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

Hejratullah Hedayat

« Residential complex with energy-efficient, low cost and environmentally friendly technologies in Taraz »

To the diploma project
EXPLANATORY NOTE

Specialty 5B072900 – Civil Engineering

Almaty 2021

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ALLOWED TO PROTECT
Head of Department
Master of technical science,
lecturer
_________N.V. Kozyukova
«__»______2021 yr.

EXPLANATORY NOTE
to the diploma project

On the theme of « Residential complex with energy-efficient, low cost and environmentally friendly technologies in Taraz »

5B072900 - "Civil Engeneering"

Prepared by Hejratullah Hedayat

Scientific adviser S.Kh. Dostanova
Doctor of technical science,
Associate professor
«_____»___2021 yr.

Almaty 2021

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Specialty 5B072900 – Civil Engineering

I APPROVE
Head of Department
________N.V. Kozyukova
Master of technical science, lecturer
«___»_______20__ yr.

ASSIGNMENT
Complete a diploma project

Student: Hejratullah Hedayat
Topic: « Residential complex with energy-efficient, low cost and environmentally friendly technologies in Taraz »
Approved by the Order of the Rector of the University No. 2131-b dated November 24, 2020.
The deadline for the completed work is May 10, 2020.
Initial data for the diploma project: construction area in Taraz city.
Structural schemes of the building -Frame structure with diaphragm, structures are made of monolithic reinforced concrete, architectural solution.
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 crossbar;
c) Organizational and technological part: development of technological maps, construction schedule and construction plan;
d) Economic part: local estimate, object estimate, summary estimate;
List of graphic material (with exact indication of required drawings):
1 Facade, standard floor plans, parts 1-1 and 2-2 - 4 sheets;
2 KZh columns, specifications - 1 sheet;
3 Technical maps of concrete works, calendar plan, construction site plan - 4 sheets.
11 slides of work presentation are provided.
Recommended main literature:

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

SCHEDULE
preparation of thesis (project)

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

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

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

Scientific adviser ______________ S.Kh. Dostanova

The task was accepted
for execution student ______________ Hejratullah Hedayat

Date "__" _____ 2021 yr.

АНДАТПА

Бұл дипломдық жобада Тараз қаласында орналасқан көп қабатты тұрғын үй. Бас жоспарға сәйкес учаскенің техникалық параметрлері:

1. Құрылыс алаңы - 3659 м2.
2. Ғимарат көлемі - 2180 м2.

Бұл жобада сәулет және құрылыс, елді мекен құрылысы және өндіріс бөліктері инженерлік шешімдер қабылдады. Жобаның жалпы техникалық-экономикалық параметрлері, сондай-ақ қоршаған ортаны қорғау және қауіпсіздік бойынша шешімдер.

АННОТАЦИЯ

В этом дипломном проекте многоэтажный жилой дом, расположенный в городе Тараз. Технические параметры участка по генплану:

1. Площадь застройки - 3659 м2.
2. Площадь здания - 2180 м2.

В этом проекте в области архитектуры и строительства, строительства поселка и изготовления деталей приняты инженерные решения. Общие технико-экономические параметры проекта, а также решения по охране окружающей среды и безопасности.

ANNOTATION

In this diploma project a multi-story residential building located in the city of Taraz. Technical parameters of the plot according to the general plan:

1. Building square – 3659 м2.
2. Building size – 2180 м2.

In this project in architecture and construction, settlement construction and manufacturing parts made engineering decisions. The general technical and economic parameters of the project, as well as decisions on environmental protection and safety.

CONTENT

INTRODUCTION

The construction industry plays a significant role in the development of the country and its economic position. Construction is not only the production of the final product itself - buildings or structures, but also processes repair, maintenance, restoration, reconstruction, and monitoring. Besides the construction of the building the maintenance and repair of buildings is crucial. The level of construction industry determines the level of development of the country, its position in the world market, economic growth, and welfare.

Construction is a very important and complex process that requires the contribution of specialists in various directions and fields, as well as a mechanized component, without which modern construction is hardly possible. In todays developed world, automation of construction stages has been actively developed, from design to maintenance and monitoring of construction. Construction automation projects are promising and promising due to the significant development of information technologies around the world, which not only make life and work easier, but also reduce financial investments and reduce risks associated with the human factor.

The project “residential building in Taraz city” is a modern residential building which is built according to the requirements of developed life and modern technology to provide convenient lifestyle and low-cost. The most important part in this project is the system of energy-efficiency used in this building which is useful for environment and welfare.

The other advantageous factor in the project is the Low-cost. In this project, attempted to provide and use low-cost materials and minimum usage of materials to provide an affordable and convenient place to live.

1 Architectural planning solution

This diploma project "Residential building in the city of Taraz" is a modern building of complex shape with ten number of storeys that meets the requirements of modern concepts of architecture and aesthetic expressiveness. This residential building is designed to accommodate people with high level of technology used in the building, modern technology and materials have been used in building and energy efficiency and low-cost system has been conducted.

In space-planning solutions a good system of soundproofing and insulation has been used, which can provide convenient and comfort living for the residents, this building has been constructed in unusual and complex shape which can provide an aesthetic view for the city and surrounding. Different amusement parts and green areas have been considered in the design of this building and an excellent system of underground parking has been added for convenient parking of vehicles.

The total number of floors of the building, including the underground parking, is 12. There are two floors of the underground parking. The number of storeys is the same in every blocks of the building, the number of which is equal to 2. The number of floors in blocks is 12 including the underground. On the 1st floor there is an entrance group, a hall, staircases, elevators. In the first underground level there is a storage part and machinery, in the second level of underground is the parking. And in the other floors are located apartments for living.

Elevators and stairwells are in each block. The connection between two blocks can the possible from underground level through parking part. The height of one floor of the building is 3.1 meters. In all rooms, natural lighting is maintained, which meets the requirements of CSA RK 2.04-02-2011 "Natural and artificial lighting".

Passenger elevators and stairs allow you to move between floors and are deployed in each block in near the entrance. The maximum lifting capacity of the elevator is 1000 kg. All elevator equipment and machinery are in the underground part of the building, which, in turn, saves on components, but can adversely affect the acoustic properties of the building envelope. The doors in the premises and stairwells swing open to the exit from the premises.

2 Constructive solution

The location of this projected building is in the city of Taraz, the settlement is an area subject to seismic impacts and is in the middle of the city. Because has a parametric floor plan and a full parking area in underground part, it was decided to adopt a frame structural scheme, that is, a frame-building scheme with reinforced concrete beams and columns with a reinforced concrete shear wall under the front circular balcony, which together provide the bearing capacity and spatial rigidity of the building.

2.1 Thermal calculations

Thermal calculation of the outer wall is carried out in accordance with the current CSA RK 2.04-01-2017 "Construction climatology", as well as CSA RK 2.04-04-2013 "Construction heat engineering". The purpose of this calculation is to determine the thickness of the outer wall insulation material.

The value of the heating season degree days is calculated according to the following formula:

$$G_{HSD} = (t_i - t_{at})\, z_{dpa} \quad (1)$$

where ti = 22 degrees is the internal air temperature.

t_{at} = 1.7 degrees- average temperature with an average daily air temperature below or equal to 8 degrees.

z_{dpa} = 160 days - the duration of the period with the average daily air temperature below or equal to 8 degrees.

G_{HSD}= (22 + 1.7) · 160 = 3792 degrees· days.

For a given G_{HSD} value, we determine R_{0ht}.

Table 1 - Materials of the outer wall and its properties

Material name	Density γ_0, kg / m	Thermal conductivity λ, W / m^2 · °C	Layer thickness δ, m	Heat transfer resistance $Rn = \delta / \lambda$, m^2 · °C / W
Cement-sand mortar plaster	1700	0.75	0.03	0.04
Polyurethane foam	80	0.041		
Reinforced concrete	2500	1.92	0.2	0.1

The required resistance to heat transfer of enclosing structures that meet sanitary and hygienic and comfortable conditions is equal to:

R_{0ht} = 2,275 м2 · °C/w.

The heat transfer resistance of the enclosing structure is determined by the formula 1.2:

$$R_0 = \frac{1}{\alpha_B} + \frac{1}{\lambda_1} + \frac{1}{\lambda_2} + \frac{1}{\gamma_3} + \frac{1}{\lambda_4} + \frac{1}{\alpha_n} \quad (2)$$

$$R_0 = \frac{1}{8.7} + 0.04 + \frac{x}{0.041} + 0.1 + 0.04 + \frac{1}{23} = .0335 + \frac{x}{0.041}$$

$$x = 0.079m$$

We preliminarily accept the thickness of the insulation equal to 0.08 m.

Check the condition:

$$R_0 \geq R_{0ht}, \quad (3)$$

R_0 = 2,286 м^2 · °C/w ≥ R_{0ht} = 2,275 м^2 · °C/w.

The condition is met. The required value of the heat transfer resistance is less than the calculated one, which fully satisfies the conditions for the location of the building. The thickness of polyurethane foam can be taken equal to 80 mm. The calculated final thickness of the outer wall is 340 mm. The calculations performed comply with all these rules and regulations.

2.2 Anti-seismic measures

Considering that the location of the construction is the city of Taraz, anti-seismic measures are mandatory. This settlement has a seismicity of 8 points.

Due to the significant seismic impact, variable number of storeys and the complex, asymmetric shape of the building, several anti-seismic measures were taken. The building is divided by two expansion joints into 3 block sections. Each block-section works independently and does not transfer efforts to the other. These expansion joints are designed to compensate for: seismic, sedimentary, temperature effects.

Since the building is monolithic reinforced concrete, this will be an advantage in case of seismic impacts. Also, load bearing reinforced concrete walls provide additional stability and rigidity of the building. There is a stiffness diaphragm in the vertical direction along the entire height of the building. All knots of crossbars and columns are rigid.

The foundation for the building was a monolithic reinforced concrete solid slab. For reasons of complex shape and variable number of storeys, this is the best option. According to NTM RK 08-03-2012 “Design of earthquake-resistant buildings. Part. Monolithic Reinforced Concrete Buildings", the project considers all the requirements and rules to prevent seismic instability.

2.3 Determination of loads

Monolithic reinforced concrete consists of the following materials:
- heavy concrete class B25
- armature class A-500 (equivalent AIII)

Section of elements:

Table 2 – Slab loads

Name of load type	Unit of measurement	Normative value of the load	γ	The estimated value of the load
Parquet, δ = 15 mm, ρ = 700 kg / m3	kg / m2	10.5	1.3	12.6
Waterproofing δ = 10 mm, ρ = 200 kg / m3	kg / m2	2	1.3	2.6
Acoustic D = 2 kg / m2	kg / m2	2	1.3	2.6
concrete δ = 200 mm, ρ = 2500 kg / m3	kg / m2	500	1.1	550
Cement plaster, δ = 25 mm, ρ = 1800kg / m3	kg / m2	45	1.3	58.8
Temporary loads:	kg / m2	200	1.3	260
Total	kg / m2	760		886.5

Table 3 – Typical slab

Name of load type	Unit of measurement	Normative value of the load	γ	The estimated value of the load
Parquet, δ = 15 mm, ρ = 700 kg / m3	kg / m2	10.5	1.3	12.6
Waterproofing δ = 0 mm, ρ = 200 kg / m3	kg / m2		1.3	0
Acoustic D = 2 kg / m2	kg / m2	2	1.3	2.6
concrete δ = 200 mm, ρ = 2500 kg / m3	kg / m2	500	1.1	550
Cement plaster, δ = 25 mm, ρ = 1800kg / m3	kg / m2	45	1.3	58.8
Temporary loads:	kg / m2	200	1.3	260
Total	kg / m2	758		884

Table 4 – load of walls

Name of load type	Unit of measurement	Normative value of the load	γ	The estimated value of the load
Con. loads:				
cement sand plaster δ = 20 mm, ρ = 1800 kg / m3	kg / m2	111.6	1.3	145.08
Rein. concrete δ = 300 mm, ρ = 2500 kg / m3, h = 3.1m	kg / m2	2325	1.3	3022.5
polyurethane foam δ= 80 mm, ρ = 125 kg / m3, h = 3.1m	kg / m2	31	1.3	40.3
Painting δ = 0.12, ρ = 1200 kg / m3 h = 3.1 m	kg / m2	0.45	1.3	0.585
Total		2468		3208.5

Table 5 – Partitions

Name of load type	Unit of measurement	Normative value of the load	γ	The estimated value of the load
Constant loads:				
Block, δ = 200 mm, ρ = 600 kg / m3, h = 3m	kg / m2	360	1.2	432
Plaster, δ = 40 mm, ρ = 1800 kg / m3, h = 3m	kg / m2	216	1.3	280.8
Total	kg / m2	576		713

3 Analysis of building in structural program LIRA-SAPR

First, the limiting deformations of the elements are checked. Let us start at the bottom. A characteristic combination is used for sediment analysis.

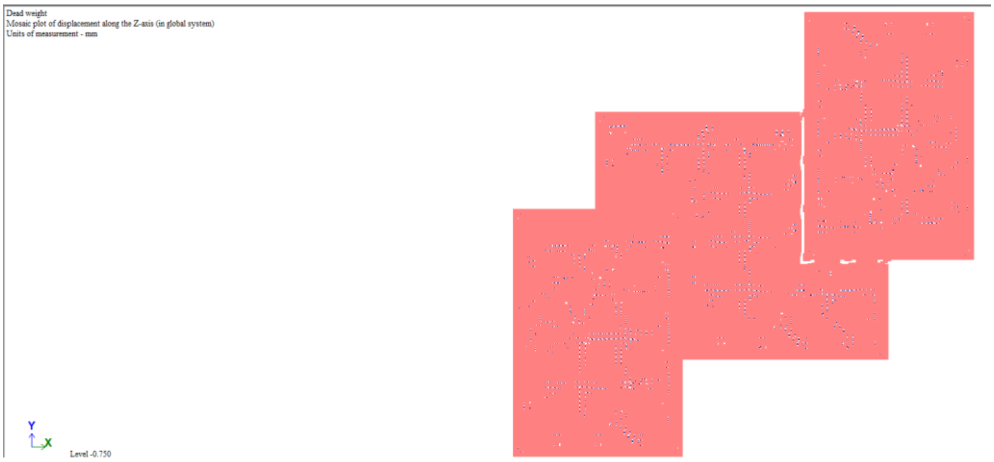


Figure 1 - Base z displacement plot

The ultimate deformation for our building type is a civil multi-storey building with a full reinforced concrete frame, the maximum draft is GXYZ, 10 cm. According to the displacement diagram, the maximum draft in our building is almost zero cm, it is being tested.

When checking the deflections, we use a quasi-constant combination, select the overlap of the 7th floor, cut out 1 span and check for deflection.

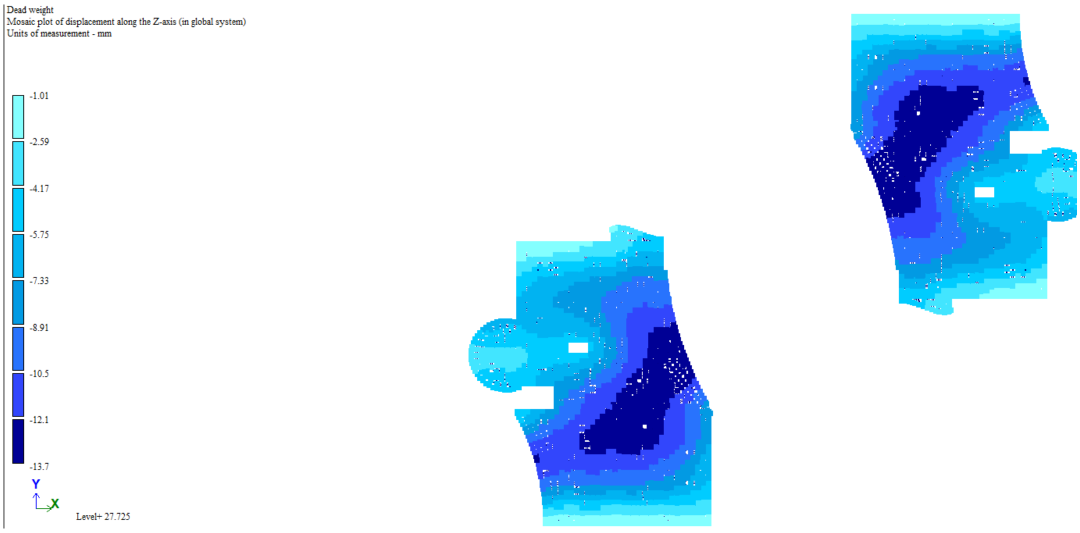


Figure 2 – Displacement along z

Check the overlap, the relative displacement is 13.7-1.01 = 12 mm. The span in both directions is L= 5700 mm.

$$\frac{L}{250} = \frac{6600}{250} = 26.4mm$$

Conditions met.

Relative ones in the girders are also not significant, they do not exceed 1 mm, and the condition is fulfilled.

Verification of horizontal displacements in the wind with a dominant wind load.

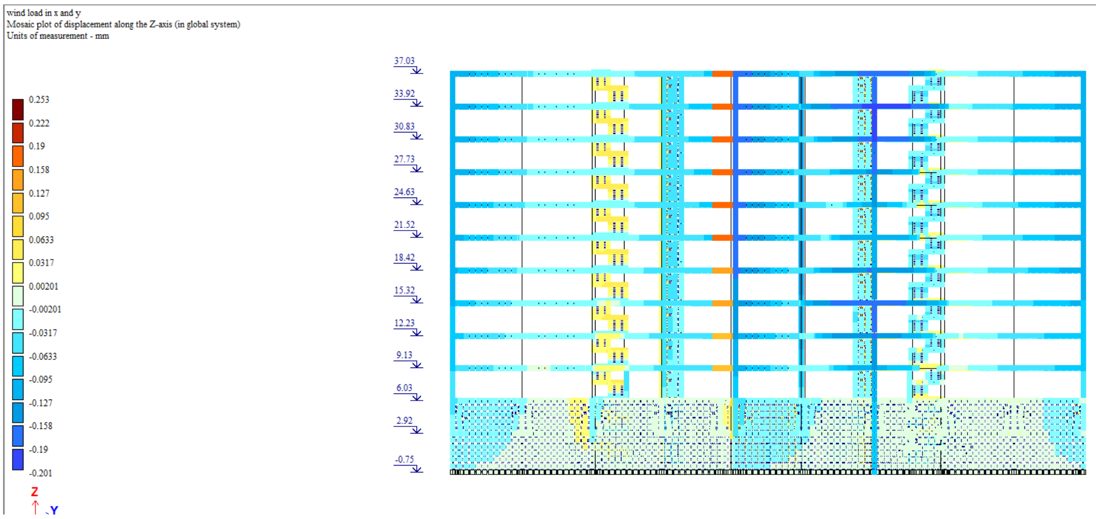


Figure 3 – Displacement along z

Building height h = 37.03 m, $\frac{h}{500} = \frac{37000}{500} = 74mm$, condition met.

Next, a seismic check is performed for floor skew according to the formula, permissible horizontal skew:

$$d_{re} \le \frac{h \cdot \varepsilon}{q} \qquad (4)$$

where d_{re}- floor skew at design seismic loads on the building.

h - floor height.

q - coefficient taken in accordance with the provisions of subsection 7.6

b – coefficient, according to the table

4 Calculation and design section

4.1 Calculation of crossbars

Crossbar-reinforced concrete products are horizontal, the main purpose of which is to connect vertical structures. Properly assembled reinforced concrete crossbars should provide sufficient strength, as they take the weight of the paving slabs. Properly calculated and the choice of the number and diameter of reinforcement determines the strength of the structure.

Supporting moments in the diagram:

M_{12}=19 kN·m

M_{21}= 62 kN·m

M_{23}= 54 kN·m

Maximum torque:

M_{max}=39 kN·m

Medium torque:

M = M = 24 kN· m

M = 29 kN· m

Maximum longitudinal force:

Q=77 kN

Calculation of the strength of crossbars on the longitudinal axis.

Concrete class C16 / 20, design resistance of concrete to axial compression f_{ck} = 16 MPa, individual safety factor for concrete γc = 1.5; design resistance of concrete for compression of prestressed structures and reinforced concrete f_{cd} = acc · f_{ck} / γ_c = 0.85 · 16 / 1.5 = 9.1 MPa; Longitudinal reinforcement class S500 (f_{yk} = 500 MPa, f_{yd} = f_{yk} / γ_c = 435 MPa); horizontal reinforcement class S240 (f_{yk} = 240 MPa, f_{yd} = f_{yk} / γ_c = 167 mPa);

Design torque of the crossbar on the edge of the support:

$M_{Ed,\ max}$ = 62.6 kNm

We determine the following coefficient:

α_{ED}= $M_{Ed.max}$ / (f_{cd} · b'f · d2) = 62.6 · 103/9100 · 103 · 0.30 · 0.552 = 0.101, where d = h-c1 = 60-5 = 55 cm, M_{Ed}, max = M_{Eds}. B.1 of Annex B to the STE RK 02-01-1.1-2011. According to the table for concreteα_{ED} = 0.101 and σ_{sd} = f_{yd} = 435 MPa - ω = 0.13, ξ = 0.189.

Required area of elongated reinforcement:

$$A_{S1} = \frac{1}{fyd}(\omega \cdot b \cdot d \cdot f_{cd} + N_{Ed}) = \frac{1}{435}(0.1330 \cdot 55 \cdot 9.1) = 4.89cm^2$$

We accept two rebars of 18 diameter (2Ø18 S500) from the assortment (A_{S1} = 5.09 cm2).

Maximum intermediate torque: M = 39.2 kN · m

$$a_{Ed} = \frac{M_{Ed,max}}{f_{cd} \cdot b_f' \cdot d^2} = 39.2 \cdot \frac{10^3}{9100 \cdot 10^3 \cdot 0.3 \cdot 0.55^2} = 0.03$$

B.1 in Annex B to the STE RK 02-01-1.1-2011. According to the table for concrete $a_{Ed} = 0.25$ and$\sigma_{sd} = f_{yd} = 435mPa - \omega = 0.0412, \xi = 0.079$

Required area of elongated reinforcement:

$$A_{S1} = \frac{1}{fyd}(\omega \cdot b \cdot d \cdot f_{cd} + N_{Ed}) = \frac{1}{435}(0.0412 \cdot 30 \cdot 55 \cdot 9.1) = 1.422cm^2$$

We accept two rebars of diameter 10 (2∅10), S500 from the assortment (AS1 = 1.57 cm2). crossbar reinforcement

Determining the area and pitch of the horizontal reinforcement According to the calculation, we determine the length of the area where the horizontal reinforcement is installed: the diagram of the transverse forces. To do this, we first determine the transverse force acting on the concrete.

$$V_{Rd,c} = \left(\left(\frac{0.18}{\gamma_c}\right) \cdot k(100\rho_1 \cdot f_{ck})^{\frac{1}{3}}\right) \cdot b_w \cdot d, \geq V_{Rd,c,min}$$

$$= \left(0.035 \cdot k^{\frac{3}{2}} \cdot f_{ck}^{\frac{1}{2}}\right) \cdot b_w \cdot d, kN$$

where V_{Rd}, c is the transverse force applied to the transversely reinforced concrete.

γc - safety factor of concrete;

ρ_1 - coefficient of longitudinal reinforcement;

f_{ck} - characteristic resistance of concrete to axial compression;

d-is the working height of the section;

$k = 1 + \sqrt{\frac{200}{d}} \leq 2, k = 1 + \sqrt{\frac{200}{550}} = 1.69,$

$\rho_1 = \frac{A_{S1}}{b_w \cdot d} = \frac{489}{300 \cdot 550} = 0.0029$

$d = h - c_1 = 600 - 50 = 550mm$

$$V_{Rd,c} = \left(\left(\frac{0.18}{1.5}\right) \cdot 1.69 \cdot (100 \cdot 0.0029 \cdot 16)^{\frac{1}{3}}\right) \cdot 300 \cdot 500 = 55.81kN$$

$$V_{Rd,c,min} = \left(0.035 \cdot 1.69^{\frac{3}{2}} \cdot 16^{\frac{1}{2}}\right) \cdot 300 \cdot 600 = 55.35kN$$

The calculation area is:

$$a_w = \frac{V_{Ed,max} - V_{Rd,c,min}}{q + g} = \frac{77.3 - 55.35}{87.9} = 0.24m$$

Assign the first design section at a distance of d_z = 550 mm from the support.

