cha	Num.par.list	№ doc	sign	Date	Multifunctional Administrative Complex Using Solar Energy in Kyzylorda
H. Department		Kozyukova.N.V			Architecture and Analytical Part
Supervisor		Kozyukova.N.V			stage: DP; List: 4; Lists: 11
Consultant		Kozyukova.N.V			
N. Controller		Bek.A.A			Third Floor Plan
Created by		Ahmadzai Mina			Civil Engineering and Building Material Department

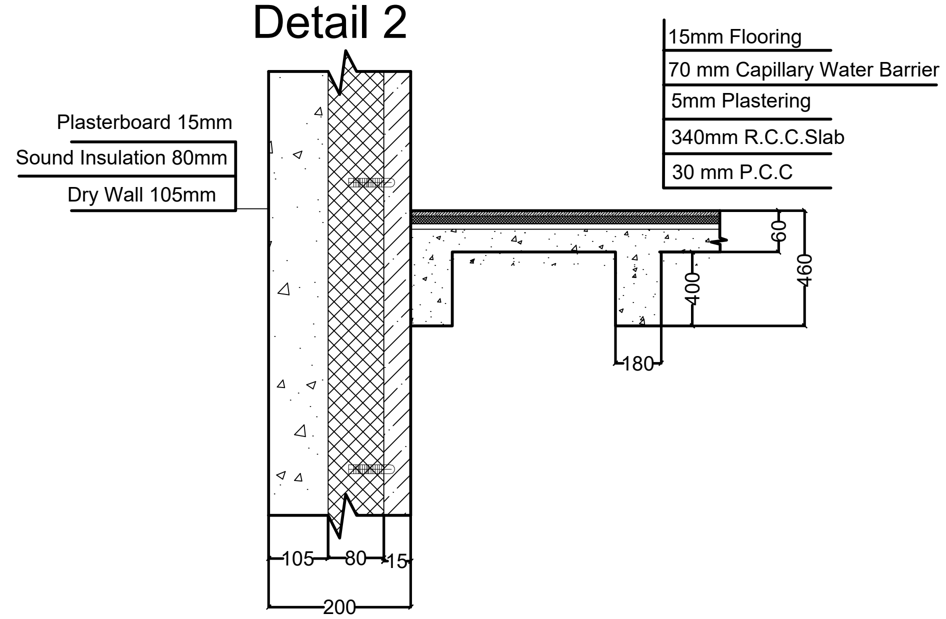
Section A-A



Detail 1

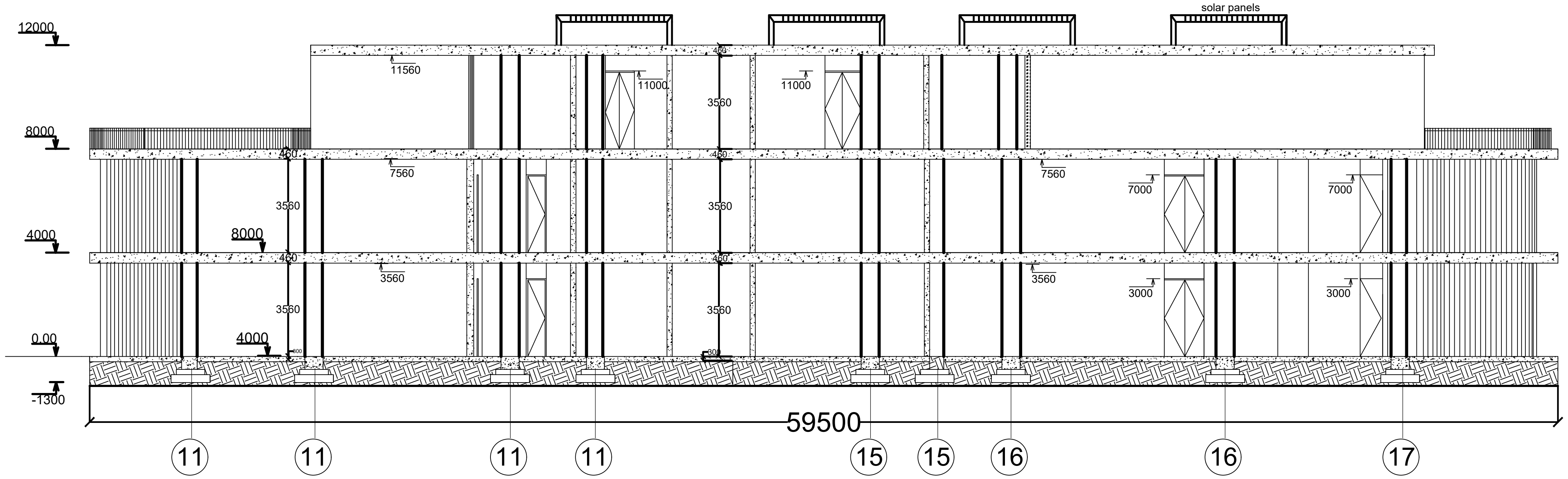


Detail 2

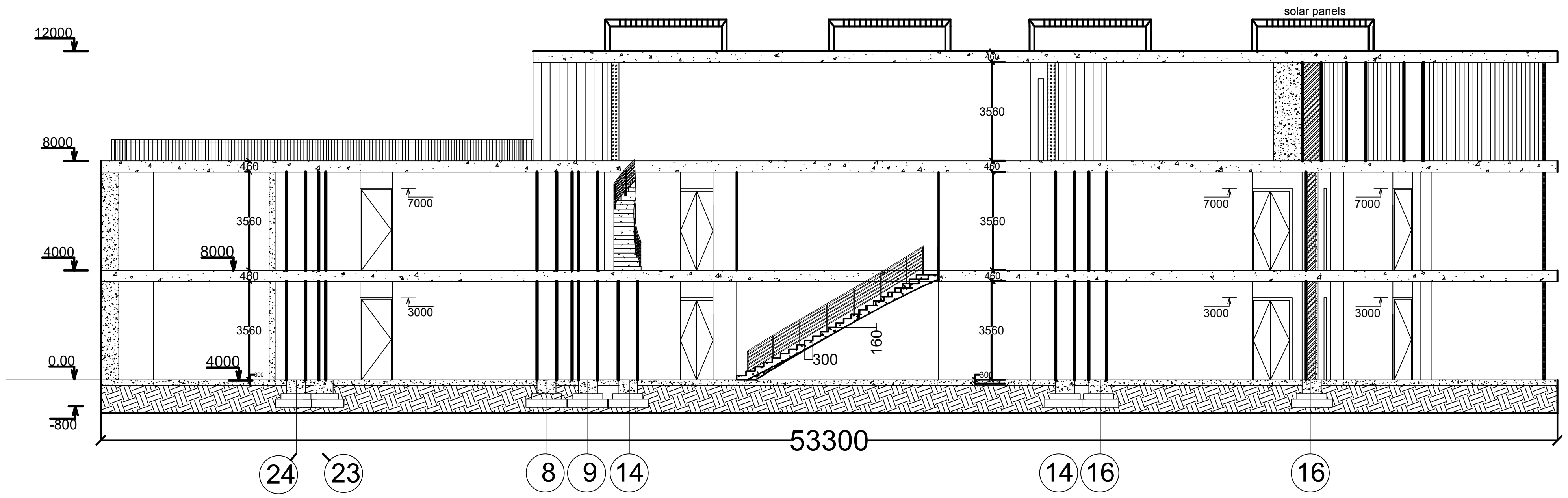


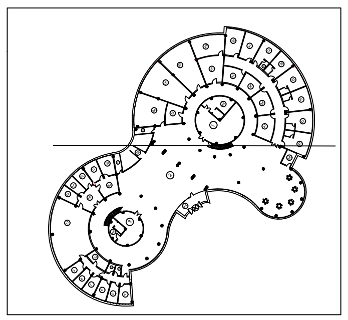
					KazNITU-5B072900-Civil Engeneering-03.08.03-2021-DP
					Multifunctional Administrative Complex Using Solar Energy in Kyzylorda
cha	Num.par.list	№ doc	sign	Date	