The value of the transverse force in this section: V_{Ed} = 77.3 kN.

The angle of inclination of the light is θ = 40.

Horizontal reinforcement of the calculation zone within the length of this zone is performed under the following conditions: $V_{Ed} = V_{Rd,sy}$; $V_{Ed} \leq V_{Rd,max}$;

Where $V_{Rd,sy}$ is the calculated transverse force, taken by the cross section of the transverse reinforcement.

Taking the pitch of the transverse reinforcement, we determine the cross-sectional area by the last formula, the number of transverse reinforcement in the given method assumes the following condition, ie it is equal to the flow limit of the voltage: $f_{sw} = f_{ywd}$

Assume the pitch of the horizontal reinforcement s = 200 mm.

$$A_{sw} = \frac{V_{Ed} \cdot s}{d_z \cdot f_{sw} \cdot cot\theta} = \frac{77.3 \cdot 10^3 \cdot 200}{550 \cdot 167 \cdot cot40} = 141.24mm^2$$

From the assortment 2Ø10 S240 (A_{sw} = 1.57cm2). crossbar reinforcement

Only if the following conditions are met:

$$\frac{A_{sw} \cdot f_{sw}}{b_w \cdot s} \leq 0.5 \cdot v \cdot f_{cd} \qquad (5)$$

$$V_{Ed} \leq V_{Rd,max} = \frac{v \cdot f_{cd} \cdot b_w \cdot d_z}{cot\theta + tan\theta} = \frac{0.571 \cdot 9.1 \cdot 300 \cdot 550}{1.192 + 0.839} = 474.9kN$$

$$V_{Ed} = 77.3kN < V_{Rd,max} = 474.9kN$$

Condition met.

where v is the coefficient that considers the tensile strength of concrete and the following for heavy concrete:

$$v = 0.6(1 - \frac{f_{ck}^{(mPa)}}{250} = 0.6 * 0.936 = 0.571 \geq 0.5$$

$$\frac{A_{sw} \cdot f_{sw}}{b_w \cdot s} = \frac{157 \cdot 167}{300 \cdot 200} = 0.43Mpa, 0.5 \cdot v \cdot f_{cd} = 0.5 \cdot 0.571 \cdot 9.1 = 2.6Mpa$$

$0.43Mpa \leq 2.6Mpa$- Condition met.

Since all the conditions are met, we take the horizontal reinforcement two 10 mm diameter rebars (2Ø10 S240), (A_{sw} = 157 mm2), pitch s = 200 mm.

4.2 Calculation of slab foundation

Initial data for design

Section with dimensions b = 1000 mm, h = 900 mm; a = 50mm; heavy concrete of class B25, modulus of elasticity E_b = 30 MPa, design concrete resistance R_b = 14.5 MPa, considering the coefficient of concrete operation condition (γ_{b2} = 0.9), we obtain R_b = 13.05 MPa, R_{bt} = 1.05 MPa; reinforcement of class A-500 (R_s = 435 MPa, E_s = 2.0 · 105); Transverse reinforcement class A-240: R_s = 215MPa, E_s = 2.1105 MPa

The calculation is made according to the results of the program of the LIRA SAPR complex.

According to the DCS tables, we make the selection of reinforcement.

It is required to determine the cross-sectional area of the main reinforcement.

1.Determination of the area of longitudinal reinforcement, in the extreme span and selection of reinforcement according to the assortment.

The average value of the moment arising in this zone from the table B.1 of the DCS (see Appendix A): M = 2247 kNm.

1) Determine the required amount of stretched reinforcement at h_0 = 850 mm

$$\alpha_m = \frac{M_1}{h_0^2 \cdot R_b \cdot b} = \frac{2247}{0.85^2 \cdot 14.5 \cdot 1000 \cdot 1} = 0.209$$

Determine the area of longitudinal reinforcement.

$$A_s = \frac{R_b \cdot b \cdot h_0(1 - \sqrt{1 - 2\alpha_m})}{R_s} = \frac{14.5 \cdot 1000 \cdot 1 \cdot (1 - \sqrt{2 * 0.290})}{435 \cdot 1000}$$
$$= 0.0068m^2 = 68cm^2$$

We accept four rebars with diameter 36mm (4Ø36 A-500), A_{s1} = 40.72 cm^2 in the stretched zone, we add four rebars of 32mm (4Ø32A-500), A_{s2} = 32,17cm2,

$$A_{s1} + A_{s1} = 40.72 + 32.17 = 72.87cm^2 \geq A_s = 68cm^2$$

Reinforcement coefficient:

$$\mu_2 = \frac{A_s}{b \cdot h_0} = \frac{72.89}{85 \cdot 1} = 0.83 > 0.0005$$

i.e. more than the minimum allowable

2 Calculation of strength along sections inclined to the longitudinal axis.

Maximum shear force Q_{max} = 1807.5 kN.

Let us check the condition according to item 3.28 [5]

$$Q_{max} \leq 2.5R_{bt} \cdot b \cdot h_0 \qquad (6)$$

$$Q_{max} = 1807.5kN \leq 2.5 \cdot 1.05 \cdot 0.86 \cdot 1000$$
$$1807.5kN \leq 2546.25kN$$

Transverse reinforcement step:

$$S < 0.75d = 0.75 \cdot 850 = 640mm$$

We accept s = 200 mm.

Punching shear design.

The punching shear design should be made based on the condition:

$$F \leq \alpha R_{bt} \mu_m h_0 \qquad (7)$$

where F is the pushing force.

α - coefficient taken equal for concrete:

μ_m is the arithmetic mean of the values of the perimeters of the upper and lower bases of the pyramid formed during punching within the working height of the section:

$$F = N - P \qquad (8)$$

where P is the pressure from the ground rebound.

F=5683-230.218=5453Kn

$$F = 5453kN \leq 1 \cdot 1.05 \cdot 1000 \cdot 0.860 \cdot 5.8 = 5907kN$$

5 Technology and organization

5.1 Underground part of the building

Depending on the work performed, the units for measuring the volume of earthworks can be either in cubic meters or in square meters. When calculating the volume of soil, primitive, standard geometric shapes are used.

Brief, basic data on the state of the soil and its characteristics: loam, heavy without impurities and with an admixture of crushed stone, gravel, pebbles up to 10 percent by volume.

This soil category is II.

Transportation distance - 10 km;

The elevation of the bottom of the pit is -10.6 m;

Building dimensions – 61.6x59.4 m;

The groundwater level is 1.52 m.

Table 6 - The main characteristics of the soil

Name	unit of measurement	Numeric data
Soil group	-	II
Average soil density	kg / m3	1725
Initial loosening ratio	-	0.24-0.3
Residual loosening factor	-	0.05-0.08
Slope steepness (m)	-	0.75

5.2 Preparation and detailing of initial data

Soil characteristics, depending on the class in ENIR Collection E2. Earthwork. Issue 1. The average density of the soil is accepted per the reference data or ENIR Collection E2. Earthwork. Issue 1.

Stability of soil in slopes is characterized by physical properties of soil, where the soil is in stable condition. The stability of soils in such cases is determined by the steepness of slopes and expressed by an inclination angle of the slope to the horizon at the ratio of 1: m or:

$$\frac{H}{a} = \frac{1}{m} \tag{9}$$

$$a = H \times m = 6.2 \cdot 0.5 = 3.1, \qquad \alpha = 72.12^{\circ}$$

where H – slope height;

a– laying of a slope or projection of a slope to the horizon;

m – Coefficient of a slope.

According to the corrected initial data of soil characteristics and work performance conditions to be prepared table:

Table 7 - Filling of basic data

Name	Unit of measure	Numerical data	Note
ID number		01552294	
Scheme No			
Foundation type			Slab
Soil class		II	
Type of soil			Sandy, loam
Coefficient of the steepness of a slope		3.1	
Range of transportation of soil	km	10	
Coefficient of an initial loosening		12…17 (1.12…1.17)	
Coefficient of a residual loosening		3…5 (1.03…1.05)	
Average winter temperature of external air	C°	15	
Step and span in longitudinal and transverse directions (*a* and *b*)	m	a = 6.6m b = 5.6m	
Structure length, l_1	m	61.6m	
Structure width, $l2$	m	59.4m	
The base of foundation mark, the depth of the pit (h_p, h_{tr})	m	-6.2m	
Level of water soil, h_{lws}	m		

5.2 Determination of work volume

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

Table 8 –Volume of works

Name of processes	Unit of measure	Volume of work	
		on one base	in total
The construction of temporary fencing	m	61.6	242
Removal of top soil	m3	91	1213.6
Soil excavation in the pit (trench) and trench access to the pit	m3		13516
Excavation of soil underrun	m3	187.2	748.8
Concrete preparation for foundations	m3		3270
Reinforcement installation, incl.:			
a) grids installation	pieces/t	56.17	2920,84
b) frames installation	pieces/t	23.64	1229,28
Formwork installation)	m2	0.175	13516
Concreting of foundations	m3		3270
Formwork removal	m2	0.175	13146
Foundation waterproofing	m2		13516
Backfilling	m3		3792.9
Soil compaction	m2		3696
Final land planning	m2		3696
Removal of temporary fencing	m		242

5.3 Determination of work labour

The labor input of operations is calculated based on the ENiR on respective works (ENiR E–2, E–4, E–11, E–22, etc.), performed by equipment or manually. For manual processes in the column “operator” put a dash. Total labor costs and wages are obtained by multiplying the amount of work on the standards of time and rates. The calculation is presented in tabular form (tab. 10) in the calculation of labor costs, make it only by the accepted type.

At the end of the table are summed up totals in columns 10, 11, 12 and 13, which are used in the future to determine the technical and economic indicators.

Data of columns 10 and 11 to be calculated.

Labor costs of processes in manhours are determined by the formula:

$$Qm{-}hour = V \cdot N_{tr} \qquad (10)$$

where V– volume of work (table 8);

N_{tr} – Standard time (table 10),

The construction of temporary fencing

$$Qm{-}hour = 242 \cdot 1.2 = 290.4$$

Removal of topsoil

$$Q_{m-hour}=1213.6 \cdot 0.56 = 6796.6$$
Soil excavation in the trench and trench access to the pit
$$Q_{m-hour}=186.2 \cdot 2.8 = 521(\text{workers})$$
$$Q_{m-hour}=186.2 \cdot 3.56 = 662(\text{drivers})$$
Excavation of soil underrun.
$$Q_{m-hour}=748.8 \cdot 1.64 = 1228.03$$
Concrete preparation for foundations
$$Q_{m-hour}=324.48 \cdot 0.79=256.33$$
Reinforcement installation foundation manually
$$Q_{m-hour}=4150.12 \cdot 22.17=92008.16$$
Formwork installation foundation manually
$$Q_{m-hour}=748.8 \cdot 0.36=269(\text{workers})$$
$$Q_{m-hour}=748.8 \cdot 0.12=89(\text{drivers})$$
Concreting of foundation
$$Q_{m-hour}=324.48 \cdot 1.2=389.3$$
Formwork removal foundation
$$Q_{m-hour}=748.8 \cdot 0.31=232.12$$
Foundation waterproofing
$$Q_{m-hour}=718.64 \cdot 10=7186.4$$
Backfilling
$$Q_{m-hour}=3792.9 \cdot 0.39=1479$$
Soil compaction
$$Q_{m-hour}=12643 \cdot 0.92=11631$$
Final land planning
$$Q_{m-hour}=3280 \cdot 0.33=1082.4$$
$$Q_{m-hour}=3280 \cdot 0.49=1607$$
Removal of temporary fencing
$$Q_{m-hour}=368 \cdot 0.9=331.2$$
And in man–days defined as:

$$Q_{m-day}=Qm{-}hour \cdot 8,2 \qquad (11)$$

The construction of temporary fencing
$$Q_{m-day}=242 \cdot 8.2= 1984.4$$
Removal of topsoil.
$$Q_{m-day}=6796.6 \cdot 8.2= 55731.12$$
Soil excavation in the trench and trench access to the pit
$$Q_{m-day}=521 \cdot 8.2= 4272\ (\text{workers})$$
$$Q_{m-day}=662 \cdot 8.2= 5428\ (\text{drivers})$$
Excavation of soil underrun.
$$Q_{m-day=}1228.03 \cdot 8.2= 10069.8$$
Concrete preparation for foundations
$$Q_{m-day}=256.33 \cdot 8.2= 2101.9$$
Reinforcement installation of columnar foundation manually

Q_{m-day}=92008.16 · 8.2= 754465.6

Formwork installation of columnar foundation manually

Q_{m-day}=269 · 8.2= 2205 (workers)

Q_{m-day}=89 · 8.2= 729 (drivers)

Concreting of columnar foundation

Q_{m-day}=389.3 · 8.2= 3192.26

Formwork removal of columnar foundation

Q_{m-day}=232.12 · 8.2= 1903.38

Foundation waterproofing

Q_{m-day}=7186.4 · 8.2= 58928.48

Backfilling

Q_{m-day}=1479 · 8.2= 12127.8

Soil compaction

Q_{m-day}=6683.8 · 8.2= 54807.16

Final land planning

Q_{m-day}=1082.4 · 8.2= 8875.68

Q_{m-day}=1082.4 · 8.2= 8875.68

Removal of temporary fencing

Q_{m-day}=331.28.2= 2715.84

The amount of the salary is determined by multiplying the volume of work on pricing. According to the accepted number of machines and composition of units recommended by ENiR is determined the team.

5.4 Preparation of work schedule

The planned schedule of works specifies sequence of the processes and the duration of their mutual coordination. Schedule of work production plan is recommended to be prepared as per the table. 5 given in SNIP–3.01.0185. The data in columns 1, 2, 3, 4, 6 are transferred from the calculation of labor input and machine input in Table 5.

The duration of the mechanized processes is determined by:

$$Pm= \frac{Nm.sh}{n \cdot A} \quad (12)$$

where, N (m.sh) – required number of machine–shift;

n – Number of machines;

A – Number of shifts per day.

Determination of the required number of machine shifts

$$N_{MS} = \frac{Q}{P} \quad (13)$$

where Q is the amount of work to be performed on this operation, ha.

P – changeable productivity of the unit, ha / shift.
Removal of topsoil

$$P_m = \frac{368}{1 \cdot 2 \cdot 18662.4} = 7 \text{ day}$$

Soil excavation in the trench and trench access to the pit

$$P_m = \frac{13516}{1 \cdot 2 \cdot 200} = 21 \text{ day}$$

Formwork installation foundation manually

$$P_m = \frac{11032.32}{2 \cdot 2 \cdot 500} = 5 \text{ day}$$

Concreting of flat foundation

$$P_m = \frac{56.784}{1 \cdot 2 \cdot 2280} = 20 \text{ day}$$

Backfilling

$$P_m = \frac{2179.68}{2 \cdot 2 \cdot 200} = 3 \text{ day}$$

Soil compaction

$$P_m = \frac{7265}{2 \cdot 2 \cdot 115} = 3 \text{ day}$$

Final land planning

$$P_m = \frac{1540}{2 \cdot 2 \cdot 200} = 7 \text{ day}$$

Duration of manual processes is determined by:

$$P_p = \frac{Q}{n \cdot A} \tag{14}$$

Where Q–labor costs (table 10), (human –day);
n– Number of workers per shift.
The construction of temporary fencing

$$P_p = \frac{441.6}{2 \cdot 10} = 2 \text{ day}$$

Soil excavation in the trench and trench access to the pit

$$P_p = \frac{246.01}{2 \cdot 5} = 2 \text{ day}$$

Excavation of soil underrun.

$$P_p = \frac{19469.03}{2 \cdot 20} = 15 \text{ day}$$

Concrete preparation for foundations

$$P_p = \frac{692.12}{2 \cdot 10} = 3 \text{ day}$$

Reinforcement installation of columnar foundation manually

$$P_p = \frac{92008.16}{2 \cdot 10} = 23 \text{ day}$$

Formwork installation of columnar foundation manually

$$P_p = \frac{3971.64}{2 \cdot 20} = 9 \text{ day}$$

Concreting of columnar foundation

$$P_p = \frac{68.14}{2 \cdot 2} = 2 \text{ day}$$

Formwork removal of columnar foundation

$$P_p = \frac{3420.02}{2 \cdot 10} = 9 \text{ day}$$

Foundation waterproofing

$$P_p = \frac{670566}{2 \cdot 10} = 17 \text{ day}$$

Final land planning

$$P_p = \frac{508.2}{2 \cdot 10} = 7 \text{ day}$$

Removal of temporary fencing

$$P_p = \frac{331.2}{2 \cdot 10} = 2 \text{ day}$$

The 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.

5.5 Installation of formwork of crossbars

Construction formwork is a temporary structure made at the construction site to limit concrete, reinforced concrete, or others.

Our object comes with a frame system of the form. The frame system of the formwork includes supporting elements, frame panels and fasteners. The frame made of hollow profile prevents damage to the sides of the hob and allows you to connect the parts as tightly as possible anywhere. Typically, frame systems are made of aluminum or steel, which simplifies not only the rigidity of the structure, but also the installation of modular parts.

When calculating the molds, vertically (all own molds, weight of the newly built concrete mix, reinforcement, partial dynamic load from the work and unloading additives and its seals), horizontal (wind load and partial dynamic loads from vibration).

Table 9 – Crossbar load

Name of load type	Unit of measurement	Normative value of the load	γ	The estimated value of the load
Loads				
Concrete mix ρ = 2400 kg / m3 S = 0.18 m2 h = 3.1 m	kg / m	432	1.2	518
Reinforcement frame q = 6.5	kg / m	6.5	1.2	7.8
Total	kg / m	438		526

Table 10 – The load on the column position

Name of load type	Unit of measurement	Normative value of the load	γ	The estimated value of the load
Loads				
Concrete mix ρ = 2500 kg / m3 S = 0.16 m2 h = 3.1m	kg / m	400	1.2	480
Total	kg / m	400		480

Table 11 – The load on the ceiling

Name of load type	Unit of measurement	Normative value of the load	γ	The estimated value of the load
Loads				
Concrete mix ρ = 2500 kg / m3 S = 0.87 m2 h = 3.1m	kg / m	2172	1.2	2607
total	kg / m	2172		2607

Calculation of the thickness of the casing, steel plate, based on the conditions of strength.

$$\delta = k_2 \cdot \sqrt{\frac{q}{R_{cr}}} = 0.8$$

Based on the required stiffness requirements

$$\delta = k_1 b \sqrt{\frac{q}{(\frac{f}{b})}} = 0.9$$

where b-the lower side of the plate

q - the load distributed on the plate, respectively, design and regulatory.

R_{cr} - is the design resistance of the steel.

[f / b] - is the allowable deflection of the plate (1/400 "intermediate").

For concreting the top supports of viaducts, a mobile frame is used, which is usually made of metal and is assembled in the form of frames and shields. The skeleton is two closed horizontal frames in the upper and lower regions of the formwork. Shields are made of steel plates with walls of hardness 3-6 mm (sometimes more). The height h, m and the velocity v of the formwork are determined by the following formula, depending on the conditions of release before the concrete formwork.

$$v = \frac{h}{t+2} = \frac{1.2}{4+2} = 0.2 m/hour$$

where t - holding time of concrete from the beginning of pouring, 4 hours; 2 - time reserve, hours.

h = 1.2 m Required capacity of the concrete plant:

$$Q = vS = 0.2 \cdot 0.16 = 0.032\, m^3/hour$$

Productivity required for one column position.

The prefabricated (prefabricated system) must meet a few design technological and economic requirements, including ensuring the correctness and immutability of the geometric shape:

- concrete structure;
- rotating, reusable device;
- hard, strong, and stable, without deformation of the concrete mix under pressure.
- technological, ie not to cause difficulties during reinforcement.
- ensuring low labor intensity of laying concrete mix, installation and dismantling of formwork;
- available materials with design simplicity;
- to ensure the quality of the concreted surface, for this purpose - to prevent the leakage of "cement milk" during concreting, threading the formwork panels with their low attachment to the concrete.

When calculating the formwork, vertically (all individual forms, weight of newly built concrete mix, reinforcement, partial dynamic load from unloading and compaction of workers and concrete mix), horizontal (wind load, lateral pressure of concrete mix, partial dynamic load from unloading and vibration of concrete mix) and Installation loads that occur during the forming process are associated with the pouring of the structure and hanging in the concrete formwork.

Templates are not inventory, they are used only once and In - inventory, ie they are rotated several times. Types of molds differ in structural features.

The classification of forms is based on functional and structural features, determined by the type of concrete structure, the ratio of their geometric dimensions and the accepted technology of production.

According to the functional purpose, depending on the type of concrete structure, there are forms:

1 For vertical surfaces;

2 For horizontal and sloping surfaces;

3 For simultaneous concreting of walls and roofs;

4 For concreting rooms and apartments;

5 For curved surfaces.

In modern industrial and civil construction practice, a significant number of inventory and non-inventory forms are selected, depending on the type and size of the concrete structure, methods of reinforcement and delivery of concrete mix and several other parameters.

In the domestic practice of mass industrial and civil construction, about 90-95 percent of concrete and reinforced concrete structures are built using prefabricated formwork. These molds are universal when concreting different types of structures of different sizes. In addition to collapsible-replacement, volumetric-shifting, movable, block, non-removable molds are often used.

Delivered to construction sites in prefabricated kits, which include: a set of shields, fasteners, holding and floating devices. Complex with special joints or combined professions of form workers in accordance with the technological documentation

33

installs and disassembles brigade positions. The master or foreman accepts the installed templates.

The support parts of the formwork are placed on a base that prevents them from settling. Upon completion of the installation, check the correct installation of the lifting, holding, and fastening elements, as well as formwork shields. Before pouring the concrete mixture, the surface of the formwork is covered with special oils.

Forming works should be carried out in accordance with the project, which includes a scheme of organization of work on the installation of a monolithic structure, marking drawings, a schedule of works indicating the number of forming sets and its rotation. The marking diagram is a schematic of a published page with the specified elements of the template. The scheme of forming works shows the location of lifting mechanisms, places of storage and aggregation, the sequence of installation of forming elements.

Necessary operations, quantitative and qualitative composition of workers during the installation of formwork can be assigned approximately in accordance with the schedule During the concreting of the foundations of the strip foundations are installed before the start of concreting, except for protrusions and depths on the top of the foundations. Initially, beacon supports, and shields are usually installed every 3-4 meters along the outer perimeter of the foundation at corners and intersections and secured with perimeter pods.

The distance between the width and length of the shields. Establishes perfection at the same time. Then the remaining shields are fastened with crosses and twists. Then the enclosure is built around the inner perimeter. From a height of 1.6 m from the bottom of the foundation, works will be carried out on the outside and inside of the foundation of inventory forests and pavements.

Forms of structures ensure the preservation of the concrete surface, edges, corners after achieving strength with concrete. The duration of the strength set depends on the mode of hardening and the grade of concrete, the type of cement and the design features of the concrete elements.

The load-bearing elements of the formwork provide the required load-bearing capacity of the cone when the concrete reaches strength. If the actual load of the structural elements is less than 70 percent of the design, then the strength of the formwork (less than the projected):

- for intermediate elements up to 2 m – 50 percent.
- 70 percent for intermediate elements up to 6 m.
- For intermediate elements over 6 m and structures with reinforcement – 80 percent.

If the actual load is more than 70 percent, then the weighted elements of the formwork are removed when the concrete reaches 100 percent design strength. In the presence of welded armored frames, the formwork is removed when the strength reaches 25 percent.

When removing the formwork of the partitions and floor slabs under the partitions, we leave the safety posts at not more than three meters from each other.

5.6 Installation of formwork of slab foundations

According to the working drawings, we install the foundation formwork on the leveled base.

Before concreting the base, horizontal and inclined concrete surfaces of working joints must be cleaned of debris, dirt, oils, snow and ice, cement film, etc. Immediately before placing the concrete mix, the cleaned surfaces must be rinsed with water and dried with an air stream.

The height of free dumping of concrete mixture into the formwork of weakly reinforced structures is not more than 4.5 m.

Concrete preparation device for the foundation:

$$V_{b.p.} = h_f \cdot S_{b.p.} \tag{15}$$

where h_f is the height, $l_f = 1.5m$

$S_{b.p.}$- area of concrete preparation (31 x 28.9).

$$V_{b.p.} = area \cdot height$$

Determine the area of formwork:

$$F_{o.r.} = l_f \cdot h_f \quad (16)$$

where l_f is the perimeter, l_f = 119.8 m,

hf - foundation height (hf = 1.5m).

$$F_{o.r.} = l_f \cdot h_f$$

Concrete work volume

$$V = V_{b.p.} \cdot V_f \quad (17)$$

where $V_{b.p.}$ is the volume of concrete preparation, m3,

V_f is the total volume of the slab foundation 3.

$$V = V_{b.p.} \cdot V_f \quad (18)$$

The foundation is reinforced with space frames.

Table 12 – volume of works

Name of works	Justification for ENiR	unit of measurement according to ENiR	Amount Of work	working hours-no workers, man-hour	The cost of labor		Link composition
					Person hour	Person hour	
Installing reinforcing bars	E4 1-46	t	57.37	6.7	384.38	48.05	Rein. worker: 5 pit-1 persons. 2 pit-3 persons.
Installation of formwork	E4 1-37	$1m^2$	107.82	0.39	42.05	5.26	Locksmiths: 4 pit-1 persons. 3 pit-1 persons.
Laying concrete in the construction of concrete pumps	E4 1-49	$1\ m^3$	888.34	0.23	204.32	25.54	concrete workers: 2 pit-1 person. 4 pit-1 person.
Disassembly of formwork	E4 1-37	$1\ m^2$	107.82	0.21	42.05	5.26	Locksmiths: 3 pit-1 person. 2 pit-1 person.
Waterproofing	E4 11-37	$100\ m^2$	1.08	2.3	2.48	0.31	workers 2 pit-1 person. 4 pit-1 person.
All:					675.28	84.42	

5.7 Construction machines and mechanisms

Because the mechanized method has shown its high efficiency in the construction industry, it was decided to use mechanized resources to carry out the soil development process. The list of works performed by machines and mechanisms is very extensive and significantly speeds up the process of construction and production of work and allows to ensure greater safety of workers and reduce labor costs.

Determine the volume of soil in a dense body in an excavator bucket:

$$V_{g.r.} = V_{kov} \cdot \frac{K_{scl}}{1 + K_{pr}} = \frac{0.8 \cdot 1.15}{1 + 1.28} = 0.72$$

where K_{nap} is the bucket filling factor (for an excavator with a front shovel equal to 1.15)

K_{csl} - coefficient of initial soil loosening.

Find the mass of soil in the excavator bucket.

$$Q = V_{gr} \cdot p = 0.72 \cdot 1.85 = 1.32$$

where p is the average soil density, t / m^3

Crane selection

The calculated data are:

- Installation weight of the structure Pm
- Mounting height N_m
- Departure of the crane hook L_{cr}

The required carrying capacity consists of the masses of the structure P itself (the mass of the container with concrete is 3.5 tons) and the equipment Ro, which is necessary for gripping, lifting, and temporarily fixing the structure.

$$P = 1.1 * P + P = 1.1 * 3.5 + 0.5 = 4.35t$$

The required lifting height of the load - it includes the design mark of the height of the structure Ho, the height of the structure He (the height of the elevator shaft 0.81.0 m), the height of the load-gripping elements N_{gr}, the stock in height $N_{zap.}$

$$H = H_o + H_a + H_{gr} + H_{zap} = 31.8 + 1 + 4 + 0.9 = 37.7m$$

The required outreach of the hook - it includes g - the rear clearance of the crane (0.7 is the minimum allowable distance), B - the width of the building,

Δl - the margin for the outreach 1.5 ... 2.0 m

$$L_{kp} = g + 0.7 + B + \Delta l = 3.8 + 0.7 + 27.9 + 2 = 34.4m$$

We accept a tower crane KB-504A.08 with the following parameters:

Carrying capacity -10 t

Boom reach -45.0 m.

Boom lift - 71.6 m

5.8 Excavator selection

When developing a pit, we need an excavator. There are two types of excavators according to the type of mechanical shovel: with a back shovel and a straight. The level of the excavator will be higher than the level of the excavated pit, in connection with this condition, we must use an excavator with a backhoe. Next, let us start comparing two modern, popular excavators and draw a conclusion based on the technical and economic indicators of each.

The volume of this pit is equal to 84580 m3, since the required value is very large and the soil category is II, then we will make a comparison three excavators with bucket volumes of 1.86 m^3 and 1.4 m3. Let us compare the technical indicators of the Hitachi ZX330-5G excavator with a bucket volume of 1.86 m3 and the Hitachi ZX350LCK-5G 1.4 m3.

Before proceeding with determining the production of excavators per shift, we need to determine the total number of machine-shifts for each:

$$N_{mach.shef.} = \frac{H_{1vr}V_{oz}+H_{2vr}V_3}{8.2 \cdot 100} \tag{19}$$

where H_{1vr} - is the working rate of development time.

H_{2vr} - is the working standard of development time, considering loading into a dump truck.

For Hitachi ZX330-5G, these values are 2.1 and 2.3, respectively. For Hitachi ZX350LCK-5G - 1.9 and 2.2.

$$N_{mach.shef.} = \frac{1.9 \cdot 8778 + 2.2 \cdot 2147}{8.2 \cdot 100} = 26$$

$$N_{mach.shef.} = \frac{2.1 \cdot 8778 + 2.3 \cdot 2147}{8.2 \cdot 100} = 28$$

The formula for the excavator's replacement output is presented below:

$$P = \frac{V_k}{N_{mach.shef.}} \tag{20}$$

where V_k is the capacity of the excavated pit, m3.

$P = \frac{84580}{26} = 3240m^3$ for Hitachi ZX350LCK-5G

$P = \frac{84580}{28} = 2967m^3$ Hitachi ZX330-5G

Price for the development of 1 cubic meter of soil:

$$C = \frac{1.08 \cdot C_{mach.shef}}{P} \tag{21}$$

where 1.08 is the overhead ratio;

$S_{mach.shef}$ - the rate for one machine shift. For Hitachi ZX330-5G it is 64,000 tenge, and for Hitachi ZX350LCK-5G - 58,000 tenge.

$$C = \frac{1.08 \cdot 58000}{3240} = 19 \text{ for Hitachi ZX350LCK-5G}$$
$$C = \frac{1.08 \cdot 64000}{2967} = 23 \text{ for Hitachi ZX330-5G}$$

Let us determine the specific capital investment for the development of 1 m3 of soil according to the formula:

$$K_{od} = \frac{1.07 \cdot C_{es} \cdot 1000}{P \cdot t_g} \quad (22)$$

where 1. 07Ce.s - is the inventory and estimated cost of the excavator. For Hitachi ZX350LCK-5G, C_{es} is 23000, for Hitachi ZX330-5G - 26000.

tg - is the standard annual number of excavator shifts. The size is 350 shifts.

$$K_{od} = \frac{1.07 \cdot 23000 \cdot 1000}{3240 \cdot 350} = 21 \text{ for Hitachi ZX350LCK-5G}$$
$$K_{od} = \frac{1.07 \cdot 26000 \cdot 1000}{2967 \cdot 350} = 26 \text{ for Hitachi ZX330-5G}$$

The given costs for the development of 1 m3 of soil are calculated using the following formula:

$$P = C + EK_{od} \quad (23)$$

where E - is the coefficient of capital investments, considering the normative efficiency, equal to 0.15.

$$P = 19 + 0.15 \cdot 21 = 22 \text{ for Hitachi ZX350LCK-5G}$$
$$P = 23 + 0.15 \cdot 26 = 27 \text{ for Hitachi ZX330-5G}$$

Based on the calculated values, we can form a conclusion that the Hitachi ZX350LCK-5G excavator is more economical.

The main characteristics of the selected excavator:

Stick length - 3.2 m;

Maximum digging depth - 7.38 m;

The highest working height - 10.36 m;

The largest digging radius - 11.1 m;

5.9 Selection of a bulldozer

A bulldozer at the construction site performs such work as cutting off the vegetation layer and backfilling the soil in the sinuses of the excavation. First, we need to compare the performance and their characteristics, and then, based on these data, draw a conclusion, and choose one of the two bulldozers.

The working performance of the desired machine is determined by the following formula:

$$P = \frac{60TqaK_v}{T_H + T_P + \frac{I_g}{V_g} + \frac{I_n}{V_n}} \quad (24)$$

where T is the duration of the work shift, h;

q is the volume of compacted soil, m^3;

a - consumption of soil during transportation;

K_v - time coefficient of machine operation, depending on the category of soil (0.8).

$T_н$ - time for filling, min;

T_p - interval for the transition between speeds, min;

lg, ln - distance of transportation with cargo and wasted, km;

V g, $V\ n$ - vehicle speed in laden and unladen states, respectively, m / min.

$$a = 1 - 0.005 \cdot I_g = 1 - 0.005 \cdot 10 = 0.95.$$

Parameters and characteristics of the first Komatsu D65EX bulldozer:

Loaded bulldozer speed - 4.2 m / min;

Empty bulldozer speed - 6.7 m / min;

Time for filling - 0.3 min; Interval for speed switching - 0.1 min;

The volume of dense soil in the bucket is 5.61 m3.

$$P = \frac{60 \cdot 8 \cdot 5.61 \cdot 0.95 \cdot 0.8}{0.3 + 0.1 + \frac{10}{4.2} + \frac{10}{6.7}} = 479$$

Parameters and characteristics of the second Komatsu D85ESS-2A bulldozer:

Loaded bulldozer speed - 4.4 m / min;

Empty bulldozer speed - 7.1 m / min;

Time for filling - 0.27 min; The interval for switching speeds - 0.11 min;

The volume of dense soil in the bucket is 6.8 m3.

$$P = \frac{60 \cdot 8 \cdot 6.8 \cdot 0.95 \cdot 0.8}{0.27 + 0.11 + \frac{10}{4.4} + \frac{10}{7.1}} = 612$$

Based on the comparison, we decide that the second Komatsu D85ESS-2A bulldozer is more economical.

5.10 Selection of dump truck

In addition to the soil, which we will need to fill the sinuses of the pit and compact, a large volume of soil needs to be transported outside the construction site. This process is carried out by dump trucks. The bucket volume of the accepted excavator is 1.4 m3. Travel range 10 km. The carrying capacity of the dump truck must be 18 tons, we choose the MAN TGX 50.480 8x8 BB-WW dump truck. The purpose of the following calculations will be to calculate the optimal number of cars.

The volume of compacted soil in the excavator bucket:

$$V_{gr} = \frac{V_{kov} V_{ff}}{1 + K_{cil}} \qquad (25)$$

where V_{ff} is the filling factor of the excavator bucket (0.8 ÷ 1);

K_{cil} - coefficient of initial loosening.

$$V_{gr} = \frac{1.4}{1.28} = 1.09m^3$$

Let us calculate the mass of soil in the bucket:

$$Q = V_{gr}\rho_{gr} \qquad (26)$$

where ρgr is the average soil density, t / m3.

$$Q = 1.09 \cdot 1.725 = 1.88t/m^3$$

Let us find the required number of soil buckets to be placed in the dump truck:

$$n = \frac{g}{Q} = \frac{18}{1.88} = 10$$

where g is the maximum tonnage of a dump truck, t.

Determination of the amount of compacted soil loaded into the dump truck:

$$V = V_{gr} \cdot n = 1.09 \cdot 10 = 10.9m^3$$

Before determining the cycle time of a dump truck, you need to find time to load soil:

$$t_n = \frac{VH_{vr}60}{100} \qquad (27)$$

where H_{vr} is the standard time of the machine according to ENiR-2-1-8 for loading 100 m3 of soil with an excavator.

$$t_n = \frac{10.9 \cdot 2.3 \cdot 60}{100} = 15\ min$$

Let's determine the duration of one cycle of the dump truck:

$$T_C = t_n + \frac{60L}{V_g} + t_p + \frac{60L}{V_n} + t_m \qquad (28)$$

Where L is the distance of soil movement, km;

V p - approximate speed when empty (24-28 km / h);

tp - the duration of unloading is 1–2 min, min;

tm - the duration of secondary actions - 2-3 minutes, min;

V g - speed of a dump truck in a loaded state, km / h.

$$T_C = 15 + \frac{60 \cdot 10}{18} + 1 + \frac{60 \cdot 10}{29} + 2 = 72min$$

Calculate the required number of cars:

$$N = \frac{T_C}{t_n} = \frac{72}{15} = 5$$

Based on the calculations, we get the number of required machines - 5.

The need for construction in the main construction machines and mechanisms is presented in table 13.

Table 13 – Vehicles

Name	Recommended type of machines	Amount	Application area
excavator	Hitachi ZX350LCK-5G	3	Excavating and smoothing earth
bulldozer	Komatsu D85ESS-2A	3	Surfacing and transferring soil
Crane	QUY-25K	2	Lifting equipments in project site
Welding machine	TD-500	3	Welding reinforcement bar and other metals
Pneumatic rammer	E-157	3	Compacting and hardening earth
Vibrators: Surface deep	EB-19 1 EB-66	3 3	For vibrating concrete for better mix and compaction
Concrete pump	BRA1406E	4	Pouring concrete in area
Self-propelled roller	DO-50	2	Compaction area in large size

5.11 Construction personnel

Maximum number of workers per shift at the facility:

$$N_{total} = 1.05 \cdot (N_{op} + N_{vp} + N_{etr} + N_{cl} + N_{mop}) \qquad (29)$$

N_{op} - the number of workers according to the main production according to the schedule of movement of workers, N_{op} = 96 people.

The number of workers in auxiliary production is taken as 20 percent of the main production. The number of engineering and technical personnel, 10 percent (N_{op} + N_{vp}), the number of employees, 5 percent (N_{op} + N_{vp}), the number of junior service personnel (cleaners, watchmen, etc.), 3 percent (N_{op} + N_{vp})

$$N_{total} = 1.05 \cdot (96 + 19 + 12 + 6 + 3) = 143\, person$$

Below is table 14 with the calculation results

Table 14 – workers

Name	unit of measurement	Quantity
Continuity of construction	days	254
Working shift	hours	8
The total number	person	143
Auxiliary r.s.	person	19
ITR	person	12
Serving 5 percent	person	6
MOP and protection 3 percent	person	3
Work	person	96

5.12 Choice of types of inventory buildings

Table 15 – Inventory buildings

Name	Unit of measurement	Normative indicator	The amount accepted in the project at Ntotal = 143 people.
Sanitary and household premises			
Wardrobe	m^2	0.9 m2 per 1 person.	128,7
Place for heating	m^2	1 on 1 person.	143
Washing	m^2	0.05 m2 per 1 person.	4.6
Placement for personal hygiene	m^2	0.18 m2 per 1 person.	25,74
Soulful	m^2	0.43 m2 for 1 person	61,49
Toilet	m^2	0.07 m2 per person	10.01
Dry	m^2	0.2 m2 for 1 person	28.6
Dining room	m^2	0.6 m2 for 4 persons	21.45
			N_{total} = 143 people.
Medical center	m^2	20 m2 for 300 - 500 people	20
Office space			
Site engineer	m^2		
Dispatcher	m^2	6 m2 for 1 person	200

Labor protection office	m^2	20 m2 per 1000 people	20

5.13 Energy and water

Energy demand

Calculations of the need for energy resources are shown in Table 3.6. The provision of electricity during the construction period is provided from the existing electrical networks through temporary overhead power lines. Water supply for industrial and household drinking needs is provided from the existing external water supply network through a permanent pipeline; for fire extinguishing - from a fire hydrant on a permanent pipeline.

Table 16 - Demand for energy resources

Resource name	Units	Need
Electricity	kw	150
Oxygen	m3	6040.32
Compressed air (compressor)	PC.	1

Calculation of internal water supply.

Water consumption for production and technological needs:

$$q_{pr} = V \cdot q_1 \cdot \frac{k_1}{3600 \cdot t} \tag{30}$$

Water consumption for construction machines for engine cooling

$$q_{pr} = \frac{W \cdot q_2 \cdot k_2}{3600} \tag{31}$$

Consumption for household and drinking needs.

$$q_{pr} = \frac{N \cdot q_3 \cdot k_3}{3600 \cdot t} \tag{32}$$

Shower water consumption

$$q_{pr} = \frac{q_1 \cdot N_1}{60 \cdot t_1} \tag{33}$$

The calculation results are presented in table 17.

Table 17 – Energy needed

Types of water consumption	Units	amount	Specific water consumption, l	Non-uniformity coefficient	Duration of consumption	Water consumption, l / day
Production Needs						
Excavator operation	1 mach. hour	3	15	1.5	8	0.002
Car wash and refueling	1 mach. shift	2	15	1.5	8	0.002
Construction Machines						
Watering concrete and formwork	1 m3	10	300	1.5	8	1.25
Plastering works	1m2 on the surface	148	8	1.5	8	0.49
Planting trees	1 tree	12	1000	1.5	8	5
Planting bushes	1 bush	9	200	1.5	8	0.75
Household Needs						
Household and drinking needs	person	96	22	2	8	0.147
Shower installations	person	48	35		0.75	37.3
					Σ=	37.5
					Total	45

5.14 Labor protection and safety measures

The performance of work must be carried out with the obligatory observance of safety regulations, fire safety, labor protection in accordance with the requirements of SNiP RK 1.03-05-2001 "Labor protection and safety in construction", SNiP

Responsibility for the implementation of measures for safety, labor protection, fire and environmental safety rests with the work managers appointed by the order.

Labor protection of workers should be ensured by the issuance by the administration of the necessary personal protective equipment (special clothing, footwear, etc.).

All persons on the construction site are required to wear protective helmets, workers and engineers and technicians without protective helmets and other necessary personal protective equipment are not allowed to work. Individual protective equipment issued to employees must correspond to their gender, height and size, the nature and conditions of the work performed and ensure, within a given time, the reduction of the impact of harmful and dangerous production factors.

The construction site is fenced with a temporary panel-post fencing with a height of 2.0 m in accordance with GOST 23407-78 Inventory fencing of construction sites and areas of construction and installation works technical conditions.

The width of the passages for one-way traffic of vehicles must be at least 3.5 m, for two-way traffic - at least 6.0 m, and for a lifting crane - at least 5.0 m.

For the correct organization of traffic on the territory of the construction site, direction indicators, road signs with the designation of the permissible speed, parking places for vehicles in accordance with GOST 10807-78 are installed.

Pits and trenches along the upper edge of the slope should be fenced off with a safety guard. For the passage through the dug trenches and pits, pedestrian bridges with a width of at least 0.8 m with double-sided railings 1.0 m high are installed.

Artificial lighting of workplaces, walkways and driveways is carried out in accordance with the "Standards for electrical lighting for construction and installation works."

In the dark, the construction site is illuminated by PKN-1000-2 floodlights installed on the building to be reconstructed and on temporary supports.

5.15 Environment protection

All personnel involved in construction and installation work in security zones must be trained in methods and instructed in the sequence of safe work. An admission order is issued to produce work of increased danger.

Collection and disposal of waste containing toxic substances is carried out in closed containers or tight bags, excluding manual loading. Incineration of construction waste at the construction site is not allowed.

In the area of production of planning works, the vegetation layer must first be removed and formed in specially designated places with subsequent use for land reclamation. In addition, measures should be taken to preserve the growing trees and shrubs existing on the territory of buildings under construction and reconstruction.

The performance of work must be carried out with the obligatory observance of safety regulations, fire safety, labor protection in accordance with the requirements of SNiP RK 1.03-05-2001 "Labor protection and safety in construction", SNiP and regulations of other organizations, the requirements of which do not contradict the above normative documents in construction.

Responsibility for the implementation of measures for safety, labor protection, fire and environmental safety rests with the work managers appointed by the order. Labor protection of workers should be ensured by the administration of the necessary personal protective equipment (special clothing, footwear, etc.), the implementation of measures for the collective protection of workers (fences, lighting, ventilation, protective and safety devices and devices, etc.), sanitary premises and devices in accordance with applicable standards and the nature of the work performed.

Workers must be provided with the necessary working, food and rest conditions. Waste containing toxic substances is collected and disposed of in closed containers or tight bags, excluding manual loading. Incineration of construction waste at the construction site is not allowed.

5.16 Installation work

At the site (capture), where installation work is being carried out, it is not allowed to carry out other work and to find unauthorized persons.

When erecting buildings and structures, it is forbidden to perform work related to finding people in one section (grab, section) on floors (tiers) over which moving, installing, and temporarily securing prefabricated structures or equipment are carried out.

When erecting single-section buildings or structures, the simultaneous installation and other construction work on different floors (tiers) is allowed if there are reliable (justified by the appropriate calculation for the impact loads) interfloor ceilings by written order of the chief engineer after the implementation of measures ensuring the safe performance of work, and subject to being directly at the place of work of specially designated persons responsible for the safe installation Ms. and the movement of goods by cranes, as well as for monitoring the implementation by the crane operator, slinger and signalman of production instructions for labor protection.

Ways of slinging structural elements and equipment should ensure their supply to the installation site in a position close to the design.

It is forbidden to lift prefabricated reinforced concrete structures that do not have mounting loops or marks that ensure their correct slinging and installation.

Cleaning of structural elements to be mounted from dirt and ice should be done before they rise.

Slinging of structures and equipment should be carried out with load-gripping means meeting the requirements of clauses 7.4.4, 7.4.5 SNiP 12-03 and providing the possibility of remote distribution from the working horizon in cases when the height to the lock of the load-gripping means exceeds 2 m.

Elements of mounted structures or equipment during movement must be prevented from swaying and rotation by flexible guy wires.

People are not allowed to stay on structural elements and equipment during their lifting or moving.

During breaks in the work, it is not allowed to leave the raised structural elements and equipment on weight.

Braces for temporary fastening of mounted structures must be attached to reliable supports (foundations, anchors, etc.). The number of braces, their materials and cross-section, methods of tension and places of fastening are established by the project of work. Braces should be located outside the dimensions of traffic and construction vehicles. Braces should not touch the sharp corners of other structures. Bending the braces at the points of contact with elements of other structures is allowed only after checking the strength and stability of these elements under the influence of efforts from the braces.

To move installers from one structure to another, inventory ladders, transition bridges and ladders with a fence should be used.

The installers are not allowed to go over the installed structures and their elements (trusses, crossbars, etc.), on which it is impossible to install a fence that provides the passage width in accordance with clause 6.2.19 of SNiP 12-03, without the use of special safety devices (reliably a rope stretched along the truss or crossbar to secure the carabiner of the safety belt, etc.).

Elements of structures or equipment installed in the design position must be fixed so that their stability and geometric immutability are ensured.

Distribution of structural elements and equipment installed in the design position should be made after their permanent or temporary reliable fixation. It is not allowed to move installed elements of structures or equipment after their distribution, except for cases justified by PPR.

It is not allowed to carry out installation work at a height in open places with a wind speed of 15 m / s or more with sleet, thunder, or fog, which excludes visibility within the front of the work. Movement and installation of vertical panels and similar structures with high wind age should be stopped at a wind speed of 10 m / s or more.

It is not allowed to find people under the mounted elements of structures and equipment before installing them in the design position and fixing.

If it is necessary to find workers under the mounted equipment (structures), as well as on equipment (structures), special measures must be taken to ensure the safety of workers.

Mounted mounting sites, ladders, and other devices necessary for the work of installers at a height should be installed and secured to the mounted structures before they are lifted.

During installation (dismantling) work in the conditions of an operating enterprise, the operated electric networks and other existing engineering systems in the work area should, as a rule, be disconnected, short-circuited, and equipment and pipelines should be freed from explosive, combustible, and harmful substances.