H. Department		Kozyukova.N.V			Architecture and Analytical Part — stage: DP; List: 5; Lists: 11
Supervisor		Kozyukova.N.V			
Consultant		Kozyukova.N.V			
N. Controller		Bek.A.A			Section of Building — Civil Engineering and Building Material Department
Created by		Ahmadzai Mina			

Section B-B



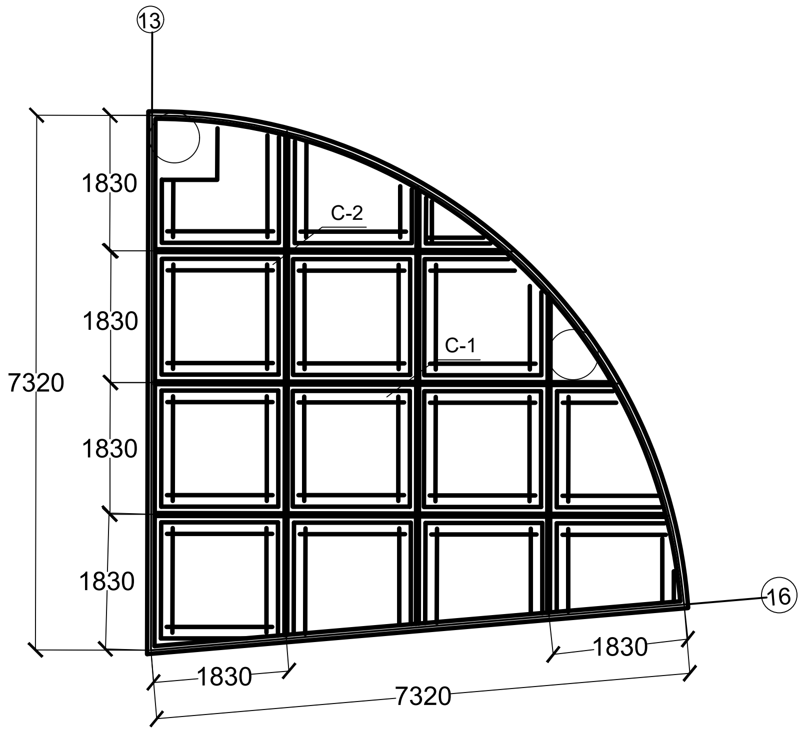
Section C-C



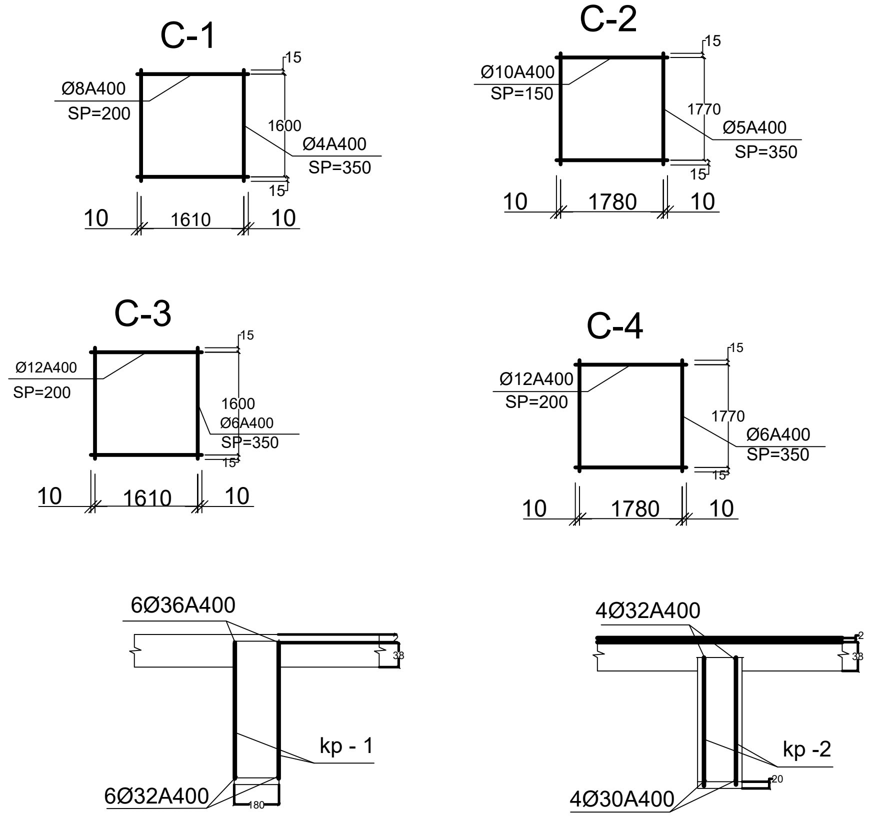


					KazNITU-5B072900-Civil Engeneering-03.08.03-2021-DP
cha	Num.par.list	№ doc	sign	Date	Multifunctional Administrative Complex Using Solar Energy in Kyzylorda
H. Department	Kozyukova.N.V				Architecture and Analytical Part
Supervisor	Kozyukova.N.V				stage: DP; List: 6; Lists: 11
Consultant	Kozyukova.N.V				
N. Controller	Bek.A.A				Section of Building
Created by	Ahmadzai Mina				Civil Engineering and Building Material Department

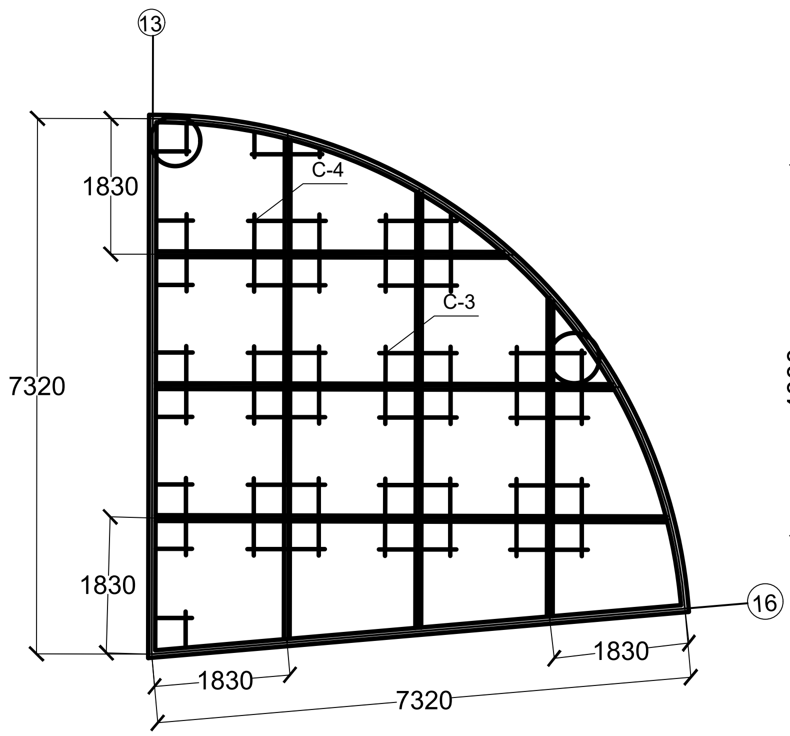
Lower Reinforcement of Coffered Slab



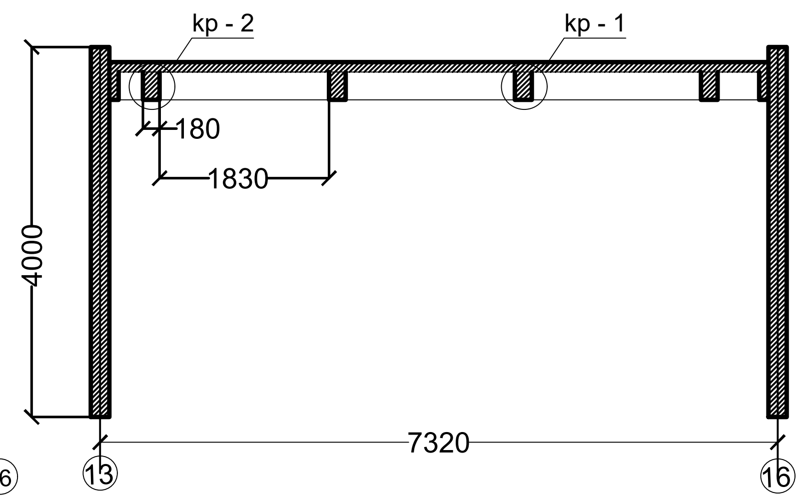
Reinforcement Detail of Coffered Slab



Upper Reinforcement of Coffered Slab



Section view of Coffered Slab

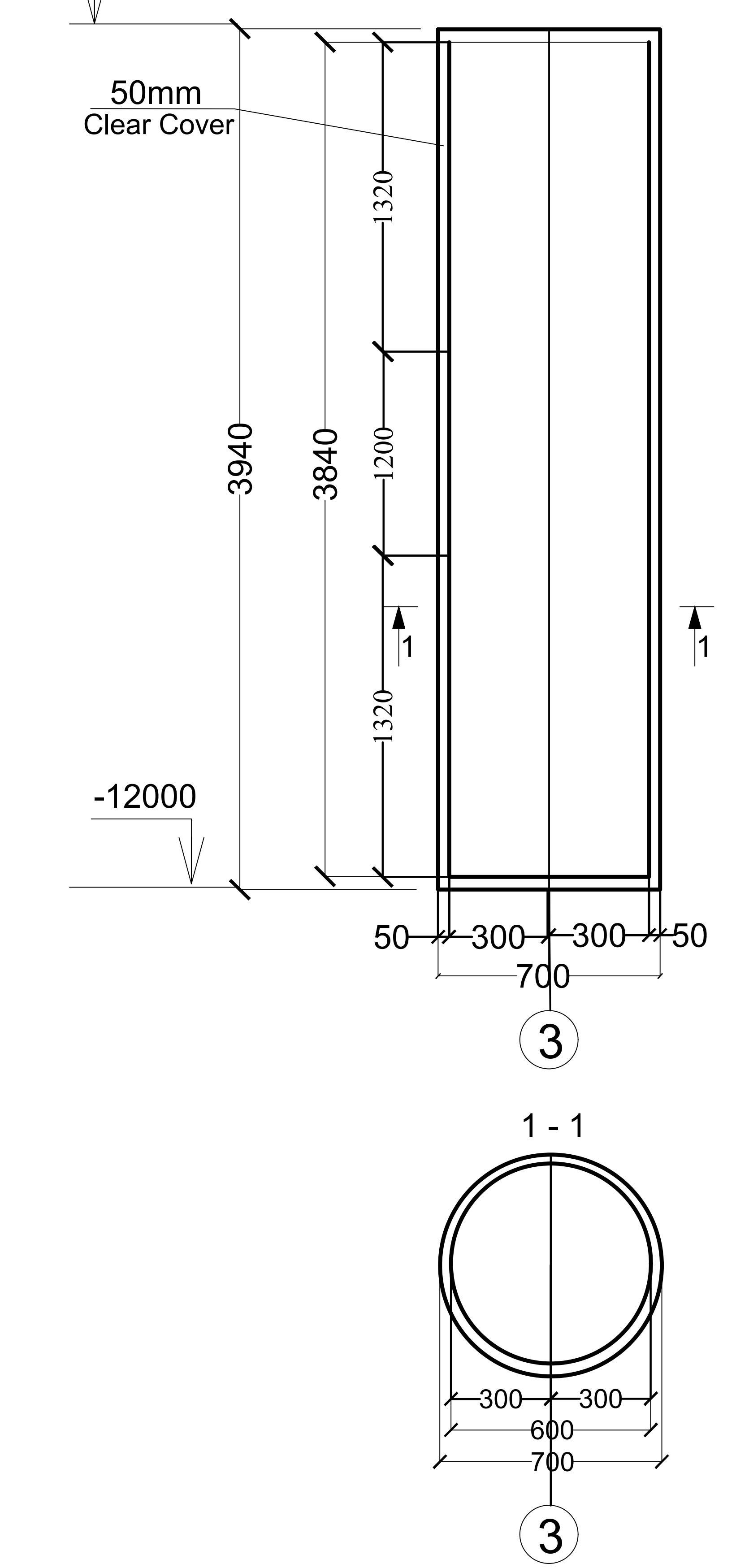


Specification of Reinforcement

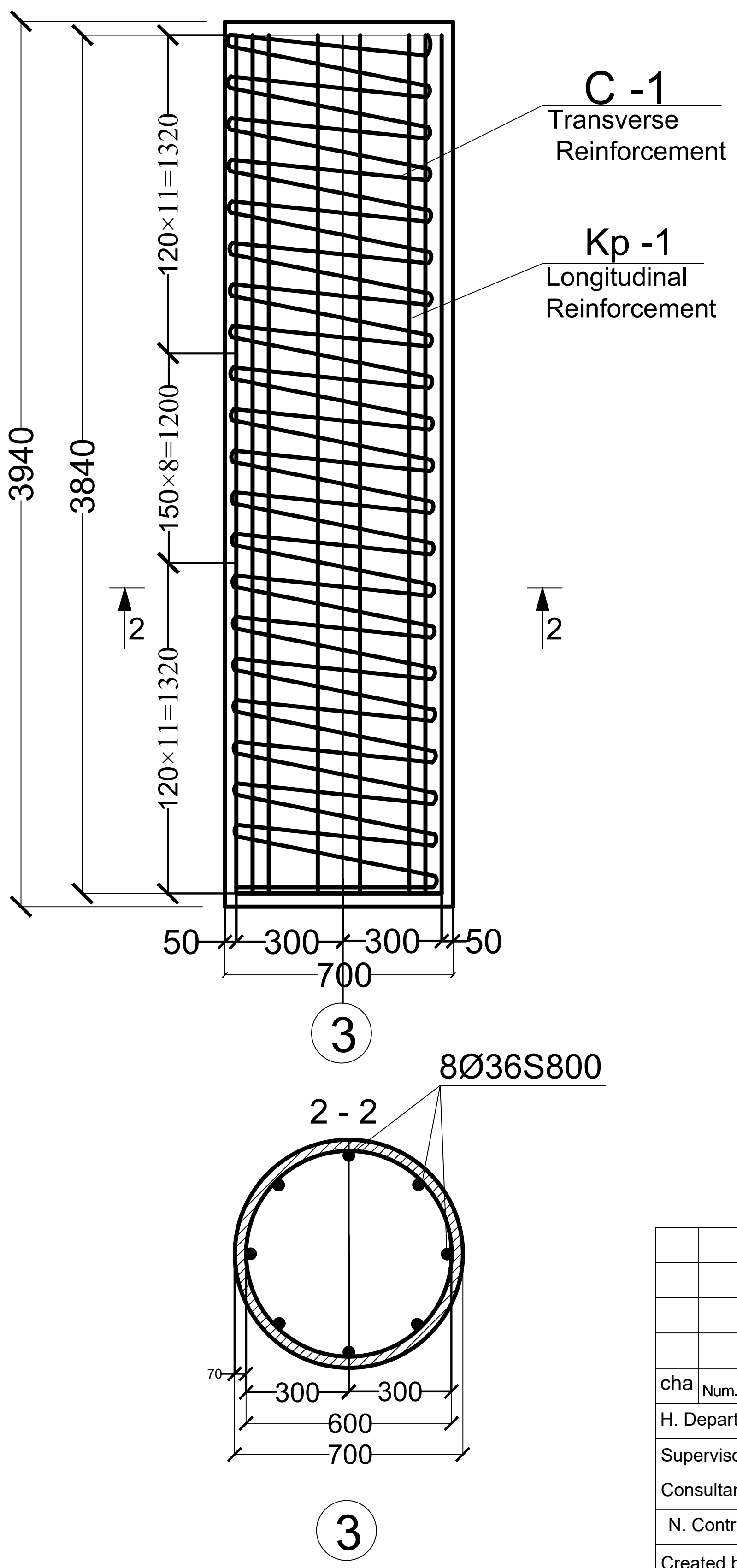
Mark	Designation	Name	Number	Mass 1 Kg.	Mass Total,Kg
Kp-1	SN RK 591-2014	6Ø36A400 L=3660	6	7.515	27.5
	SN RK 591-2014	6Ø32A400 L=3660	6	6.313	23.1
	SN RK 591-2014	Ø10Bp-I L=150	15	0,1	0.015
Kp-2	SN RK 591-2014	4Ø32A400 L=3660	4	6.313	23.1
	SN RK 591-2014	4Ø30A400 L=3660	4	4.32	15.8
	SN RK 591-2014	Ø10Bp-I L=150	15	0.1	0.015
C-1	SN RK 591-2014	Ø8A400 L=1630	8	0.395	0.643
	SN RK 591-2014	Ø4A400 L=1630	6	0.09	0,146
C-2	SN RK 591-2014	Ø10A400 L=1800	13	0.617	1.11
	SN RK 591-2014	Ø5A400 L=1800	7	0,154	0.277
C-3	SN RK 591-2014	Ø12A400 L=1630	8	0,888	1.447
	SN RK 591-2014	Ø6A400 L=1630	6	0.222	0.361
C-4	SN RK 591-2014	Ø12A400 L=1800	10	0,888	1.6
	SN RK 591-2014	Ø6A400 L=1800	7	0.222	0.4

cha	Num.par.list	№ doc	sign	Date	KazNITU-5B072900-Civil Engeneering-03.08.03-2021-DP			
					Multifunctional Administrative Complex Using Solar Energy in Kyzylorda			
H. Department	Kozyukova.N.V				Calculation and Design Part	stage	List	Lists
Supervisor	Kozyukova.N.V					DP	7	11
Consultant	Kozyukova.N.V							
N. Controller	Bek.A.A				Coffered Slab Scheme	Civil Engineering and Building Material Department		
Created by	Ahmadzai Mina							

General view of Column



Constructive Scheme of Column



Specification of Reinforcement

Mark	Designation	Name	Number	Mass 1 Kg/m	Mass Total,Kg
Kp-1	SN RK 591-2014	8Ø36S800 L=3840	8	7.515	28.8
C-1	SN RK 591-2014	Ø10 A-1 L=22930	1	0.617	14