When carrying out installation works, it is not allowed to use equipment and pipelines, as well as technological and building structures to fix technological and installation equipment, without coordination with the persons responsible for their correct operation.

Before performing installation work, it is necessary to establish the procedure for exchanging conditional signals between the person managing the installation and the driver (minder). All signals are given by only one person (foreman of the installation team, link, rigging and slinger), except for the “Stop” signal, which can be given by any employee who has noticed a clear danger.

In especially important cases (when lifting structures using complex rigging, the turning method, when sliding large and heavy structures, when lifting them with two or more mechanisms, etc.), signals should be given only by the foreman of the installation team in the presence of engineers and technicians, responsible for the development and implementation of technical measures to ensure safety requirements.

When sliding (moving) structures and equipment with winches, the load capacity of brake winches and chain hoists should be equal to the load capacity of traction, unless otherwise specified by the project.

Installation of structures of each subsequent tier (section) of a building or structure should be carried out only after reliable fastening of all elements of the previous tier (section) according to the design.

Mounted metal stairs with a height of more than 5 m must meet the requirements of clause 6.2.19 of SNiP 12-03 or be fenced with metal arches with vertical ties and securely attached to the structure or equipment. Workers can climb stairs to a height of more than 10 m if the stairs are equipped with rest areas at least every 10 m in height.

When installing frame buildings, it can install a subsequent tier of the frame only after the installation of building envelopes or temporary fences on the previous tier.

During the installation of structures, buildings or structures, installers must be on previously installed and securely fixed structures or scaffolds.

Installation of flights of stairs and platforms of buildings (structures), as well as cargo-passenger building lifts (elevators) should be carried out simultaneously with the installation of building structures. On mounted staircases, fences should be installed immediately.

On the capture, in which the building structure is being installed, it is not allowed to use the passenger-and-freight elevator (elevator) directly during the movement of structural elements.

When assembling metal structures from rolled billets, measures must be taken against spontaneous folding of the roll.

Painting and anticorrosive protection of structures and equipment in cases when they are carried out at a construction site should be carried out, as a rule, before they rise to the design mark. After lifting, paint or anticorrosion protection should only be done at joints or joints of structures.

Unpacking and de-preservation of equipment to be installed must be carried out in the area allocated in accordance with the project of work, and carried out on special racks or linings with a height of at least 100 mm.

When conservation of equipment is not allowed the use of materials with explosion and fire hazard properties.

The assembly and retrofitting of structures and equipment to be installed (threading on pipes, bending pipes, fitting joints, and the like) should be performed, as a rule, at specially designated places.

In the process of assembly operations, the alignment of the holes and verification of their coincidence in the mounted parts should be carried out using a special tool (cone mandrels, assembly plugs, etc.). It is not allowed to check the coincidence of the holes in the mounted parts with fingers.

When assembling horizontal cylindrical containers, consisting of separate casing, wedge linings and other devices should be used that exclude the possibility of spontaneous rolling of the casing.

When installing equipment in an explosive atmosphere, tools, equipment, and accessories should be used that exclude the possibility of sparking.

When installing equipment, the possibility of spontaneous or accidental switching it on should be excluded.

When moving structures or equipment with several lifting or traction means, the possibility of overloading any of these means must be excluded.

When moving structures or equipment, the distance between them and the protruding parts of the mounted equipment or other structures should be horizontal at least 1 m, vertical - 0.5 m.

The angles of deviation from the vertical of the cargo ropes and hoists of the lifting equipment during the installation process should not exceed the value specified in the passport, the approved project, or the technical specifications for this lifting equipment.

When installing equipment using jacks, measures must be taken to exclude the possibility of skewing or tipping jacks.

When lowering structures or equipment on an inclined plane, brake means should be used that provide the necessary regulation of the speed of descent.

6 Economic part

The economics section contains the data of the consolidated estimate of the construction cost. In a market economy, it all comes down to monetary relations determined by the prices of resources and finished products. Budgeting involves the process of forming the price of construction products based on the project, estimate norms, prices, prices, and other data.

The modern estimate and regulatory framework allow us to generally determine the cost of construction products at all stages of development.

Today, there are many budget programs. In the Republic of Kazakhstan, these are ABC, SANA, Estimate of the RK 2018.

ABC 4.1.2 version was used to calculate the economic section in this thesis project. Estimates are calculated using the basic-index method based on the estimated regulatory base on January 1, 2001.

When drawing up estimates for the construction of facilities, the following regulatory documents were applied:

SSC 8.04-08-200 Collections of estimated prices at the current level for building materials, products, and structures. ESN RK 8.04-01-200 Collection of elementary estimate rates of resource consumption for construction work. ESN RK 8.04-01-200 Collection of elementary estimated resource consumption rates for equipment installation. SN RK 8.02-02-200 Overhead costs by type of construction and installation work. NDZ SN RK 8.02-09-2002 Collection of estimated cost norms for the construction of temporary buildings and structures. NDZ RK 8.02-07-2002 Collection of estimated norms and additional costs in the production of construction and installation work in the winter. SNiP RK 1.03-03-2001 Regulations on designer supervision of project developers over the construction of enterprises, buildings, structures, and their overhaul.

Economic data is listed in Appendix B.

CONCLUSION

This diploma project consists of the following sections: architectural and construction section, computational design section, construction technology, economic section, and labor protection section.

In the architectural and construction department there are volumetric planning solutions and design solutions.

In the section of technology of construction production, the methods of construction production are defined, the general plan of construction, and the calendar schedule is developed. The accepted methods of work production provide for complex mechanization and the use of high-performance construction machinery, which ensures high quality of work and safety, flow, and continuity of the construction process.

The department of labor protection pays special attention to the prevention and work of hazards in construction. Developed considering the construction site and hazards from construction, considering the standards.

The economics section contains the data of the consolidated estimate of the construction cost. In a market economy, it all comes down to monetary relations determined by the prices of resources and finished products. Budgeting involves the process of forming the price of construction products based on the project, estimate norms, prices, prices, and other data.

Using modern software, the task was achieved. At the same time, the architectural and construction section, the computational and constructive part, the technology of construction production, as well as the economic part have been developed.

LIST OF REFERENCES

1 SP RK 2.04-107-2013 Construction heat engineering. Astana, 2013

2 SN RK 5.01-01-2013 Earthworks, foundations, and foundations. Astana, 2013.

3 SP RK 2.04-01-2017 Construction climatology. Astana, 2017.

4 EniR Collection 2, excavation

5 EniR Collection 4, Installation of prefabricated and installation of monolithic reinforced concrete structures

6 EniR Collection 11, Insulation works

7 EniR Collection 1, In-building transport works

8 SN RK 1.03-05-2011 "Occupational health and safety in construction." Astana, 2011.

9 SN RK 8.02-09-2002 Collection of estimated cost norms for the construction of temporary buildings and structures. Astana, 2002.

10 SNiP 2.0107-85. Loads and effects.

11 SNiP 2.0107-85. Loads and effects.

12 SNiP RK 5.03-33-2005 "Concrete and reinforced concrete structures".

13 Criminal Code of the Republic of Kazakhstan 2.04-103-2013 "Instructions on lightning protection of buildings and structures", Astana 2013.

14 Criminal Code of the Republic of Kazakhstan 2.04-04-2014 "Thermal protection of buildings", Astana 2014.

15 RK RK 2.03-30-2017 "Constructions in seismic areas (regions) of the Republic of Kazakhstan", Astana 2017.

16 Criminal Code of the Republic of Kazakhstan 2.01-101-2013 "Corrosion protection of building structures", Astana 2013.

Appendixes

Appendix A

Displaying analysis results as follow from LIRA-SAFR.

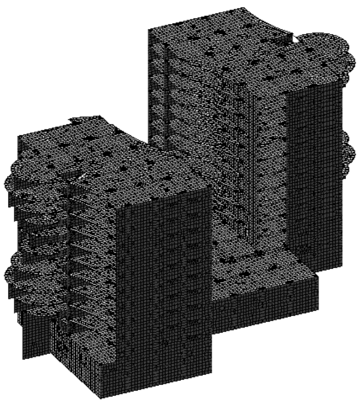


Figure A.1- 3D model of structure

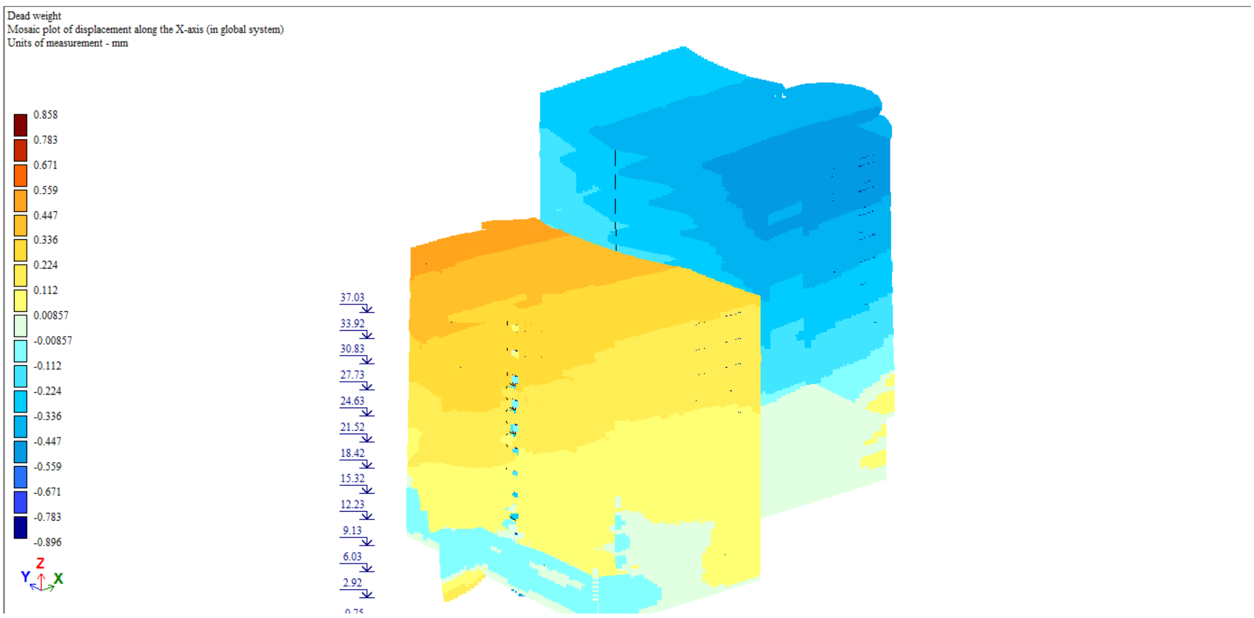


Figure A.2 - Displacement along x-axis due own-load

Continuation Appendix A

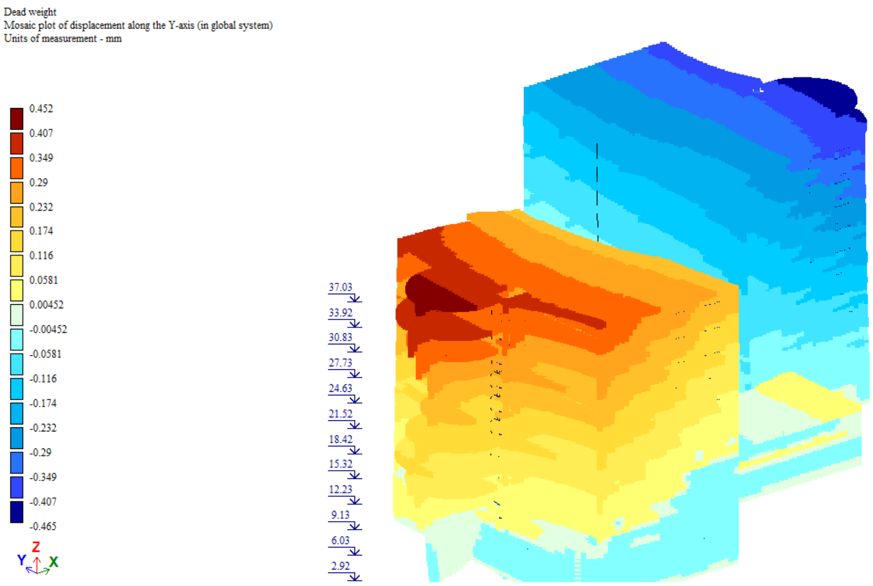


Figure A.3 - Displacement along y-axis due own-load

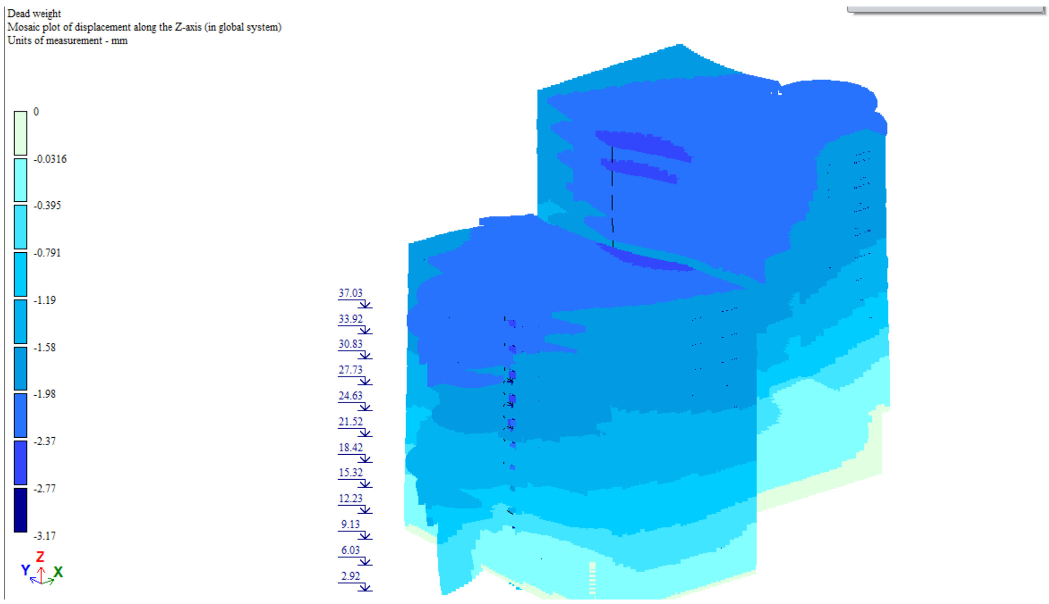


Figure A.4 - Displacement along z-axis due own-load

Continuation Appendix A

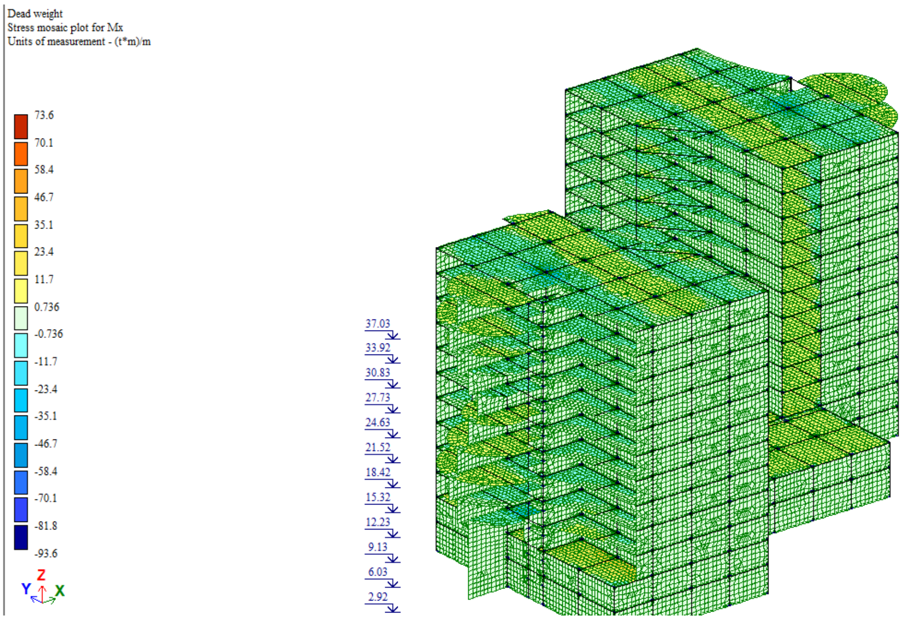


Figure A.5 - Stress mosaic plot for Mx

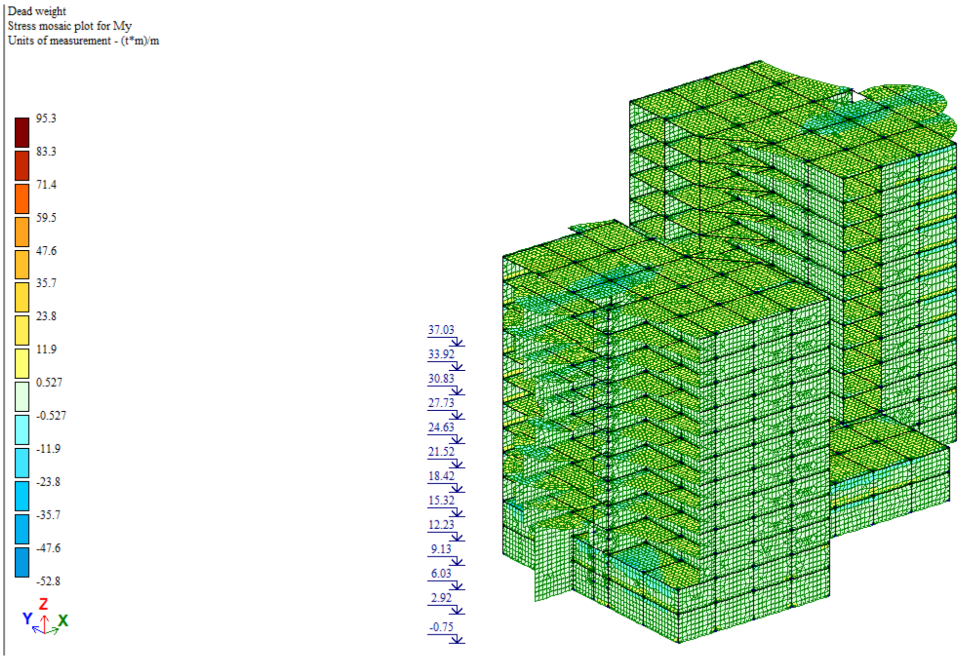


Figure A.6 - Stress mosaic plot for My

Continuation Appendix A

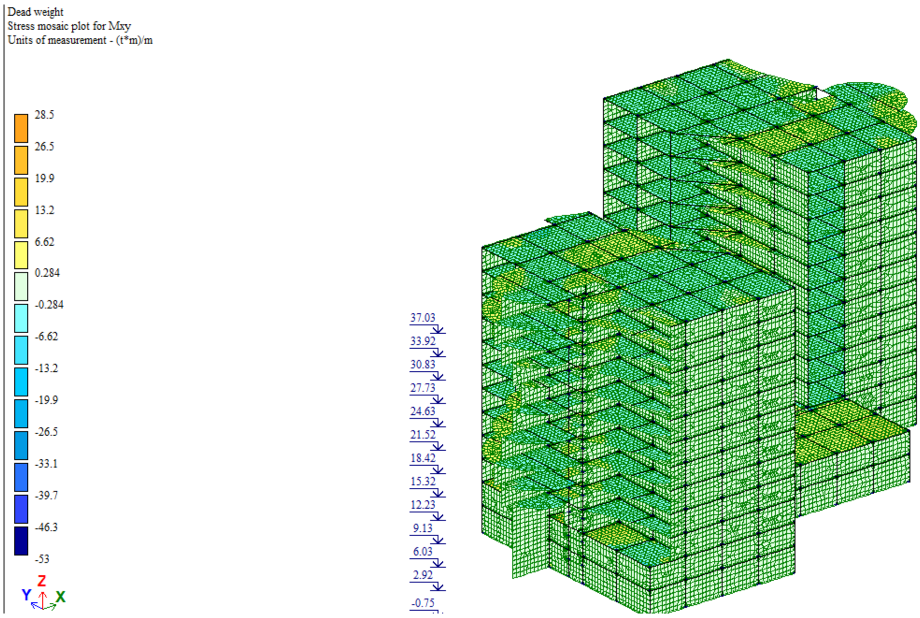


Figure A.7 - Stress mosaic plot for Mz

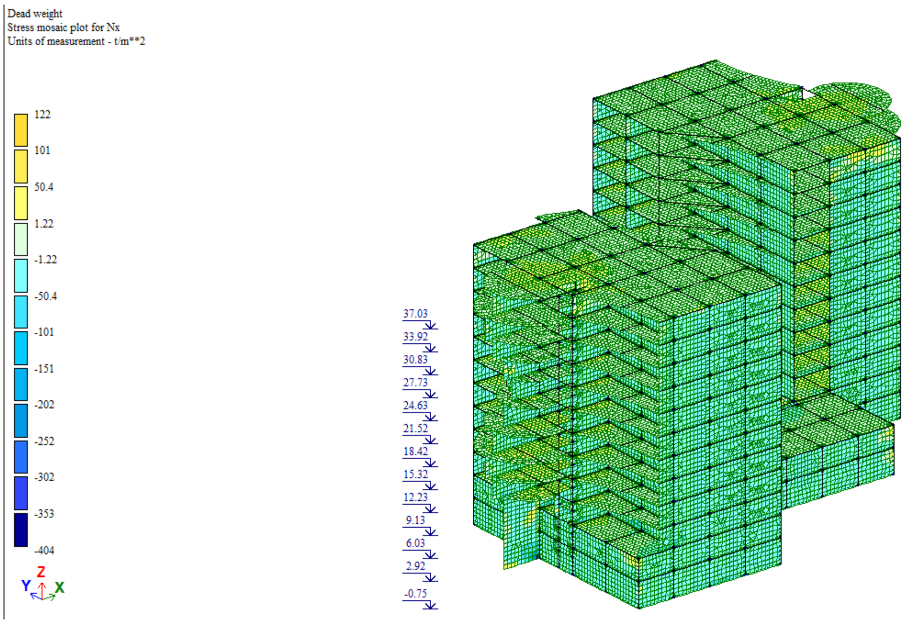


Figure A.8 – Diagram of normal force

Continuation Appendix A

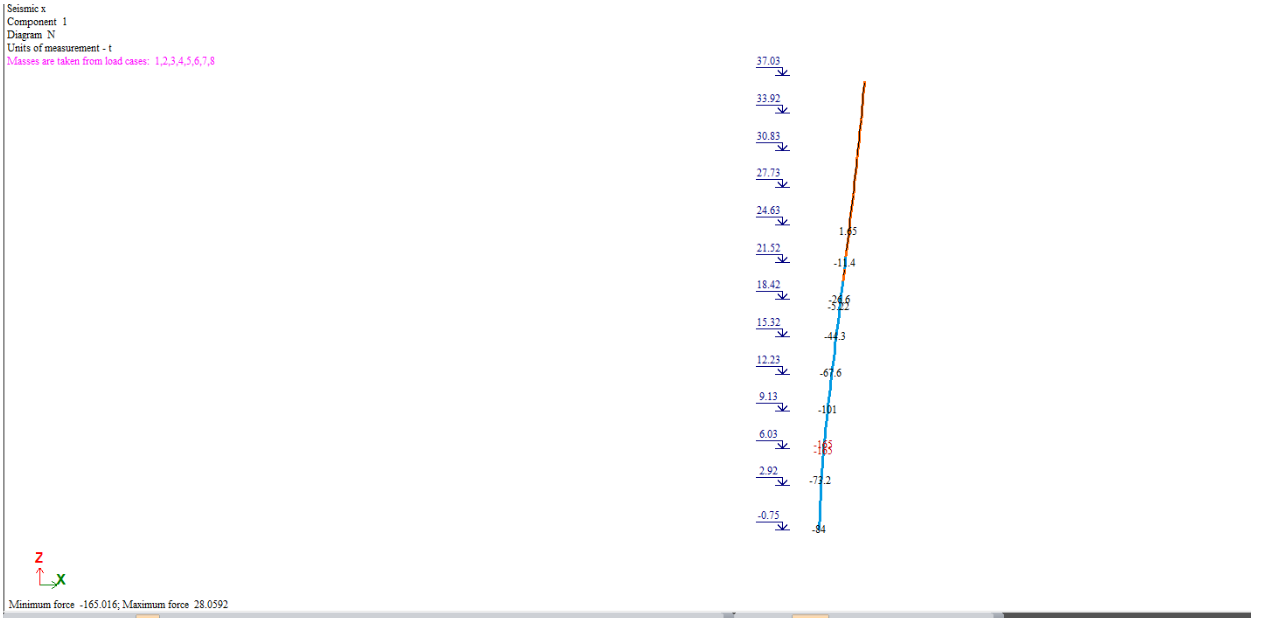


Figure A.9 – Normal force diagram due seismic in x-axis

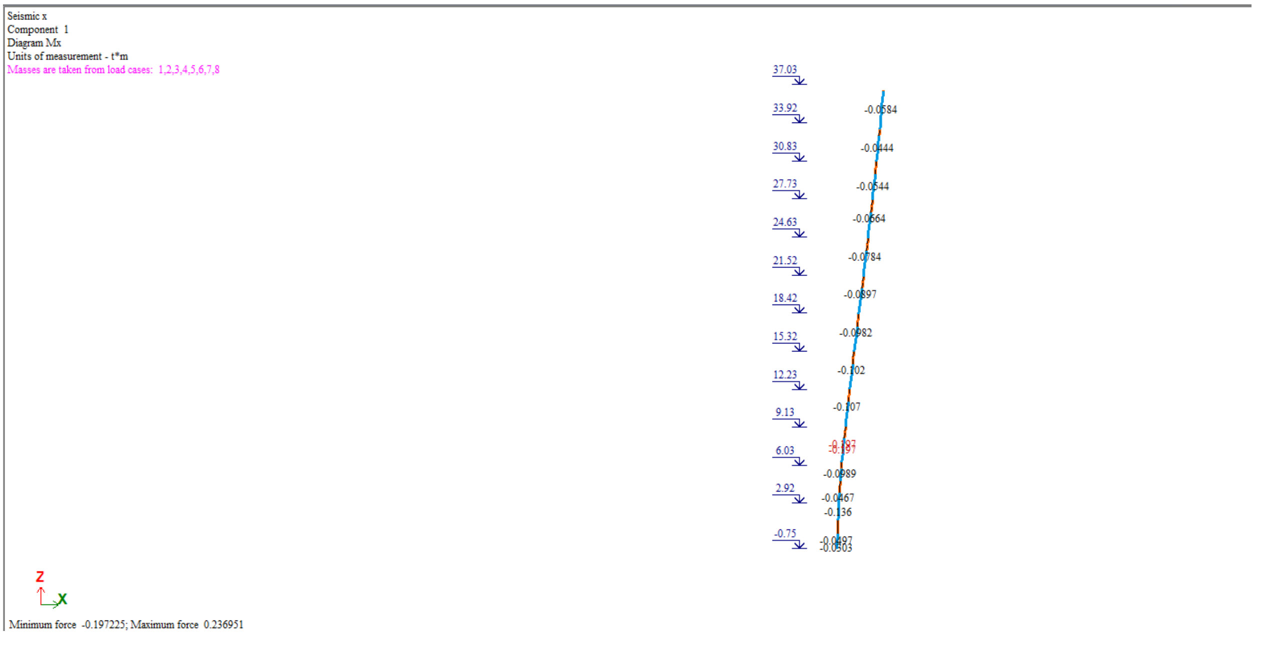


Figure A.10 - Diagram Mx due seismic in x-axis

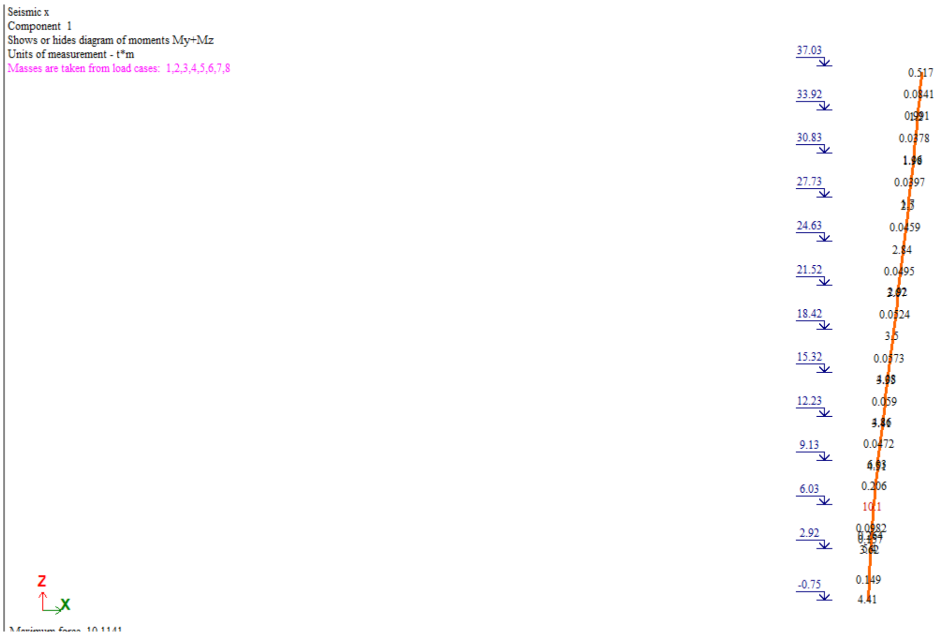


Figure A.11 – Diagram My+Mz due seismic load in x-axis

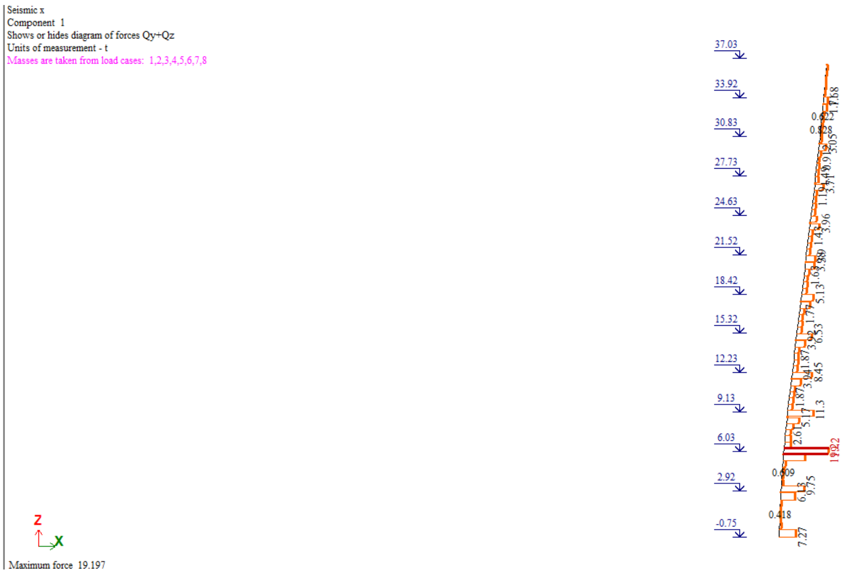


Figure A.12 – Diagram Qy+Qz due seismic load in x-axis

Appendix B

Estimated cost	74204,386	thousand tenge
Standard labor intensity	62246,61	person-h
Estimated wages	18443,409	thousand tenge

Compiled in 2020

N п/п	Code and item number of the standard	Name of works and costs, unit of measure	number	Unit cost, tenge: total / Salary of construction workers	Unit cost, tenge: Expl. machines / incl. Salary of drivers	Total cost, tenge: Total / Salary of construction workers	Total cost, tenge: Expl. machines / incl. Salary of drivers	Overheads: tenge / %	Labor costs, man-h, construction workers / workers serving machines: for one.	Labor costs, man-h, construction workers / workers serving machines: Total
1	2	3	4	5	6	7	8	9	10	11
SECTION 1. Earthwork										
1	E11-01-03-072-02	Layout of areas with bulldozers up to 132 (up to 180) kW (hp) m2	3 371,87	120,56 --	7,38 0,74	406 512,65 --	24 884,40 2 488,44	1 791,68 72,00	-- 0,41	-- 1 382,47
2	E11-01-01-001-04	Development of soil of the 4th group into the dump with single-bucket dragline excavators, with bucket with a capacity of 5-6 m3, electric walking when working on	2 930,93	115,60 3,64	204,18 3,52	338 815,51 10 668,59	598 437,29 10 316,87	15 109,53 72,00	1,36 0,94	3 986,06 2 755,07
3	E11-010104-0603	hydropower construction Backfilling of trenches and pits with bulldozers with a capacity of 243 (330) kW (hp), at	311,25	56,43 --	56,43 4,18	17 563,78 --	17 563,78 1 301,02	936,73 72,00	-- 0,66	-- 205,42
		TOTAL SECTION 1 DIRECT COSTS	**Tenge**			**762 891,94**	**640 885,47**			**3 986,06**
			Tenge			**10 668,59**	**14 106,33**			**4 342,97**
	The cost of general construction works -		Tenge			762 891,94				
	Materials -		Tenge							
	Total salary -		Tenge			24 774,92				
	The cost of materials and structures -		Tenge							
		Overhead costs -	Tenge					17 837,94		
		Normative labor intensity in N.R. -	person-h							416,45
		Estimated wages in N.R. -	Tenge			2 675,69				
		Irregular and unforeseen costs -	Tenge			46 843,79				
	TOTAL, the cost of general construction works -		Tenge			827 573,67				
		Standard labor intensity -	person-h							8 329,03
		Estimated salary -	Tenge			27 450,61				
		TOTAL SECTION 1	Tenge			827 573,67				
		Standard labor intensity -	person-h							8 329,03
		Estimated salary -	Tenge			27 450,61				
SECTION 2. Foundations										
4	E11-060101-0101	**Concrete preparation device, concrete class B7.5** м3	62,25	1 200,56 685,20	1 346,00 12,56	74 734,62 42 653,56	83 788,23 781,86	39 526,23 91,00	1,43 0,19	89,02 11,83
5	E11-060101-0113	**Construction of concrete pillars, concrete class B15** м3	3 797,24	2 150,60 220,66	3 408,30 27,31	8 166 344,34 837 898,98	12 942 133,09 103 702,62	856 857,46 91,00	4,17 0,17	15 834,49 645,53
6	E11-080101-0307	Side coating bituminous waterproofing in 2 layers on a leveled surface rubble masonry brick, concrete walls, foundations	16 434,00	365,30 21,20	27,01 0,35	6 003 340,20 348 400,80	443 882,34 5 751,90	329 362,01 93,00	0,19 0,00	3 122,46 26,29
7	C121-050301-3202	Reinforcing blanks, not assembled into frames and meshes steel of periodic profile class A-III, d 18 mm	5,19	210 000,00 --	-- --	1 089 370,80 --	-- --	-- --	-- --	-- --
8	C121-050301-3001	**Reinforcing blanks not assembled into frames and meshes smooth steel of class A-I, d** **8 мм**	2,59	96 200,00 --	-- --	249 517,79 --	-- --	-- --	-- --	-- --
		TOTAL SECTION 2 DIRECT COSTS	Tenge			**15 583 307,75**	**13 469 803,66**			**19 045,97**
			Tenge			**1 228 953,34**	**110 236,38**			**683,65**
	The cost of general construction works -		Tenge			14 244 419,16				
	Materials -		Tenge			1 338 888,59				
	Total salary -		Tenge			1 339 189,72				
		Overhead costs -	Tenge					1 225 745,70		
		Normative labor intensity in N.R. -	person-h							986,48
		Estimated wages in N.R. -	Tenge			183 861,86				
		Irregular and unforeseen costs -	Tenge			1 008 543,21				
	TOTAL, the cost of general construction works -		Tenge			17 817 596,66				
		Standard labor intensity -	person-h							19 729,62
		Estimated salary -	Tenge			1 523 051,58				
		TOTAL SECTION 2	Tenge			17 817 596,66				
		Standard labor intensity -	person-h							19 729,62
		Estimated salary -	Tenge			1 523 051,58				

Continuation Appendix B

					SECTION 3. Columns					
9	E11-060501-0201	**Arrangement of columns of civil buildings in metal formwork, concrete class B25** м3	77,81	23 012,14 7 436,23	13 416,07 1 479,17	1 790 627,60 578 630,16	1 043 935,26 115 097,62	631 292,28 91,00	13,55 5,07	1 054,36 394,51
10	C121-050301-3203	Reinforcing blanks, not assembled into frames and meshes steel of periodic profile class A-III, d 25-28 mm	9,08	153 000,00 --	-- --	1 388 949,30 --	-- --	-- --	-- --	-- --
11	C121-050301-3202	Reinforcing blanks, not assembled into frames and meshes steel of periodic profile class A-III, d 16-18 mm	2,59	217 000,00 --	-- --	562 841,58 --	-- --	-- --	-- --	-- --
12	C121-050301-3001	**Reinforcing blanks not assembled into frames and meshes smooth steel of class A-I, d** 8 мм	1,30	65 745,09 --	-- --	85 262,83 --	-- --	-- --	-- --	-- --
		TOTAL SECTION 3 DIRECT COSTS	Tenge Tenge			3 827 681,31 578 630,16	1 043 935,26 115 097,62			1 054,36 394,51
	The cost of general construction works -		Tenge			1 790 627,60				
	Materials -		Tenge			2 037 053,71				
	Total salary -		Tenge			693 727,78				
		Overhead costs -	Tenge					631 292,28		
		Normative labor intensity in N.R. -	person-h							72,44
		Estimated wages in N.R. -	Tenge			94 693,84				
		Irregular and unforeseen costs -	Tenge			267 538,42				
	TOTAL, the cost of general construction works --		Tenge			4 726 512,01				
		Standard labor intensity -	person-h							1 448,87
		Estimated wages -	Tenge			788 421,62				
		TOTAL SECTION 3	Tenge			4 726 512,01				
		Standard labor intensity -	person-h							1 448,87
		Estimated wages -	Tenge			788 421,62				
					SECTION 4. Walls					
13	E11-080201-0103	Laying of reinforced external walls made of bricks of medium complexity at a height floors over 4 m in areas with a seismicity of 7-8 points	2 520,65	4 875,72 1 820,44	812,62 206,49	12 289 983,62 4 588 684,84	2 048 330,60 520 499,13	4 751 541,09 93,00	4,90 0,41	12 351,19 1 033,47
14	E11-080201-0107	**Laying of internal brick walls with a floor height of up to 4 m** м3	630,28	3 745,55 1 556,64	259,44 195,56	2 360 742,07 981 117,50	163 519,58 123 259,93	1 027 071,01 93,00	4,25 0,39	2 678,69 245,81
15	E11-080401-0301	Laying of partitions made of bricks, reinforced with a thickness of 1/4 brick at a height floors up to 4 m	10 448,10	1 248,11 637,92	181,80 30,30	13 040 378,09 6 665 051,95	1 899 464,58 316 577,43	6 492 915,33 93,00	1,39 0,03	14 522,86 313,44
		TOTAL SECTION 4 DIRECT COSTS	Tenge Tenge			27 691 103,78 12 234 854,30	4 111 314,77 960 336,49			29 552,73 1 592,72
	The cost of general construction works -		Tenge			27 691 103,78				
	Materials -		Tenge							
	Total salary -		Tenge			13 195 190,78				
		Overheads -	Tenge					12 271 527,43		
		Normative labor intensity in N.R.-	person-h							1 557,27
		Estimated wages in N.R.-	Tenge			1 840 729,11				
		Irregular and unforeseen costs -	Tenge			2 397 757,87				
	TOTAL, the cost of general construction works -		Tenge			42 360 389,09				
		Standard labor intensity -	person-h							31 145,45
		Estimated wages -	Tenge			15 035 919,90				
		TOTAL SECTION 4	Tenge			42 360 389,09				
		Standard labor intensity -	person-h							31 145,45
		Estimated wages -	Tenge			15 035 919,90				
					SECTION 5. Overlap					
16	E11-060801-0105	Arrangement of ribbed slabs at a height of more than 6 m from the support area, concrete class B15	129,69	23 999,10 6 568,91	1 534,00 120,30	3 112 371,28 851 902,23	198 939,86 15 601,35	789 428,26 91,00	11,05 0,36	1 433,04 46,69
17	C121-050301-3202	Reinforcement blanks, not assembled into frames and meshes steel of a periodic profile class A-III, d 22 mm	25,94	124 000,00 --	-- --	3 216 237,60 --	-- --	-- --	-- --	-- --
18	C121-050301-3001	**Reinforcing blanks not assembled into frames and meshes smooth steel of class A-I, d** 6 мм	1,65	96 200,00 --	-- --	158 783,87 --	-- --	-- --	-- --	-- --
		TOTAL SECTION 5 DIRECT COSTS	Tenge Tenge			6 487 392,75 851 902,23	198 939,86 15 601,35			1 433,04 46,69
	The cost of general construction works -		Tenge			3 112 371,28				
	Materials -		Tenge			3 375 021,47				
	Total salary -		Tenge			867 503,58				
		Overhead costs -	Tenge					789 428,26		
		Normative labor intensity in N.R. -	person-h							73,99
		Estimated wages in N.R. -	Tenge			118 414,24				
		Irregular and unforeseen costs -	Tenge			436 609,26				
	TOTAL, the cost of general construction works -		Tenge			7 713 430,27				
		Standard labor intensity -	person-h							1 479,73
		Estimated salary -	Tenge			985 917,82				
		TOTAL SECTION 5	Tenge			7 713 430,27				
		Standard labor intensity -	person-h							1 479,73
		Estimated wages -	Tenge			985 917,82				

Continuation Appendix B

				SECTION 6. Roof						
19	**E11-120101-0701**	Roofing made of corrugated asbestos-cement sheets, ordinary profile on a wooden crate with its device	**226,36**	**2 300,00** **252,80**	**47,91** **8,96**	**520 634,90** **57 224,57**	**10 845,05** **2 028,46**	**54 512,78** **92,00**	**0,42** **0,02**	**95,07** **4,53**
20	**E11-120101-0102**	Installation of pitched roofs from three layers of roofing roll materials on bituminous mastic with a protective layer of gravel on bituminous mastic	**59,66**	**2 153,65** **216,93**	**41,39** **7,23**	**128 478,36** **12 941,20**	**2 469,12** **431,35**	**12 302,74** **92,00**	**0,23** **0,01**	**13,72** **0,60**
		TOTAL SECTION 6 DIRECT COSTS	Tenge			**649 113,26**	**13 314,17**			**108,79**
			Tenge			**70 165,76**	**2 459,80**			**5,12**
	The cost of general construction works -		Tenge			**649 113,26**				
	Materials -		Tenge							
	Total salary -		Tenge			**72 625,57**				
		Overheads -	Tenge					**66 815,52**		
		Normative labor intensity in N.R.-	person-h							**5,70**
		Estimated wages in N.R.-	Tenge			**10 022,33**				
		Irregular and unforeseen costs -	Tenge			**42 955,73**				
	TOTAL, the cost of general construction works -		Tenge			**758 884,51**				
		Standard labor intensity -	person-h							**113,92**
		Estimated wages -	Tenge			**82 647,89**				
		TOTAL SECTION 6	Tenge			**758 884,51**				
		Standard labor intensity -	person-h							**113,92**
		Estimated wages -	Tenge			**82 647,89**				
		TOTAL DIRECT COSTS BY ESTIMATE:	Tenge			**55 001 490,80**	**19 478 193,19**			**55 180,95**
			Tenge			**14 975 174,38**	**1 217 837,97**			**7 065,65**
	The cost of general construction works -		Tenge			**48 250 527,02**				
	Materials -		Tenge			**6 750 963,77**				
	Total salary -		Tenge			**16 193 012,35**				
		Overheads -	Tenge					**15 002 647,13**		
		Normative labor intensity in N.R.-	person-h							**3 112,33**
		Estimated wages in N.R. -	Tenge			**2 250 397,07**				
		Irregular and unforeseen costs -	Tenge			**4 200 248,28**				
	TOTAL, the cost of general construction works -		Tenge			**74 204 386,20**				
		Standard labor intensity -	person-h							**62 246,61**
		Estimated wages -	Tenge			**18 443 409,42**				
		TOTAL BY AN ESTIMATE:	Tenge			**74 204 386,20**				
		Standard labor intensity -	person-h							**62 246,61**
		Estimated salary -	Tenge			**18 443 409,42**				
		TOTAL DIRECT COSTS BY ESTIMATE:	Tenge			**55 001 490,80**	**19 478 193,19**			**55 180,95**
			Tenge			**14 975 174,38**	**1 217 837,97**			**7 065,65**
	The cost of general construction works -		Tenge			**48 250 527,02**				
	Materials -		Tenge			**6 750 963,77**				
	Total salary -		Tenge			**16 193 012,35**				
		Overheads -	Tenge					**15 002 647,13**		
		Normative labor intensity in N.R.-	person-h							**3 112,33**
		Estimated wages in N.R. -	Tenge			**2 250 397,07**				
		Irregular and unforeseen costs -	Tenge			**4 200 248,28**				
	TOTAL, the cost of general construction works -		Tenge			**74 204 386,20**				
		Standard labor intensity -	person-h							**62 246,61**
		Estimated wages -	Tenge			**18 443 409,42**				
		TOTAL BY AN ESTIMATE:	Tenge			**74 204 386,20**				
		Standard labor intensity -	person-h							**62 246,61**
		Estimated salary -	Tenge			**18 443 409,42**				
	Recalculation of totals into prices as of 04/26/2020									
	Total direct costs					**55 001 490,80**				
	Overheads					**15 002 647,13**				
	Irregular and unforeseen costs					**4 200 248,28**				
	TOTAL in prices as of 01.01.2001					**74 204 386,20**				
	Total with the cost of seniority					**74 946 430,06**				
	Total with the cost of additional. leave					**75 243 247,61**				
	Total in current prices as of 03.24.					**257 331 906,82**				
	Total with taxes, fees and obligations. payments					**262 478 544,96**				
	Value Added Tax (VAT)		**12%**			**31 497 425,40**				
	Total with value added tax (VAT)					**293 975 970,35**				

MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN

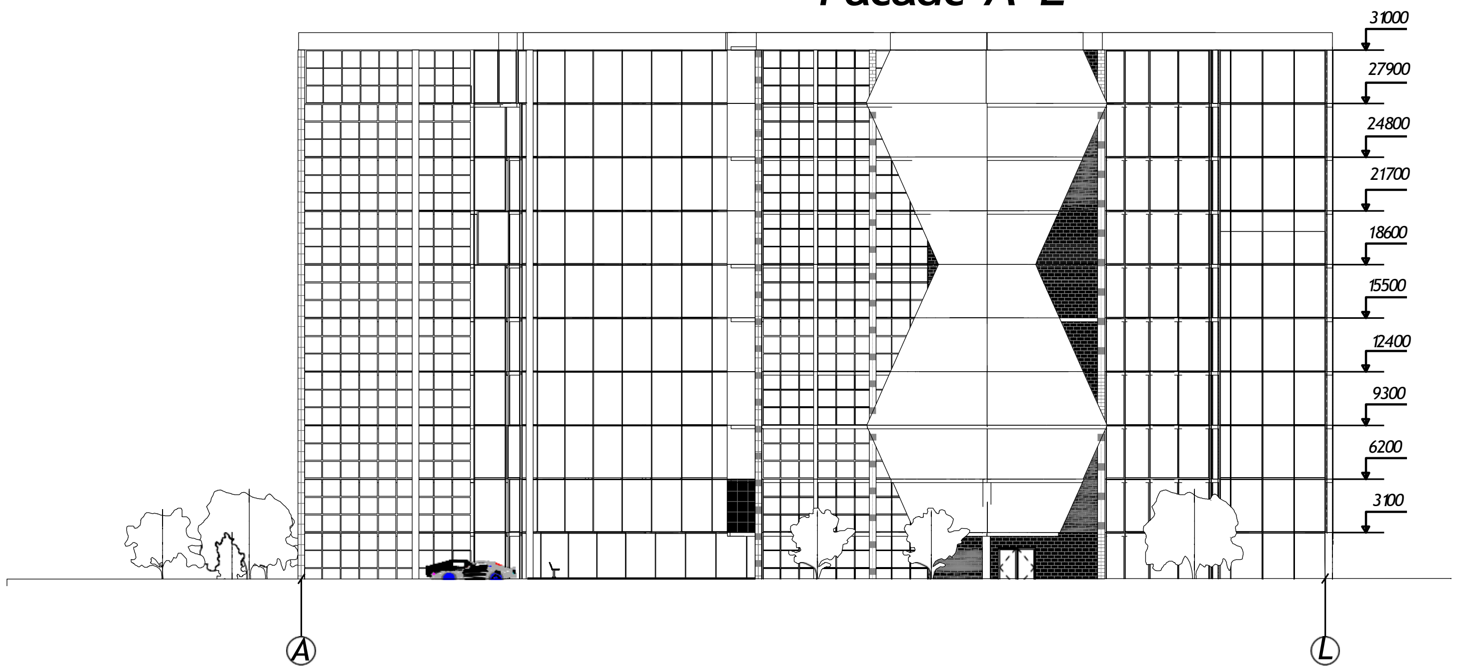
SATBAYEV UNIVERSITY

Diploma project
On the theme «Multi-storey Residential Building in Taraz»