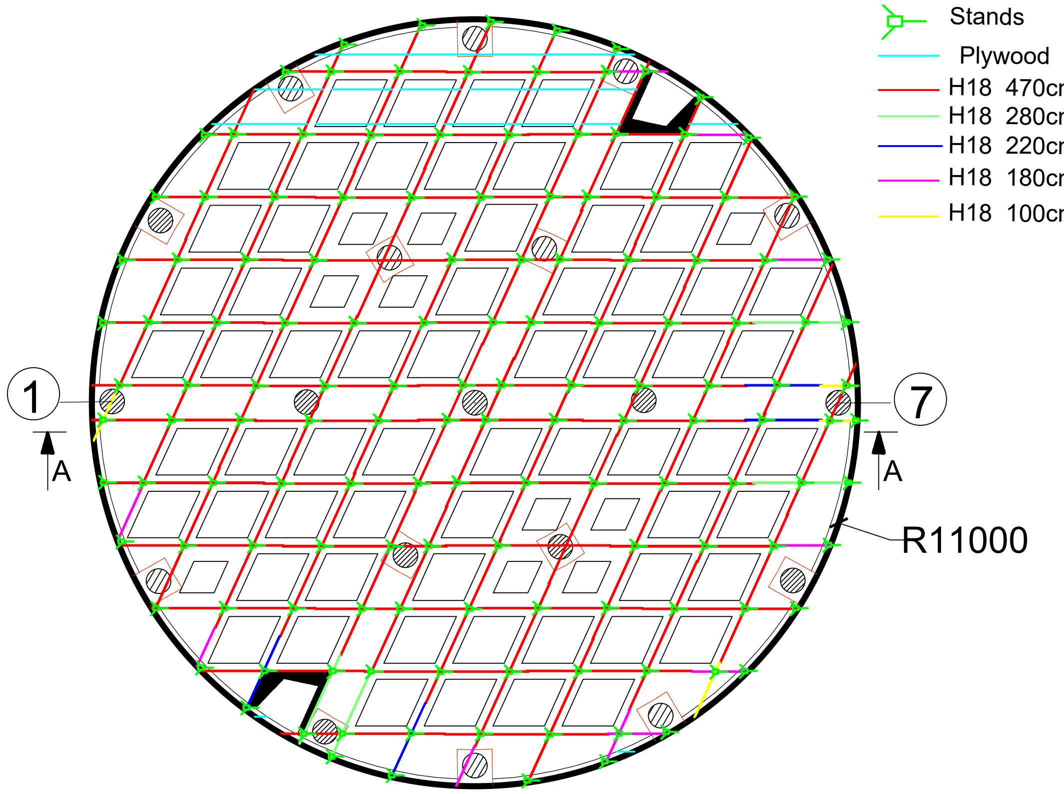
Steel Consumption

Mark	Ware Reinforcement		
	class of Reinforcement		
	S800	A -1	All
	SN RK		
	Ø36	Ø10	
	28.8	14	42.8

cha	Num.par.list	№ doc	sign	Date	KazNITU-5B072900-Civil Engeneering-03.08.03-2021-DP
					Multifunctional Administrative Complex Using Solar Energy in Kyzylorda
H. Department		Kozyukova.N.V			Calculation and Design Part — stage: DP; List: 8; Lists: 11
Supervisor		Kozyukova.N.V			
Consultant		Kozyukova.N.V			
N. Controller		Bek.A.A			Column Scheme and Detail — Civil Engineering and Building Material Department
Created by		Ahmadzai Mina			

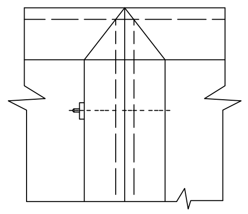
Technological Map for Formwork work M 1:200

Scheme of Third Floor Slab Formwork Racks and Caissons



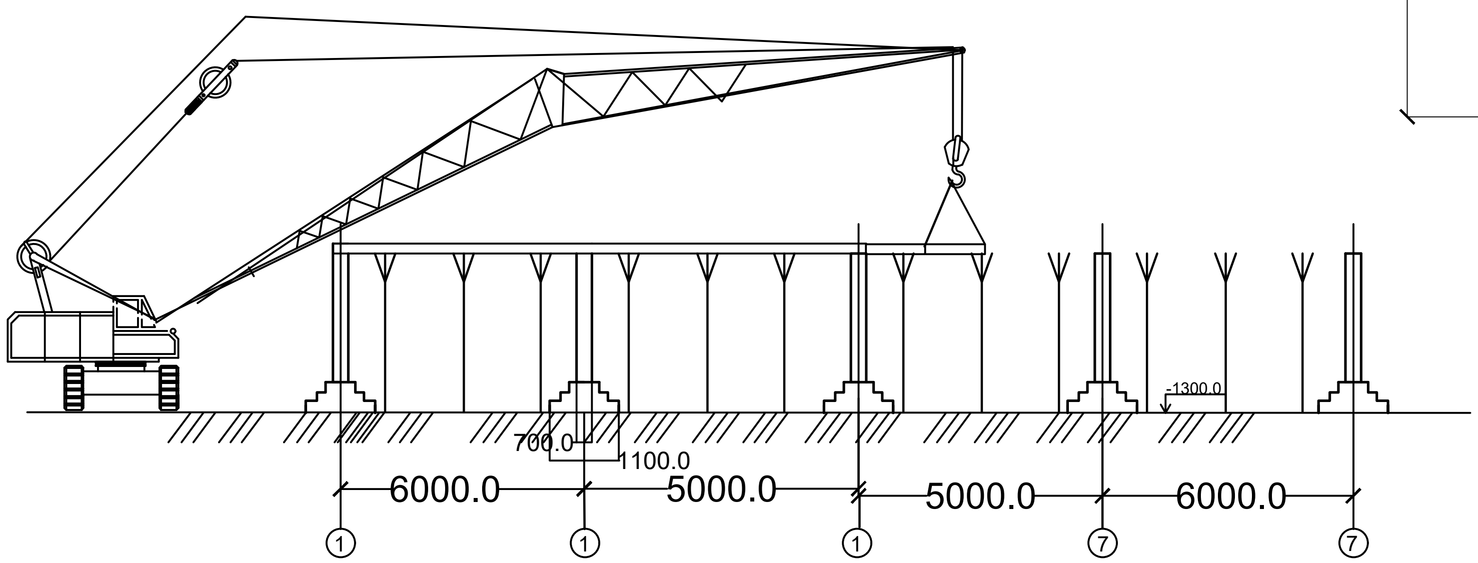
Stands
Plywood 24mm 250×100cm
H18 470cm 84
H18 280cm 3
H18 220cm 4
H18 180cm 9
H18 100cm 4