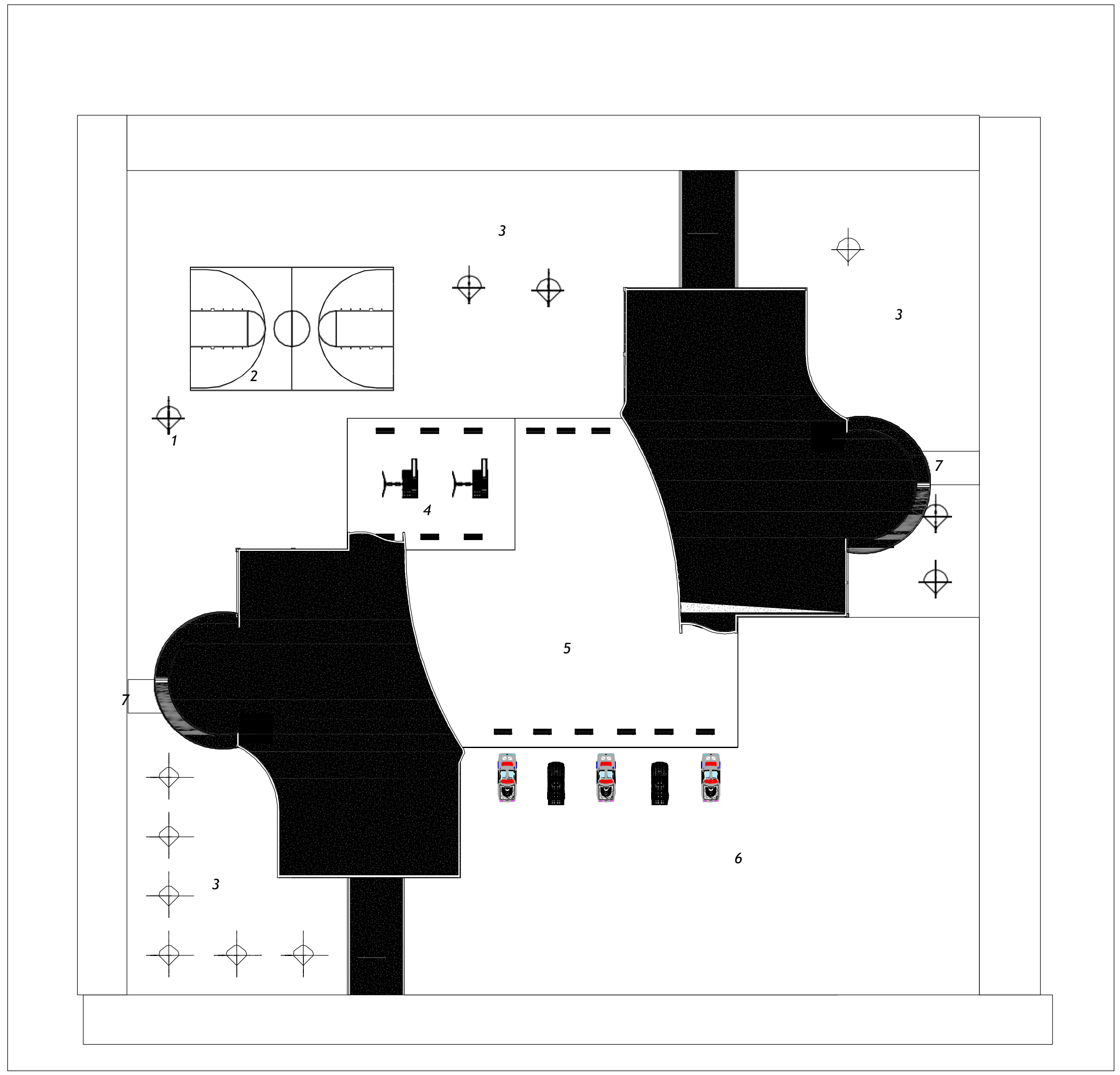
Graduate Student: Hedayat Hejratullah
Adviser: S.Kh. Dostanova

Facade

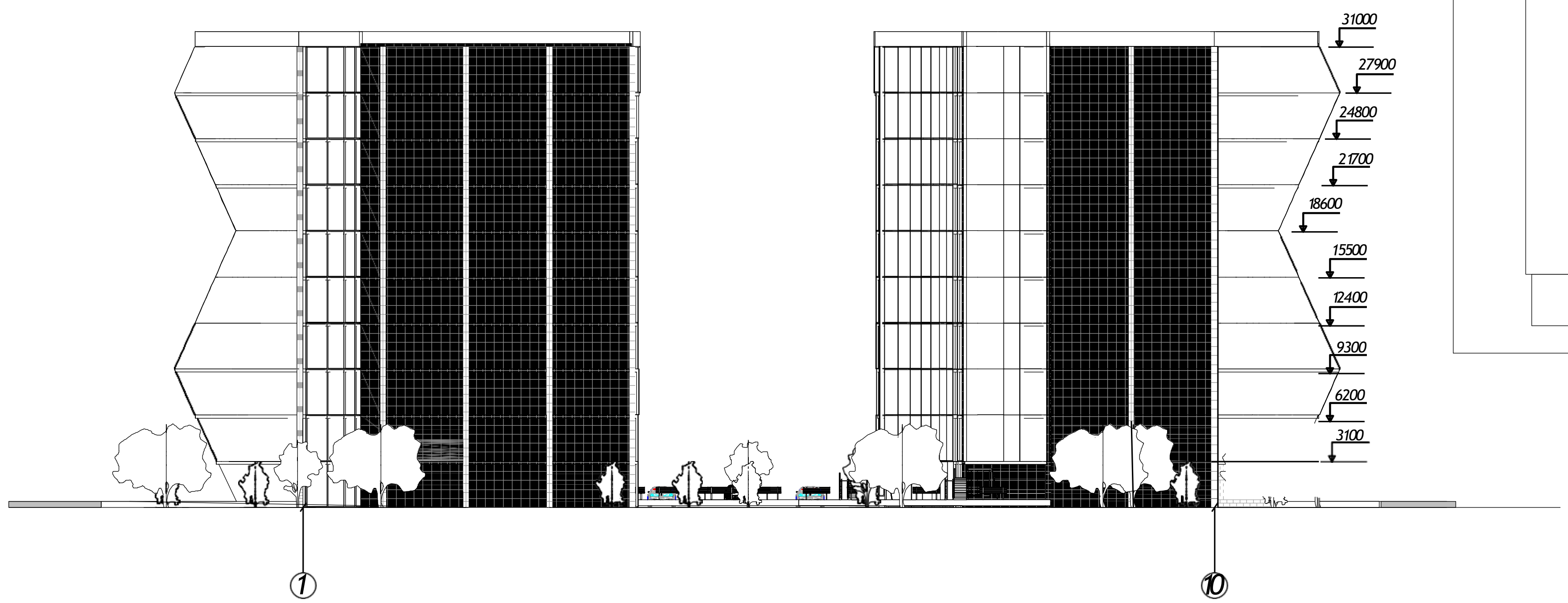
Facade A-L



General plan



Facade 1-10



	Explanation		Explanation
1	Trees	5	Resort
2	Backet ball court	6	Parking
3	Green area	7	Entrances
4	Play ground	8	Parking entrance

Chan.	Num.par.	List	№doc	Sign	Date
H. of depart.	N.V. Kozyukova				
Superviser	S.Kh. Dostanova				
Norm control	A.A.Bek				
Consultant	N.V. Kozyukova				
Created by	H.Hejratullah				

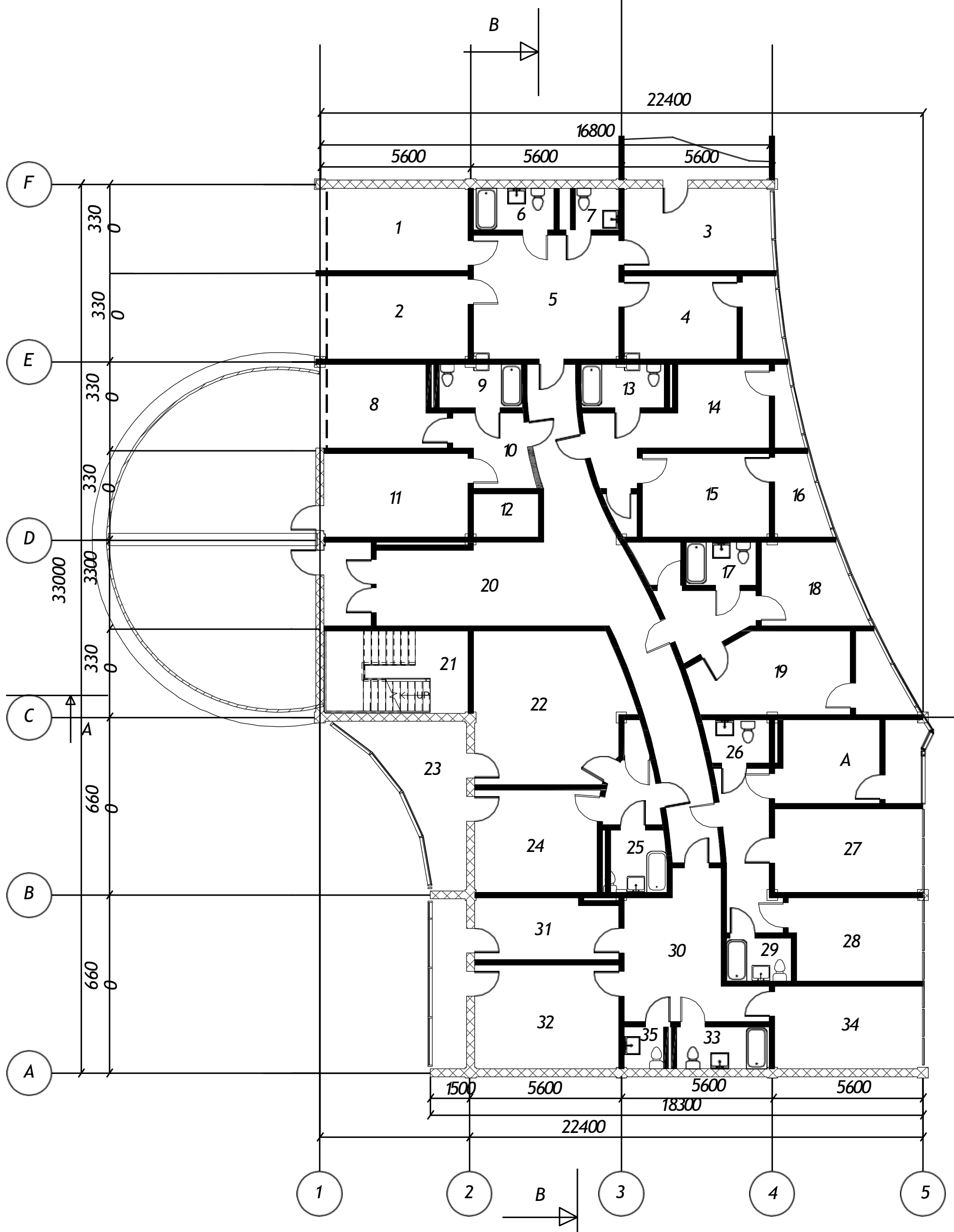
KazNRTU-5B072900-Civil Engineering-03.08.03-2021-DP

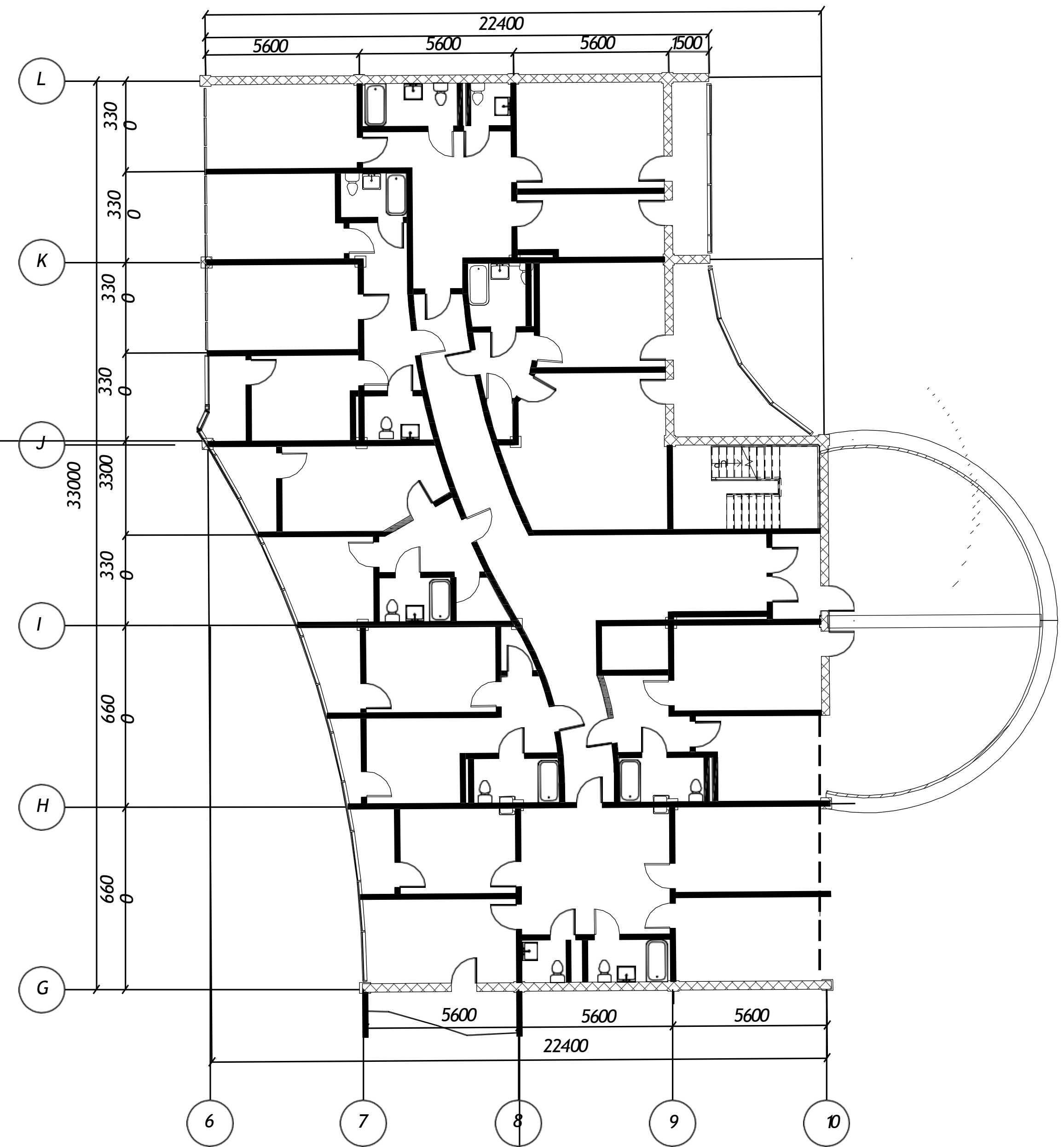
Social residential building in Taraz city

Architectural part	stage	list	lists
	DP	1	8

Facade	Civil engineering and building materials department

Typical floor plan





	Type of room	Area
1	Bedroom	18.48m2
2	Bedroom	18.48m2
3	Living room	18.48m2
4	Kitchen	15.18m2
5	Hall	31.36m2
6	Bathroom	11.16m2
7	Bathroom	7.44m2
8	Kitchen	15.18m2
9	Bathroom	11.16m2
10	Hall	12.15m2
11	Living room	18.48m2
12	Lift	4m2
13	Bathroom	11.16m2
14	Kitchen	14.61m2
15	Living room	15.18m2
16	Balcony	10.94m2

	Type of room	Area
17	Bathroom	11.16m2
18	Kitchen	14.61m2
19	Bedroom	18.48m2
20	Entrance hall	36.96m2
21	Stairs	18.48m2
22	Bedroom	20.32m2
23	Balcony	18.48m2
24	Kitchen	28.12m2
25	Bathroom	11.16m2
26	Bathroom	11.16m2
27	Bedroom	18.48m2
28	Bedroom	18.48m2
29	Bathroom	11.16m2
30	Hall	31.36m2
31	Kitchen	15.61m2
32	Bedroom	25.76m2
33	Bathroom	11.16m2
34	Bedroom	18.48m2
35	Bathroom	3.72m2

KazNRTU-5B072900-Civil Engineering-03.08.03-2021-DP

Social residential building in Taraz city

Chan.	Num.par.	List	№doc	Sign	Date
H. of depart.	N.V. Kozyukova				
Superviser	S.Kh. Dostanova				
Norm control	A.A.Bek				
Consultant	N.V. Kozyukova				
Created by	H.Hejratullah				

Architectural part

stage	list	lists
DP	2	8

Typical floor plan

Civil engineering and building materials department

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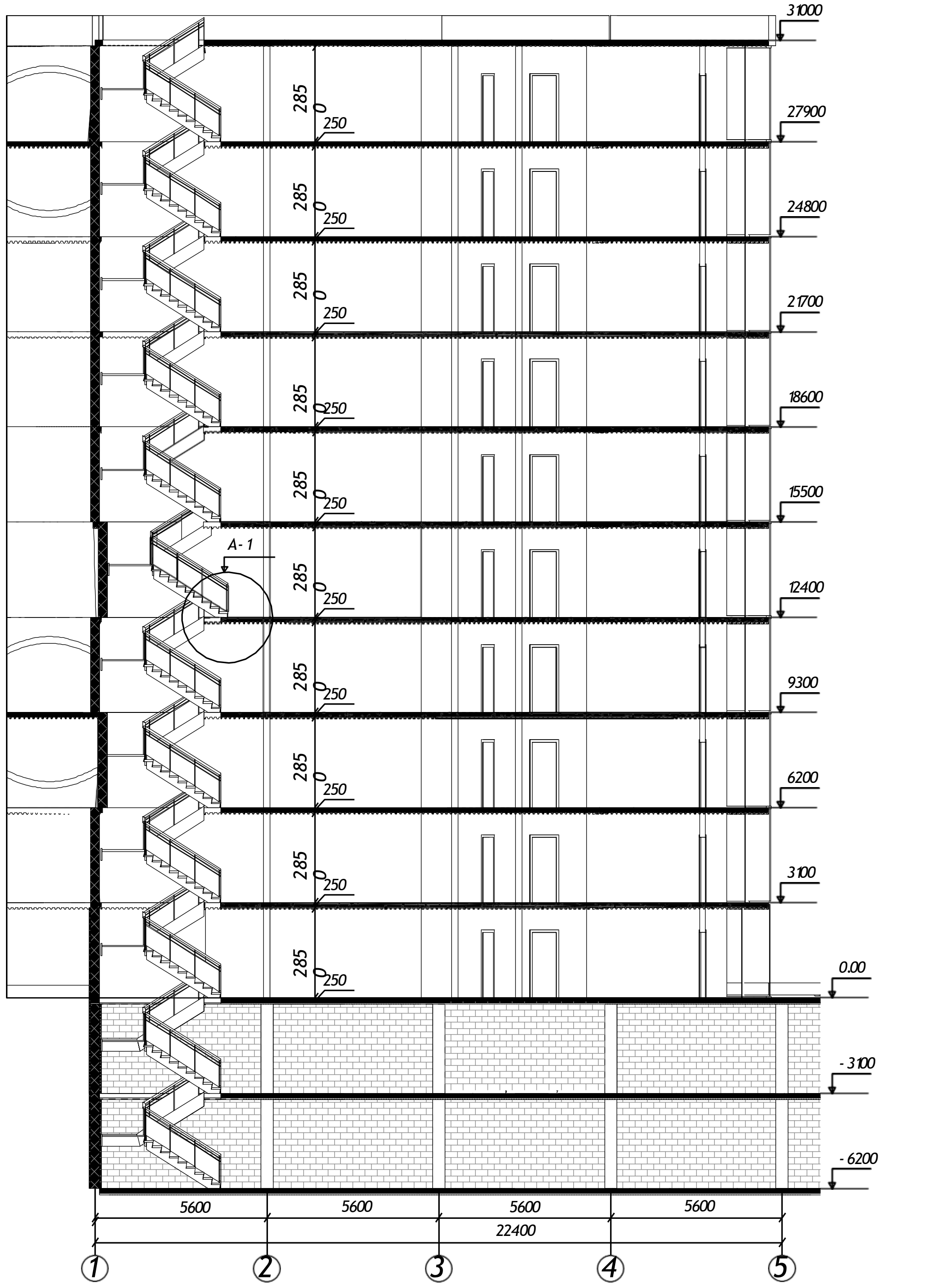
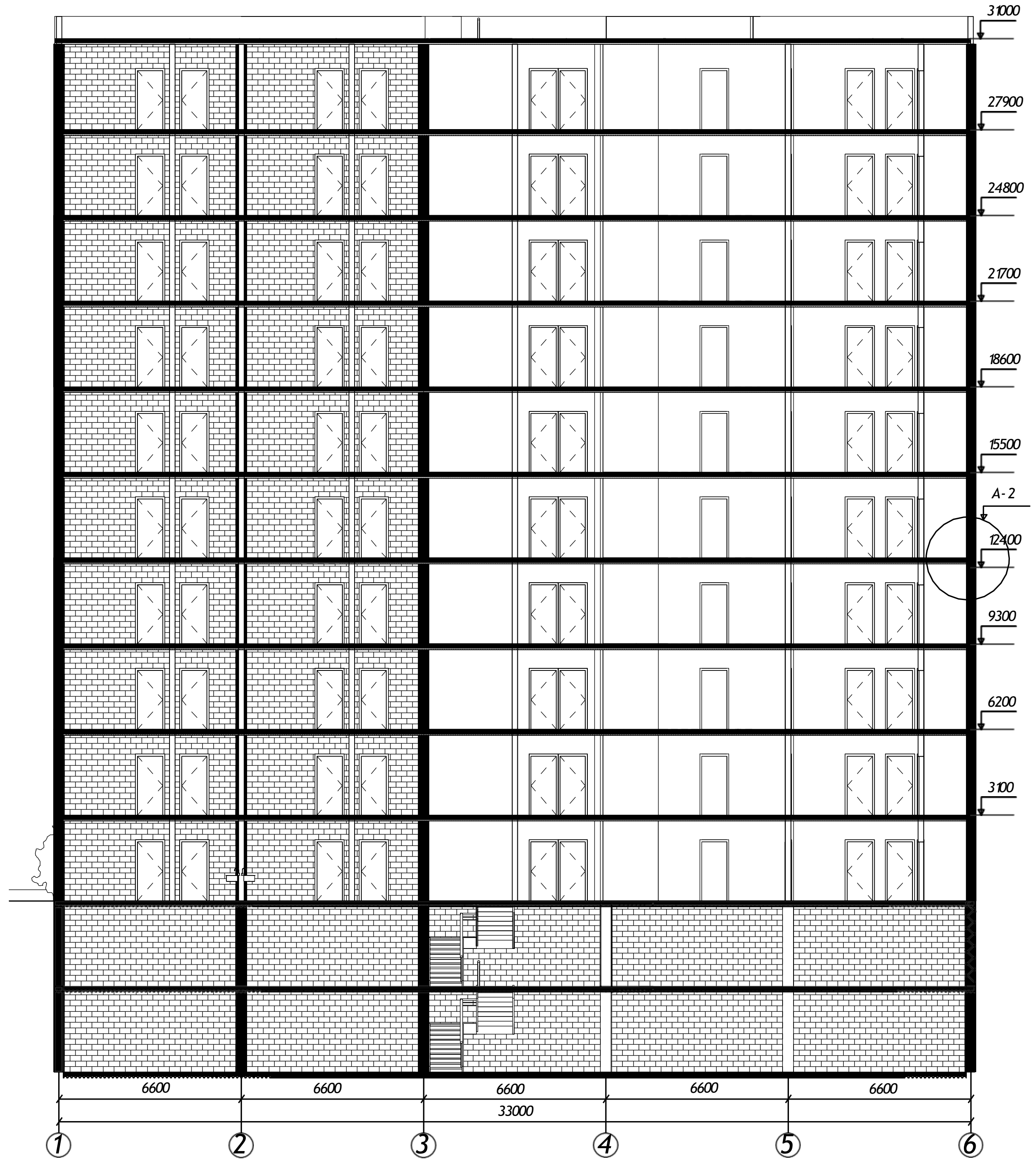
PRODUCED BY AN AUTODESK STUDENT VERSION
PRODUCED BY AN AUTODESK STUDENT VERSION

Sections

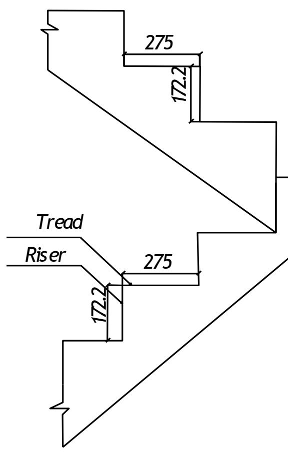
A - A



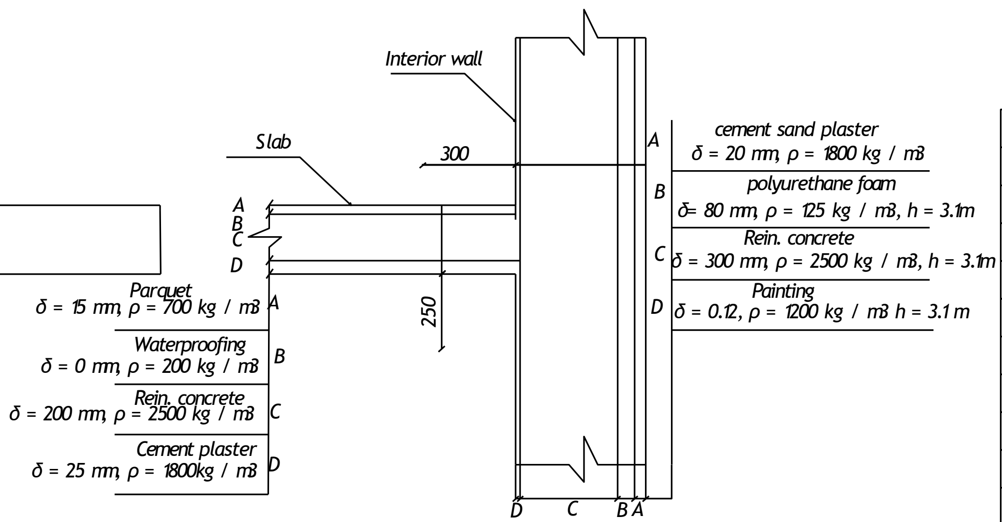
B - B



A-1

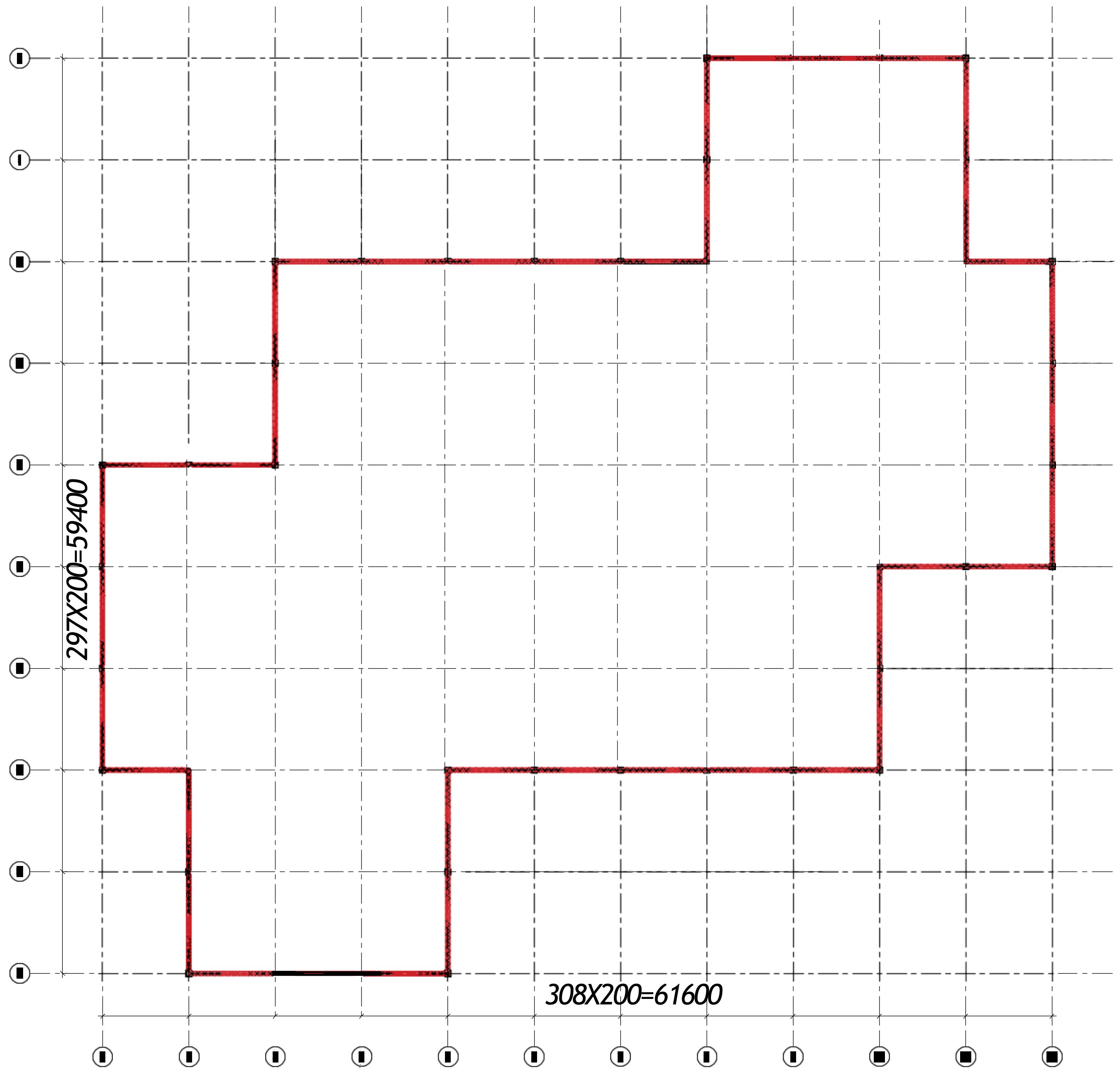


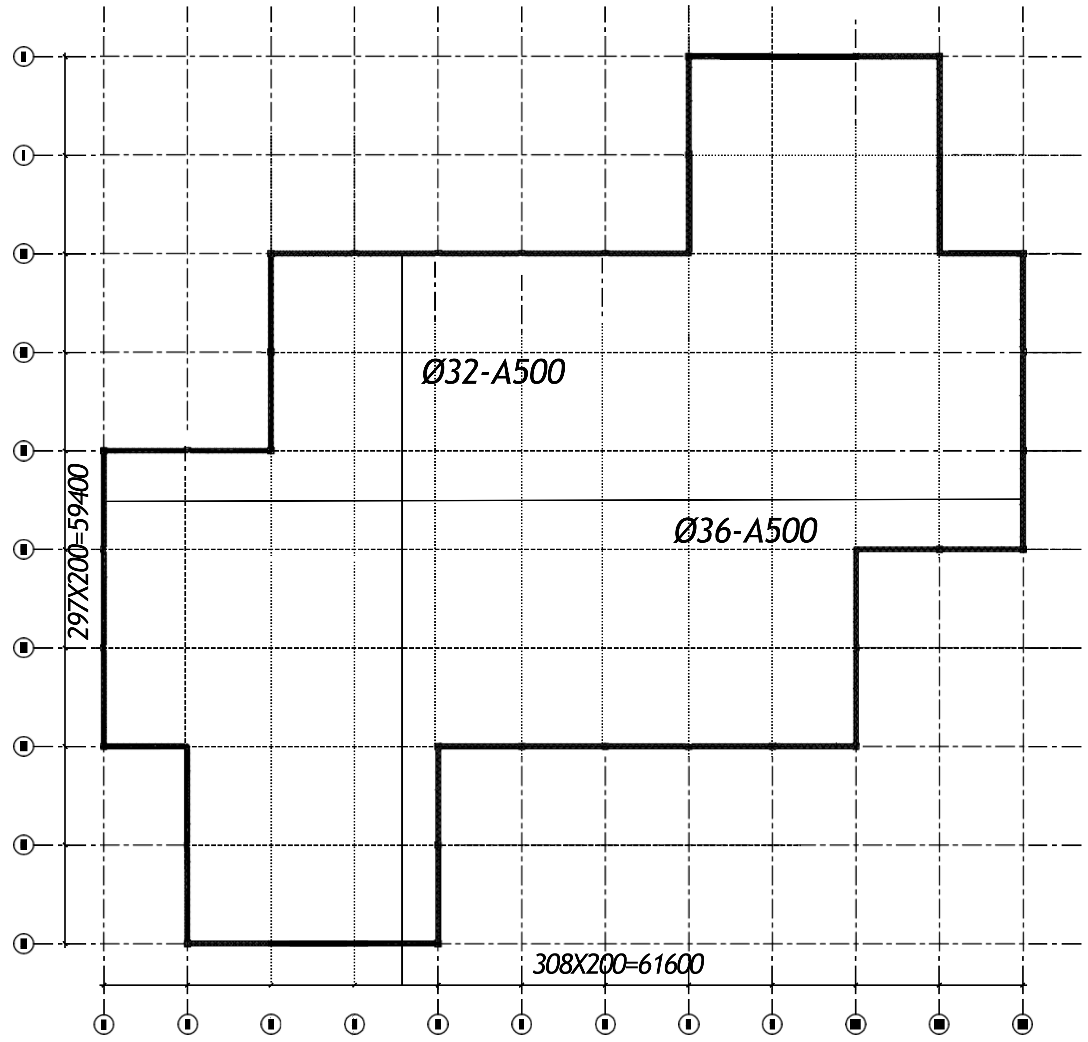
A-2

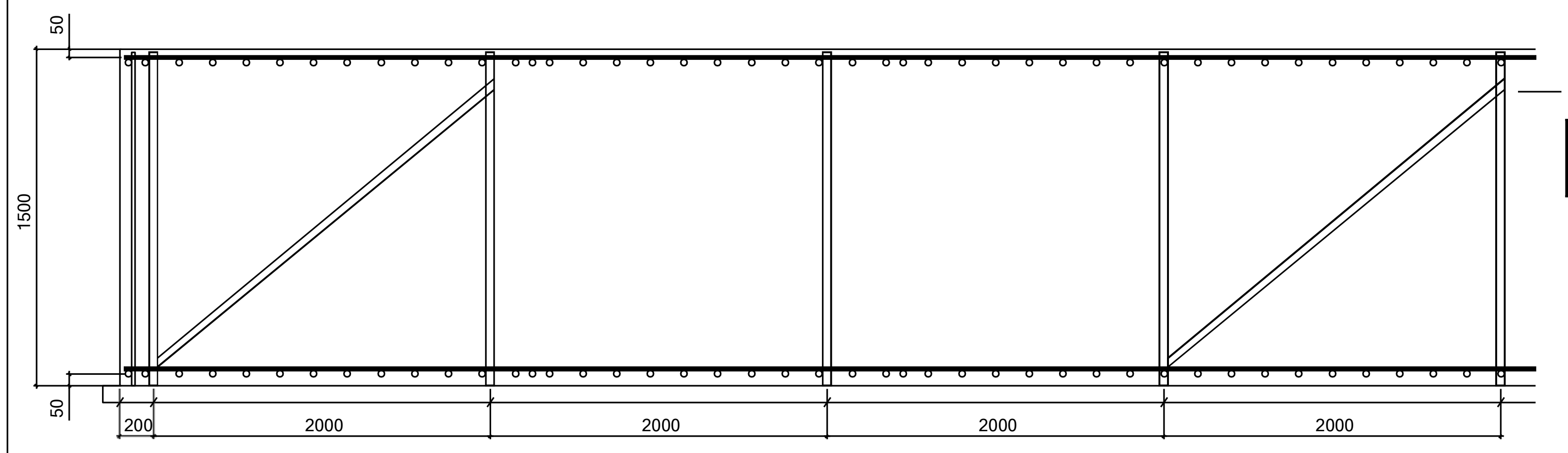


KazNRTU-5B072900-Civil Engineering-03.08.03-2021-DP						
Chan.	Num.par.	List	№doc	Sign	Date	Social residential building in Taraz city
H. of depart.	N.V. Kozyukova					Architectural part — stage: DP; list: 3; lists: 8
Superviser	S.Kh. Dostanova					
Norm control	A.A.Bek					
Consultant	N.V. Kozyukova					Sections — Civil engineering and building materials department
Created by	H.Hejratullah					

Foundation



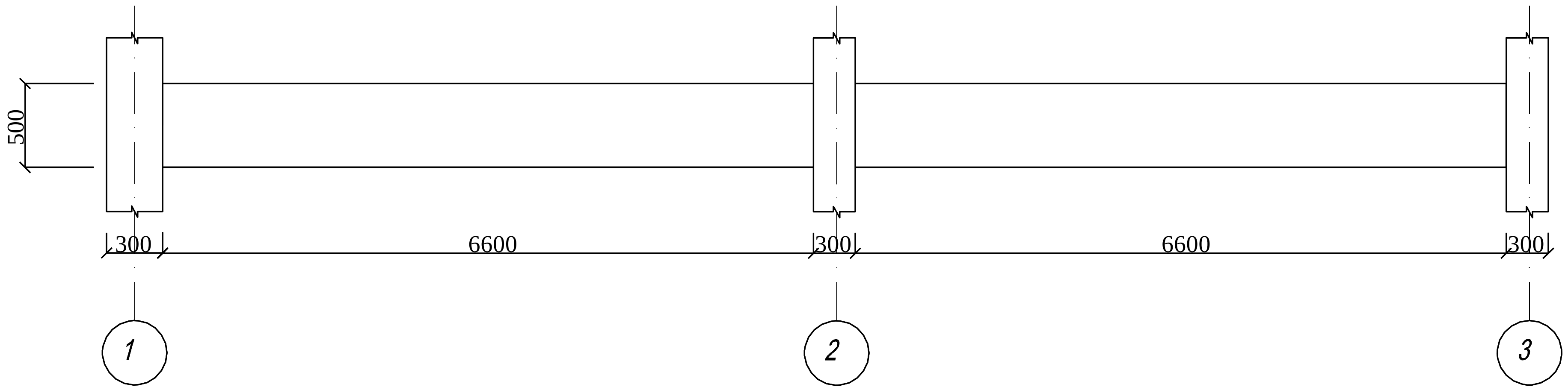


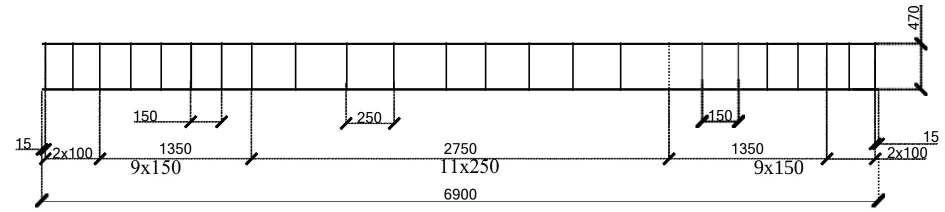


	Name	Amount	Mass	Total
1	Ø36-A500	2228	8	17824
2	Ø32-A500	2310	6.31	14576.1
3	Ø18-A500	8800	2	17600
4	Ø16-A500	4500	1.58	7110
5	Concrete: B25	3270		

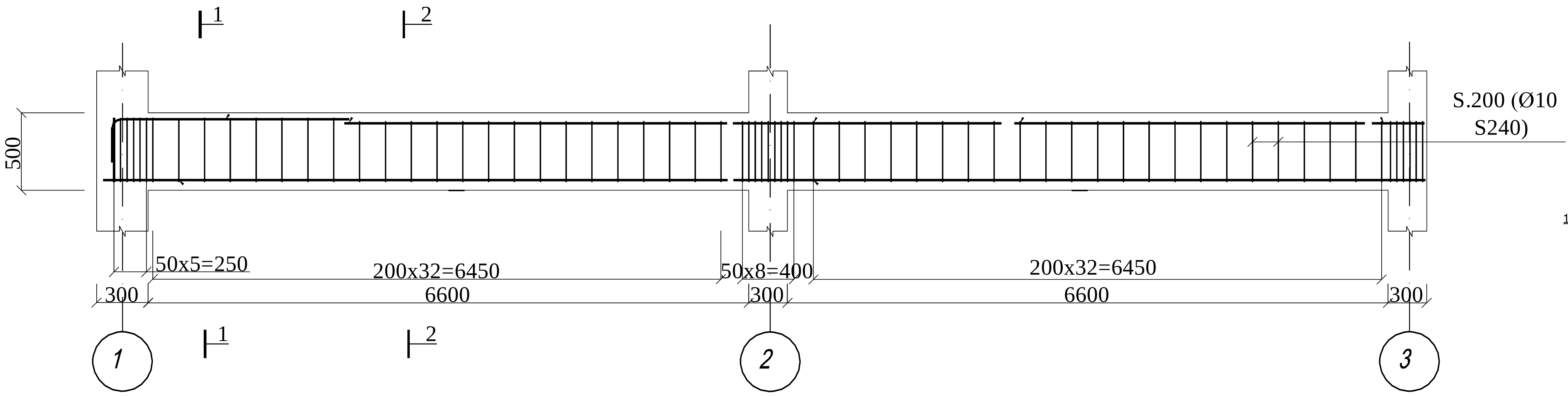
Chan.	Num.par.List	№doc	Sign	Date	KazNRTU-5B072900-Civil Engineering-03.08.03-2021-DP			
					Social residential building in Taraz city			
H. of depart.	N.V. Kozyukova				Structural part	stage	list	lists
Superviser	S.Kh. Dostanova					DP	4	8
Norm control	A.A.Bek							
Consultant	N.V. Kozyukova				Foundation	Civil engineering and building materials department		
Created by	H.Hejratullah							

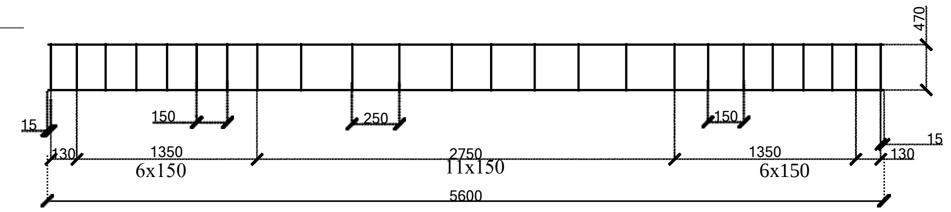
Crossbar spaning



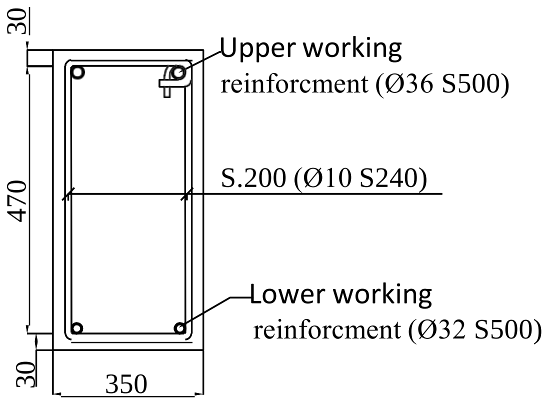


Crossbar reinforcement

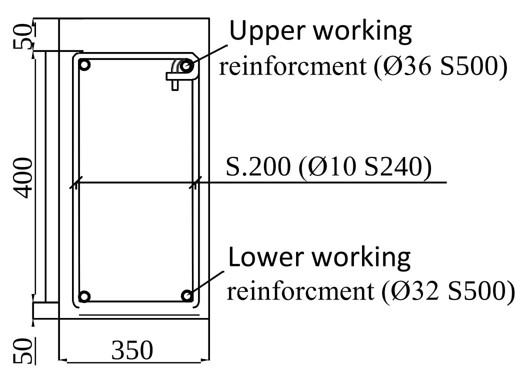




Section 1-1



Section 2-2



	29.06	Amount	Mass	Total
	Ø36 S-500 L=5890	480	8	3840
	Ø32 S-500 L=5890	480	6.31	3028.8
	Ø20 S-250 L=5750	2640	3.2	8448
	Ø10 S-250 L=3550	3840	2.5	9600
	Ø5 Bp-I L=490	3840	1.3	4992

Chan.	Num.par.	List	№doc	Sign	Date
H. of depart.	N.V. Kozyukova				
Superviser	S.Kh. Dostanova				
Norm control	A.A.Bek				
Concultant	N.V. Kozyukova				
Created by	H.Hejratullah				

KazNRTU-5B072900-Civil Engineering-03.08.03-2021-DP

Social residential building in Taraz city

	stage	list	lists
Structural part	DP	5	8

Crossbar

Civil engineering and building materials department

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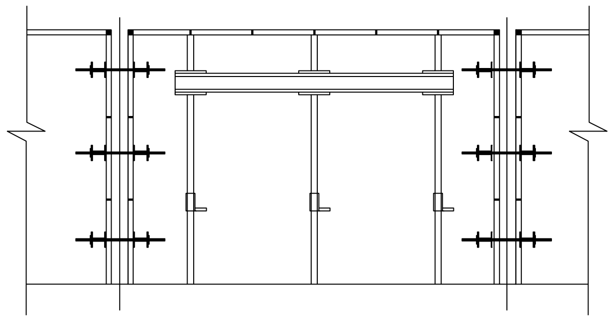
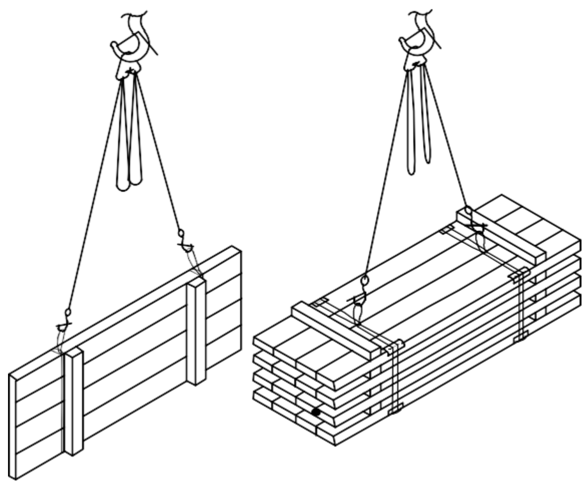
Formwork