Connection of two shields to each other



Scheme of Jib crane,when mounting formwork elements

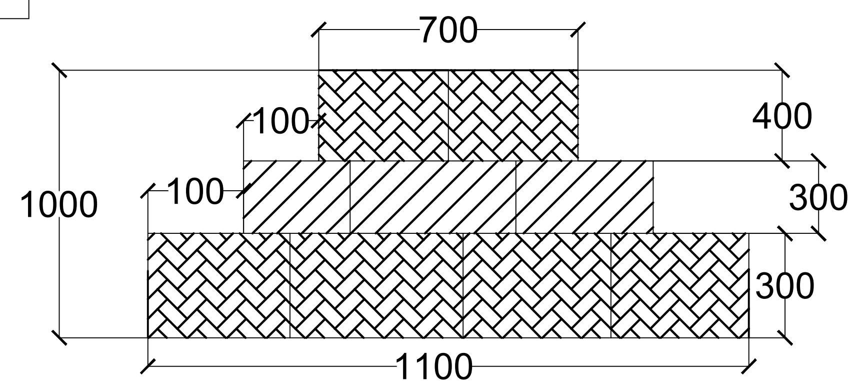
A- A

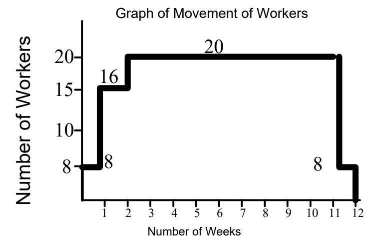


Planned Schedule of Formwork Works

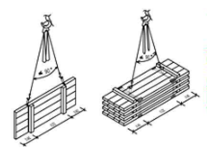
Name of Processes	Work Volume: Unite of Measures	Work Volume: Volume	Labor Cost, h- D	The Required Cars: Required Car	The Required Cars: Number. shift	Duration of Days, (P)	N. of Changes (A)	Number of workers in a Change, n	Duration of Time, h	Months (I January, II February, III March) — Number of Week 1–12
1	2	3	4	5	6	7	8	9	10	
Formwork works of Building										
Installation of Footing Formwork	m^3	39.039	5	2	1	1	1	8	6	8
Footing Formwork Removal	m^3	39.039	5	1	1	1	1	8	6	8
Formwork Installation of First Floor Column	$1m^2$	800.1	39.1	2	2	3	2	8	6	16
First Floor Column Formwork Removal	$1m^2$	800.1	39.1	1	1	5	1	8	6	16
First Floor Formwork Installation of Slab	$1m^2$	3437	461	2	2	24	2	10	6	20
First Floor Slab Formwork Removal	$1m^2$	3437	377	1	2	19	2	10	6	20
Formwork Installation of First Floor Walls	$1m^3$	228.72	13	2	1	2	1	10	6	20
First Floor Wall Formwork Removal	$1m^3$	228.72	7	1	1	2	1	8	6	8

Scheme of formwork panels for Footing





Slinging Scheme



cha	Num.par.list	№ doc	sign	Date
H. Department	Kozyukova.N.V			
Supervisor	Kozyukova.N.V			
Consultant	Kozyukova.N.V			
N. Controller	Bek.A.A			
Created by	Ahmadzai Mina			

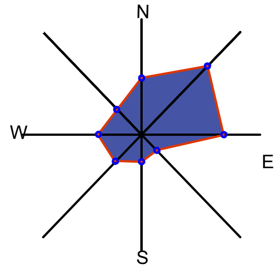
KazNITU-5B072900-Civil Engeneering-03.08.03-2021-DP

Multifunctional Administrative Complex Using Solar Energy in Kyzylorda

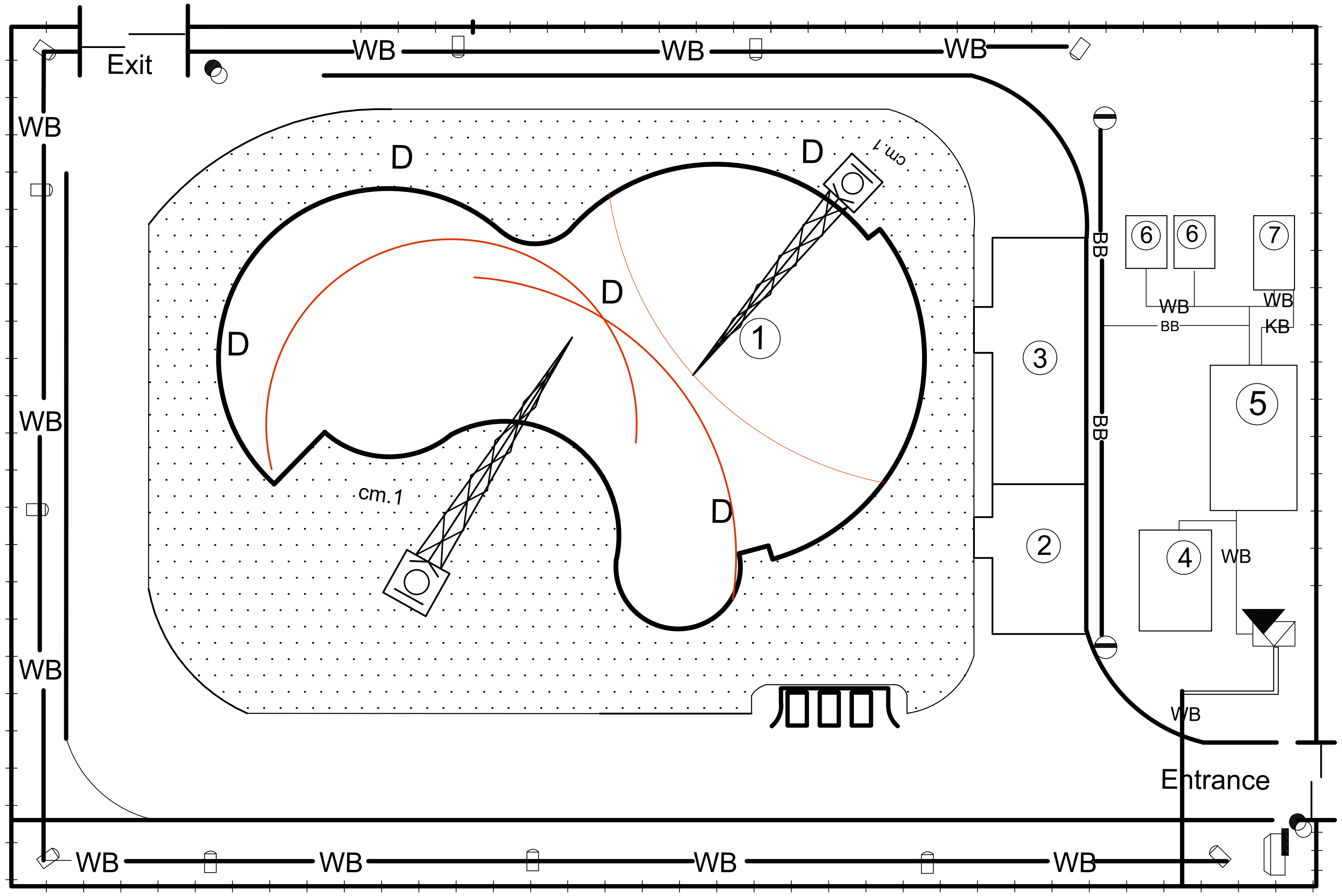
	stage	List	Lists
Technological Part	DP	9	11

Technological Map for Formwork

Civil Engineering and Building Material Department



General Master Plan M 1:200



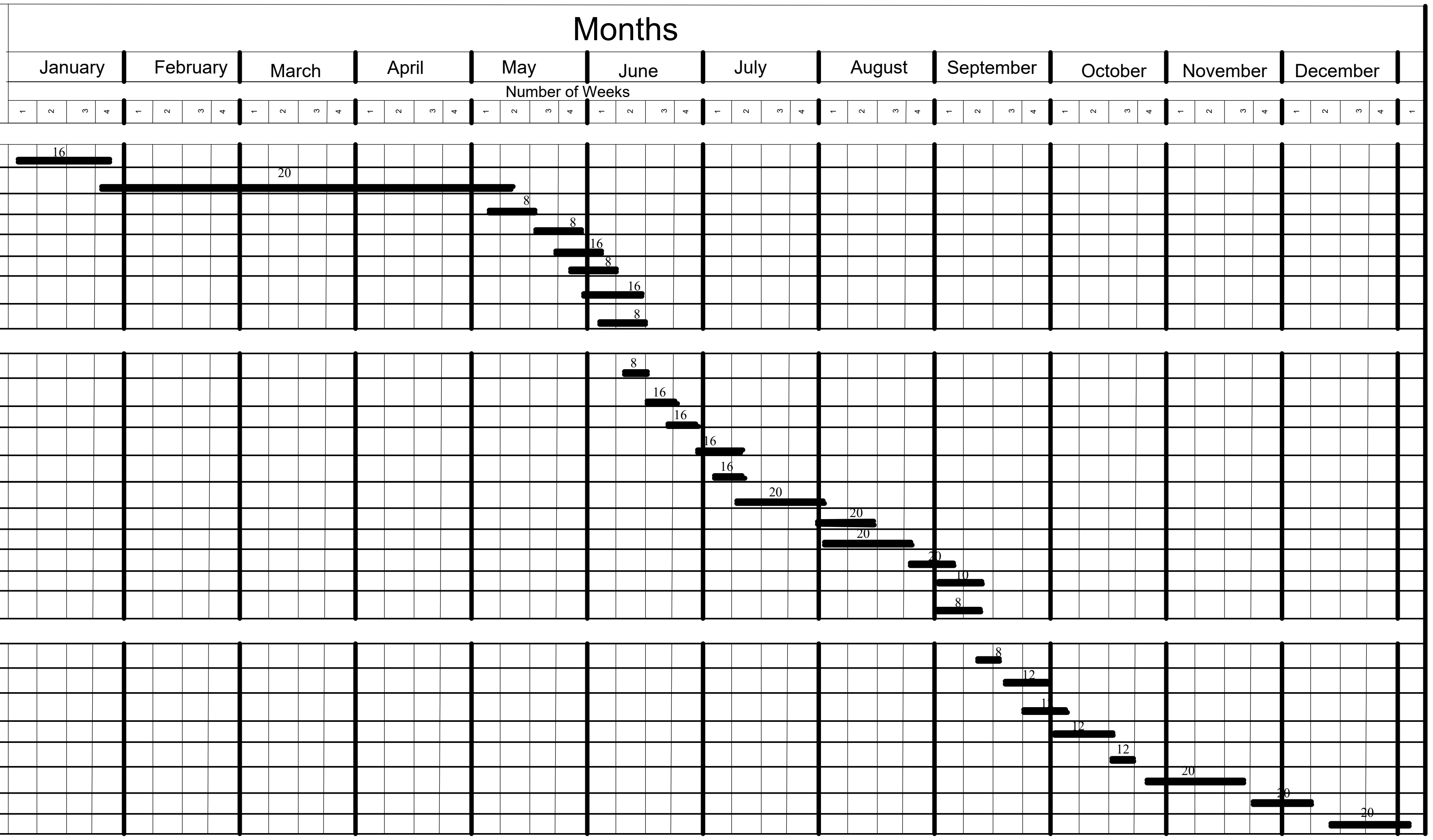
Legend

sign	Name	Area	Quantity
1	Building Under Construction	3437	
2	Open storage area and Sheds	150m^2	2
3	Closed Warehouses	150m^2	1
4	office and control room	22.5m^2	1
5	Food reception room and rest	49m^2	1
6	Rest room for workers	2.73m^2	2
7	Toilet and shower room	12m^2	1
	Temporary Fencing		
WB	Temporary Power Lines		
BB	Temporary Water Supply		
KB	Temporary canalization		
	Searchlight		12
	Fire hydrant		2
	Transformer substation station		1
cm.1	Crane stopping		
	Shield with fire extinguishing means		1
	Barrel With Water		1
D	Dangerous area of possible falling cargo		
	places for receiving concrete mix and mortar		

					KazNITU-5B072900-Civil Engeneering-03.08.03-2021-DP
					Multifunctional Administrative Complex Using Solar Energy in Kyzylorda
cha	Num.par.list	№ doc	sign	Date	
H. Department		Kozyukova.N.V			Organizational Part — stage: DP; List: 10; Lists: 11
Supervisor		Kozyukova.N.V			
Consultant		Kozyukova.N.V			
N. Controller		Bek.A.A			General Master Plan — Civil Engineering and Building Material Department
Created by		Ahmadzai Mina			