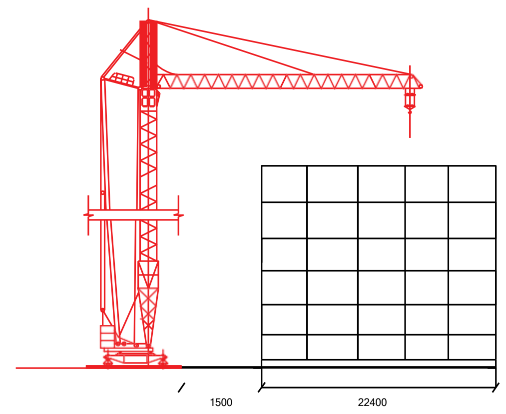
Formwork

Connections of formworks

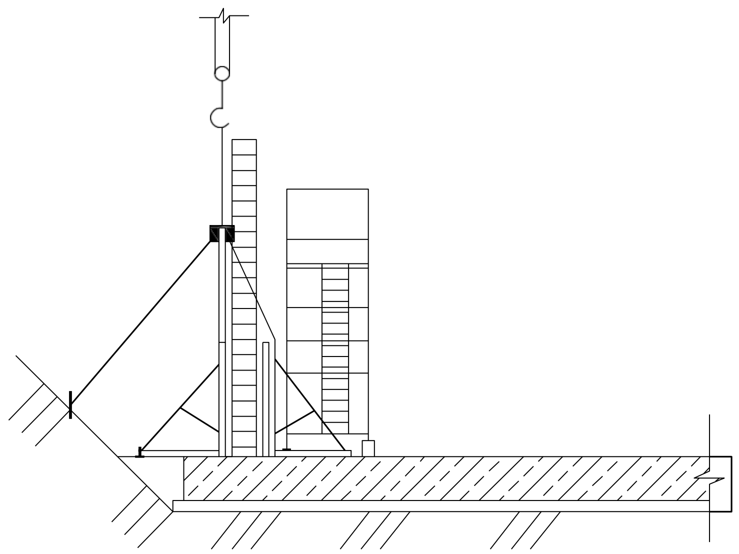


Transfering formworks by crane

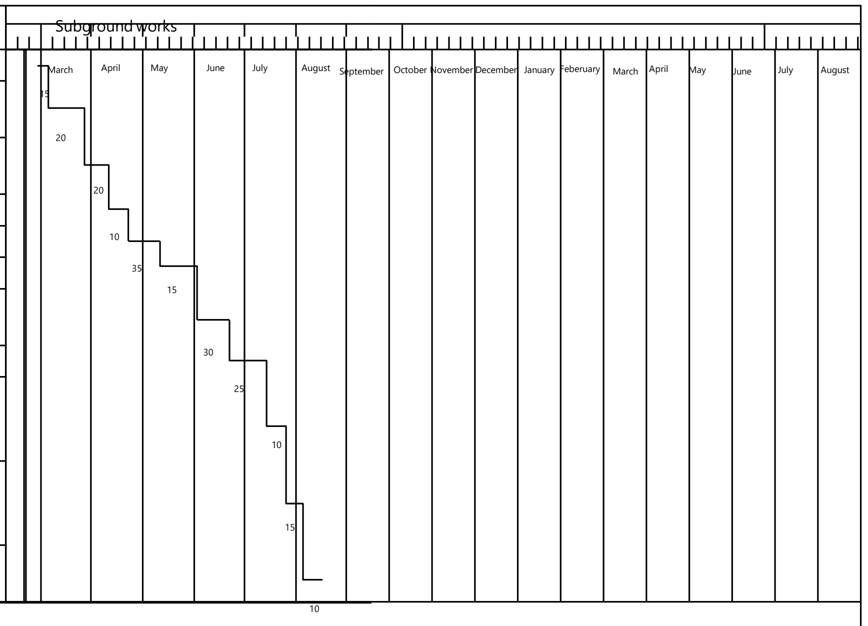




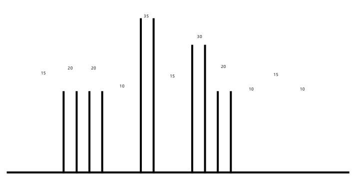
Installation of formworks in foundation



ID		Task Mode	Task Name	Duration	Start	Finish	Predecessors
1			Sites works	3 days	Mon 25.05.20	Wed 27.05.20	
2			Development of a pit	21 days	Thu 28.05.20	Thu 25.06.20	1
3			Development of shortage of soi	7 days	Fri 26.06.20	Thu 06.08.20	2
4			Compaction of soil	3 days	Fri 07.08.20	Tue 11.08.20	3
5			Construction of foundation	20 days	Wed 12.08.20	Tue 15.09.20	4
6			Water proofing found	12 days	Wed 16.09.20	Thu 01.10.20	5
7			Basement wall construction	25 days	Fri 02.10.20	Thu 08.10.20	6
8			Installation of floor slabs and basement beams	25 days	Fri 09.10.20	Fri 16.10.20	7
9			Basement wall waterproofing	7 days	Mon 19.10.20	Tue 27.10.20	8
10			Backfilling of soil	10 days	28.10.20	Tue 10.11.20	9
11			Finishing subearth work	7days	11.11.20	Tue 01.12.20	10

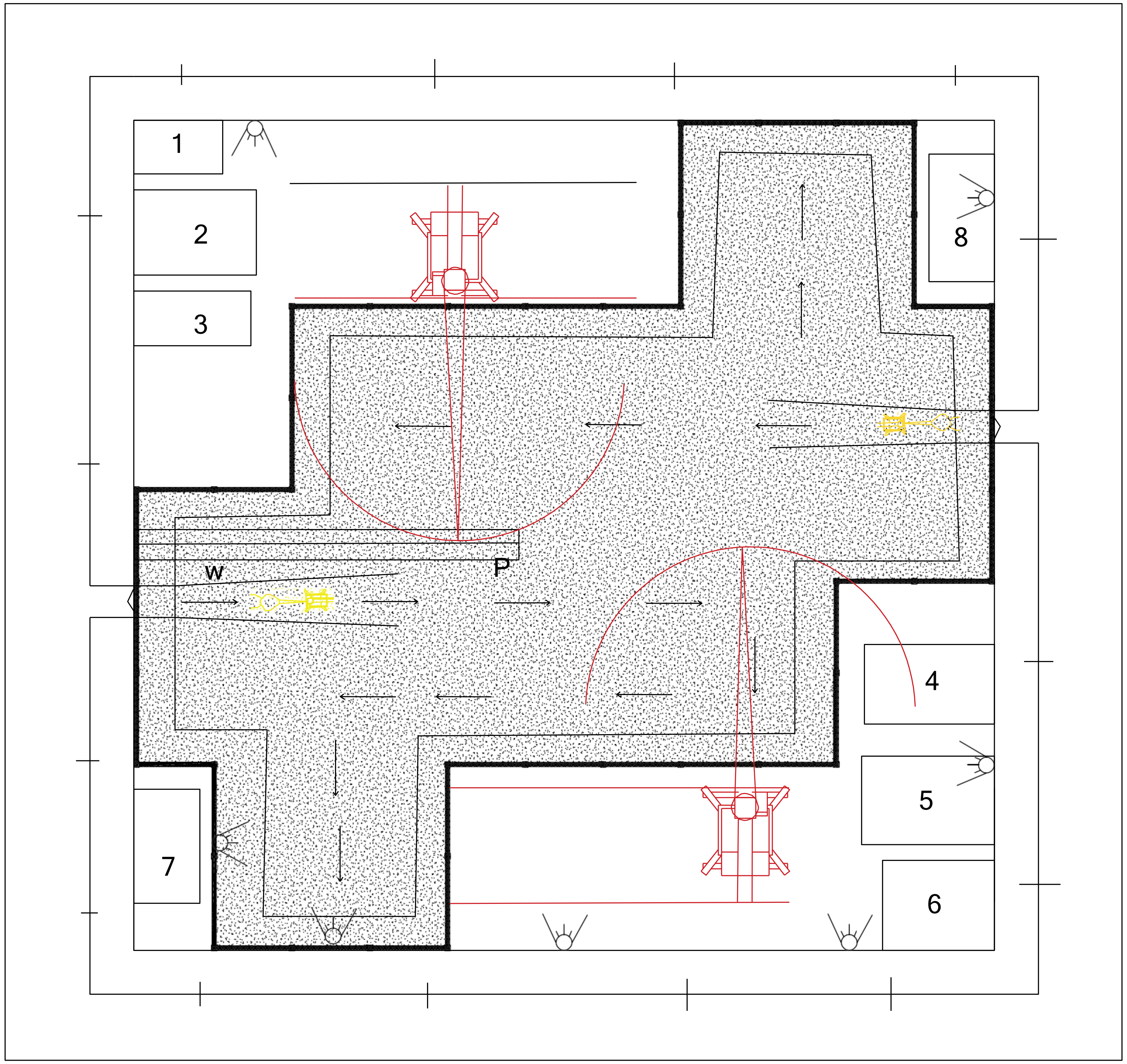


Name of works	Justification for ENiR	unit of measurement according to ENiR	Amount Of work	working hours-no workers, man-hour	The cost of labor		Link comp
					Person hour	Person hour	
1	2	3	4	5	6	7	8
Installing reinforcing bars	E4 1-46	t	57.37	6.7	384.38	48.05	Rein. wo 5 pit-1 pe 2 pit-3 pe
Installation of formwork	E4 1-37	1m ²	107.82	0.39	42.05	5.26	Locksm 4 pit-1 pe 3 pit-1 pe
Laying concrete in the construction of concrete pumps	E4 1-49	1 m ³	888.34	0.23	204.32	25.54	concr worke 2 pit perso 4 pit perso
Disassembly of formwork	E4 1-37	1 m ²	107.82	0.21	42.05	5.26	Locksm 3 pit-1 p 2 pit-1 p
Waterproofing	E4 11-37	100 m ²	1.08	2.3	2.48	0.31	worke 2 pit-1 p 4 pit-1 p
All:					675.28	84.42	



Chan.	Num.par.	List	№doc	Sign	Date	KazNRTU-5B072900-Civil Engineering-03.08.03-2021-DP		
						Social residential building in Taraz city		
H.of depart.		N.V. Kozyukova				Technological part	stage	list	lists
Supervisor		S.Kh. Dostanova					DP	6	8
Norm control		A.A.Bek							
Consultant		Zh.Sh.Mukhanbetzhanova				Formwork	Civil engineering and building materials department		

Master Plan



Роза ветров в Таразе

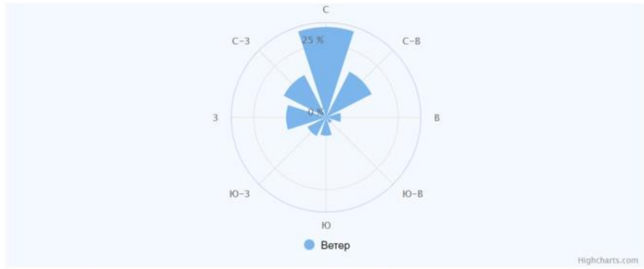


График ветра (направление - откуда дует ветер) в Таразе, с усредненными значениями согласно нашим данным.

С ▼ Северный	С-В ▲ Северо-Вос...	В ◄ Восточный	Ю-В ▼ Юго-Восточ...	Ю ▲ Южный	Ю-З ◄ Юго-Западн...	З ► Западный	С-З ▲ Северо-Зап...
31.2%	17.7%	5.1%	2.3%	6.3%	7.2%	13.8%	16.4%

1 Superintendent's office

2 Office of masters

3 Workshop

4 storehouse

5 Security point

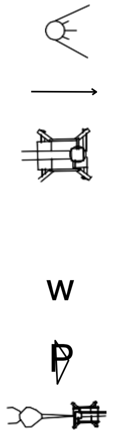
6 Dining room

7 Shower room

8 Garbage

Earthwork machines

Heavy equipment is essential for construction jobs of almost any size, from home building to large-scale commercial and civil projects. Earth-moving equipment covers a broad range of machines that can excavate and grade soil and rock, along with other jobs. Earth movers and other heavy equipment help to speed not only earth work but also materials handling, demolition, and construction. Many types of heavy construction equipment are designed for multiple functions, making them indispensable on job sites.



Temporary lighting system

Excavating direction

Cranning system

W Water supply system

P Powering system

Entrances

excavating process

Chan.	Num.par.	List	№doc	Sign	Date
H.of depart.	N.V. Kozyukova				
Superviser	S.Kh. Dostanova				
Norm control	A.A.Bek				
Consultant	Zh.Sh.Mukhanbetzhanova				
Created by	H.				

KazNRTU-5B072900-Civil Engineering-03.08.03-2021-DP

Social residential building in Taraz city

Technological part

stage	list	lists
DP	7	8

Master plan

Civil engineering and building materials department

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PRODUCED BY AN AUTODESK STUDENT VERSION

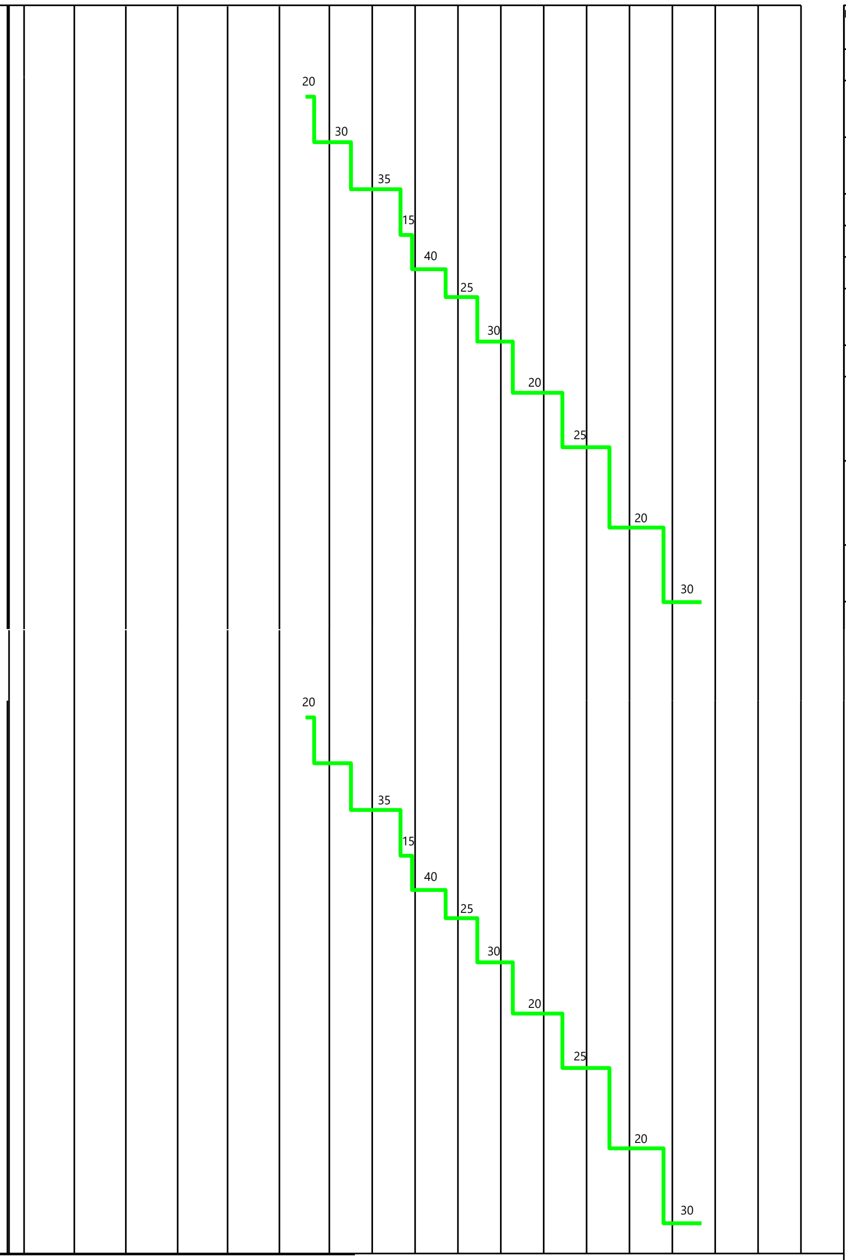
Work schedule

Upground works

ID		Task Mode	Task Name	Duration	Start	Finish	Predecessors
1			Cleaning area	3 days	Mon 25.05.20	Wed 27.05.20	
2			Superstructure-floor concreting	21 days	Thu 28.05.20	Thu 25.06.20	1
3			Formwork installation and concreting Beams	30 days	Fri 26.06.20	Thu 06.08.20	2
4			Removal of formwork	7 days	Fri 07.08.20	Tue 11.08.20	3
5			Brick masonry work	25 days	Wed 12.08.20	Tue 15.09.20	4
6			Roofing work	12 days	Wed 16.09.20	Thu 01.10.20	5
7			Installing doors and windows	15 days	Fri 02.10.20	Thu 08.10.20	6
8			Electrical and plumbing	15 days	Fri 09.10.20	Fri 16.10.20	7
9			Exterior finishing-Insulation and plastering	20 days	Mon 19.10.20	Tue 27.10.20	8
10			Internal finishing-Plastering internal walls	25 days	28.10.20	Tue 10.11.20	9
11			Final finishing-Painting and cleaning area	15 days Wed	11.11.20	Tue 01.12.20	10

Second block — Upground works

ID		Task Mode	Task Name	Duration	Start	Finish	Predecessors
1			Cleaning works	3 days	Mon 25.05.20	Wed 27.05.20	
2			Superstructure-floor concreting	21 days	Thu 28.05.20	Thu 25.06.20	1
3			Formwork installation and concreting columns	30 days	Fri 26.06.20	Thu 06.08.20	2
4			Removal of formwork	7 days	Fri 07.08.20	Tue 11.08.20	3
5			Brick masonry work	25 days	Wed 12.08.20	Tue 15.09.20	4
6			Roofing work	12 days	Wed 16.09.20	Thu 01.10.20	5
7			Installing doors and windows	15 days	Fri 02.10.20	Thu 08.10.20	6
8			Electrical and plumbing	15 days	Fri 09.10.20	Fri 16.10.20	7
9			Exterior finishing-Insulation and plastering	7 days	Mon 19.10.20	Tue 27.10.20	8
10			Internal finishing-Plastering internal walls	10 days Wed	28.10.20	Tue 10.11.20	9
11			Final finishing-Painting and cleaning area	15 days Wed	11.11.20	Tue 01.12.20	10



Subground works

ID		Task Mode	Task Name	Duration	Start	Finish	Predecessors
1			Sites works	3 days	Mon 25.05.20	Wed 27.05.20	
2			Development of a pit	21 days	Thu 28.05.20	Thu 25.06.20	1
3			Development of shortage of soi	7 days	Fri 26.06.20	Thu 06.08.20	2
4			Compaction of soil	3 days	Fri 07.08.20	Tue 11.08.20	3
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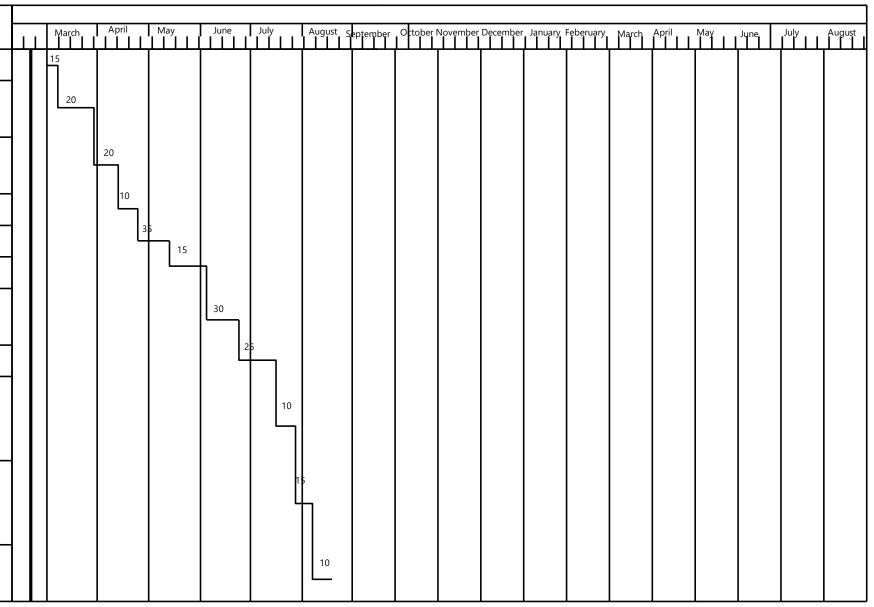
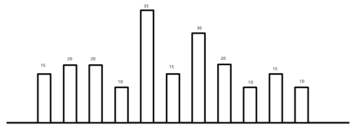
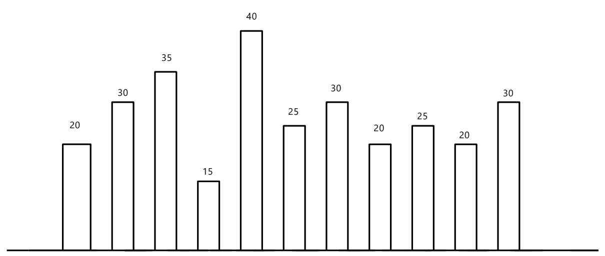




	Name	Uni.measu.	Amount
1	Total duration of project	Day	486
2	Total labor intensity	Person	855
3	Total cost of construction works	KZT	300m KZT
4	Total cost of meter squqre	KZT	135k KZT

$$k \le \frac{Nmax}{Nmed.}$$

$$k=1,5 \le \frac{40}{22} =1.8$$



Chan.	Num.par.	List	№doc	Sign	Date
H. of depart.	N.V. Kozyukova				
Superviser	S.Kh. Dostanova				
Norm control	A.A.Bek				
Consultant	Zh.Sh.Mukhanbetzhanova				
Created by	H.Hejratullah				

KazNRTU-5B072900-Civil Engineering-03.08.03-2021-DP

Social residential building in Taraz city

Technological part	stage	list	lists
	DP	8	8
Work schedule	Civil engineering and building materials department		

Thank you for your attention

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: Хедаят Хеджратуллах

Название: Residential complex with energy-efficient, low cost and environmentally friendly technologies in Taraz

Координатор:Сауле Достанова

Коэффициент подобия 1:0.3

Коэффициент подобия 2:0

Замена букв:20

Интервалы:0

Микропробелы:26

Белые знаки: 0

После анализа Отчета подобия констатирую следующее:

☐ обнаруженные в работе заимствования являются добросовестными и не обладают признаками плагиата. В связи с чем, признаю работу самостоятельной и допускаю ее к защите;

☐ обнаруженные в работе заимствования не обладают признаками плагиата, но их чрезмерное количество вызывает сомнения в отношении ценности работы по существу и отсутствием самостоятельности ее автора. В связи с чем, работа должна быть вновь отредактирована с целью ограничения заимствований;

☐ обнаруженные в работе заимствования являются недобросовестными и обладают признаками плагиата, или в ней содержатся преднамеренные искажения текста, указывающие на попытки сокрытия недобросовестных заимствований. В связи с чем, не допускаю работу к защите.

Обоснование:

……

……………………… ……………………………………

Дата *Подпись Научного руководителя*

Протокол анализа Отчета подобия

заведующего кафедрой / начальника структурного подразделения

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

Автор: Хедаят Хеджратуллах

Название: Residential complex with energy-efficient, low cost and environmentally friendly technologies in Taraz

Координатор: Сауле Достанова

Коэффициент подобия 1:0.3

Коэффициент подобия 2:0

Замена букв:20

Интервалы:0

Микропробелы:26

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:

……
……
……
……
……

………………………
…………………………………………………

Дата *Подпись заведующего кафедрой /*

начальника структурного подразделения