Planned Schedule of Work

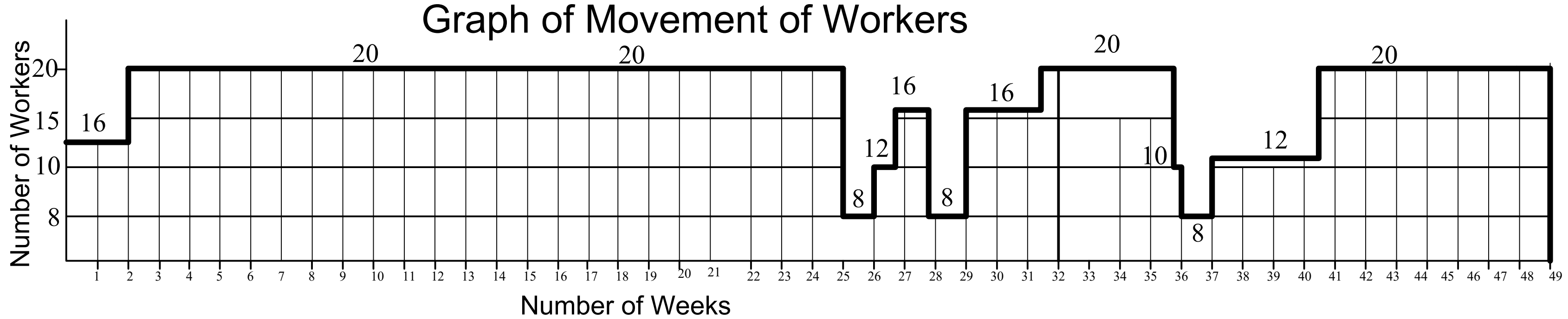
Name of Processes	work volume: unit of measurement	work volume: Volume	Labor Cost, h- D	The Required Cars: Required Car	The Required Cars: Number. shift	Duration of Days, (P)	N. of Changes (A)	Number of workers in a Change, n	Duration of Time, h
Underground Part of Building									
Removal of top Soil	$1000m^2$	7005.6	478.4	2	2	24	2	10	6
Soil Excavation in the Trench access	$100m^2$	7106	2426	3	2	155	2	10	6
Backfilling	$1m^3$	3481.2	8	2	1	2	1	8	6
Soil Compaction	$1m^2$	8703	8	3	1	2	1	8	6
Reinforcement Installation of Footing	1t	5.725	15.86	2	2	2	2	8	6
Installation of Footing Formwork	$1m^3$	39.039	8	2	1	1	1	8	6
Concreting of Footing	$1m^3$	143.14	21	4	2	3	2	8	6
Footing Formwork Removal	$1m^3$	39.039	8	1	1	1	1	8	6
First and Second Floor Of Building									
Reinforcement Installation of First Floor Column	t	11.19	10	2	1	2	1	8	6
Formwork Installation of First Floor Column	$1m^2$	800.1	39.1	2	2	3	2	8	6
Volume of Concrete For First Floor Column	$1m^3$	139.95	26	3	2	2	2	8	6
First Floor Column Formwork Removal	$1m^2$	800.1	39.1	1	1	5	1	8	6
Reinforcement Installation of First Floor Slab	t	82.7	24.5	2	2	3	2	8	6
First Floor Formwork Installation of Slab	$1m^2$	3437	461	2	2	24	2	10	6
Volume of Concrete For First Floor Slab	$1m^3$	1271.7	232.6	3	2	12	2	10	6
First Floor Slab Formwork Removal	$1m^2$	3437	377	1	2	19	2	10	6
Formwork Installation of First Floor Walls	$1m^3$	228.72	13	2	1	2	1	10	6
Volume of Concrete For First Floor Walls	$1m^3$	121.36	12	3	2	2	2	5	6
First Floor Wall Formwork Removal	$1m^3$	228.72	7	1	1	2	1	8	6
Third Floor Of Building									
Reinforcement Installation of Third Floor Column	t	6.275	2	2	1	1	1	5	6
Formwork Installation of Third Floor Column	$1m^2$	448.4	22	2	2	2	2	6	6
Volume of Concrete For Third Floor Column	$1m^3$	78.43	14.5	3	2	2	2	6	6
Third Floor Column Formwork Removal	$1m^2$	448.4	22	1	1	4	1	6	6
Reinforcement Installation of Third Floor Slab	t	32.28	10	2	1	1	1	6	6
Formwork Installation of Third Floor Slab	$1m^2$	1383.7	182.61	2	2	10	2	10	6
Volume of Concrete For Third Floor Slab	$1m^3$	512	94	3	2	5	2	10	6
Third Floor Slab Formwork Removal	$1m^2$	13837	152	1	2	8	2	10	6



$$Ku = n_{max}/n_{av} = 20 / 15.22 = 1.31 \leq 1.5$$

$$n_{av} = \sum Q / P_{total} = 5710.91 / 375 = 15.22$$

Graph of Movement of Workers



Technical and Economical Indicators

N	Name	Unite	Quantity
1	Construction Volume	m^3	41244
2	Area of Building	m^2	3437
3	Normative Labor Intensity	h- pers	38082
4	Estimated Wages	Thous.tg	2736
5	Standard Construction Period	mon	24
6	Actually the Construction Period	mon	12.2

cha	Num.par.list	№ doc	sign	Date	KazNITU-5B072900-Civil Engeneering-03.08.03-2021-DP			
H. Department		Kozyukova.N.V			Multifunctional Administrative Complex Using Solar Energy in Kyzylorda			
Supervisor		Kozyukova.N.V			Technological Part	stage	List	Lists
Consultant		Kozyukova.N.V				DP	11	11
N. Controller		Bek.A.A			Planned Schedule of work	Civil Engineering and Building Material Department		
Created by		Ahmadzai Mina						

МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ РЕСПУБЛИКИ КАЗАХСТАН
СӘТБАЕВ УНИВЕРСИТЕТІ

RESPONSE

OF THE SUPERVISOR
for the graduation project

Ahmadzai Mina
5B072900-Civil Engineering

Topic: “Multifunctional administrative complex using solar energy in Kyzylorda”

The following tasks were solved in the work: a space-planning decision was made, the thermotechnical calculation of the enclosing structures was performed, the calculation and design of building structures, technological maps, a construction plan were developed, and the cost of construction was also calculated.

The student successfully completed all the tasks. Ahmadzai Mina conducted an initial study of the assignment at a high level, competently conducted analysis of data from literary sources, applied many years of experiencein designing this type of building, based on various design guidelines in the design and construction and technological sections. According to the calculations, the cost of construction was calculated. The design assignment was completed in full and on time.

In the process, the student showed responsibility, creative and analytical thinking, independence and showed excellent knowledge on completed professional disciplines during the educational process.

The project was carried out at a good level and the work fully meets the requirements for graduation projects of the "bachelor" level, the student is allowed to defend.

Supervisor
Master of technical science, lecturer

____________________Kozyukova N.V.

«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: Ахмадзай Мина

Название: Multifunctional administrative complex using solar energy in Kyzylorda

Координатор:Надежда Козюкова

Коэффициент подобия 1:1.9

Коэффициент подобия 2:1.2

Замена букв:39

Интервалы:0

Микропробелы:0

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:

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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: Ахмадзай Мина

Название: Multifunctional administrative complex using solar energy in Kyzylorda

Координатор: Надежда Козюкова

Коэффициент подобия 1:1.9

Коэффициент подобия 2:1.2

Замена букв:39

Интервалы:0

Микропробелы:0

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*