MINISTRY OF HIGHER EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN

Non-profit joint stock company «Kazakh National Research Technical University named after K. I. Satpaev»

Bassenov institute of Architecture and Civil Engineering

Department of Civil Engineering and Building Materials

6B07302 – «Civil Engineering»

Yessengeldinova A.K.

Oncological hospital with high-tech departments in Almaty

EXPLANATORY NOTE
to the diploma project

6B07302– «Civil Engineering»

Almaty 2025

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FOR PROTECTION SENT
Head of the Department
Doctor of Technical Sciences,
Professor
__________Shayakhmetov S.B.
«05» __06__ 2025

EXPLANATORY NOTE
to the diploma project
Topic: Oncological hospital with high-tech departments in Almaty

6B07302 – «Civil Engineering»

Performed by Yessegeldinova A.K.

Reviewer
m.t.s., Chief Engineer of the Architectural and Construction Department of «Mega Center Management JSC»
__________Rudnyayev R.G.
«04» __06__ 2025

Scientific supervisor
Ph.D., Senior Lecturer
__________Niyetbay S.Y.
«04» __06__ 2025

Қазақстан Республикасы Алматы қ. Акционерлік қоғамы
КАДР ҚҰЖАТТАР ҮШІН
Mega Center Management
(Мега Центр Менеджмент)
ДЛЯ КАДРОВЫХ ДОКУМЕНТОВ
Акционерное общество Республика Казахстан г. Алматы

Almaty 2025

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«05» 06 2025

ASSIGNMENT
for the diploma project

Education recipient Yessegeldinova A.K.
Topic: Oncological hospital with high-tech departments in Almaty
Board Member - Vice-Rector for Academic Affairs 2025
« 29 » January *№ 26-P/O* by order of approved
Submit completed work deadline *« 05 » June 2025*
Initial data of the diploma project: Construction area - Almaty. Structural system of the building - frame-braced framework.
Diploma in the project to develop belonging problems list:
a) Architectural and analytical section: basic initial data, volumetric and planning solutions, thermal and technical calculation of enclosing structures (external walls), lighting technical calculation, calculation of foundation options and placement depth, justification of energy efficiency measures;
b) Calculation and design department:
c) Organizational and technological department: development of technological maps, construction calendar plan and construction master plan;
d) Economic department: local estimate, object estimate, consolidated estimate;
Graphic materials list (required) drawings exactly showing):
1. Facades, plans, sections – 4 sheets
2. Schemes of the reinforcing elements
3. Plans of implementation of earthwork, calendar plan, general master plan
Recommended main literature: SN RK EN 1990: 2002+A1: 2005/2011 «General design of load-bearing structures»

Diploma work (project) preparation
TABLE

Name of sections, list of issues to be studied and prepared	30%	60%	90%	100%	Note
Architectural-analytical	28.12.2024-08.01.2025				
Calculation and construction		08.01.2025-23.02.2025			
Organizational and technological			24.02.2025-06.04.2025		
Economic				07.04.2025-20.04.2025	
Preventive protection	14.04.2025 - 25.04.2025				
Quality Control (QC)	21.04.2025 - 16.05.2025				
Anti-plagiarism	08.05.2025 - 21.05.2025				
Norm control, Quality control (drawings)	12.05.2025 - 05.06.2025				
Protection	09.06.2025 - 28.06.2025				

For the completed thesis (project), the advisors' and the standard supervisor's, indicating the work (project) of the relevant departments
signatures

Sections name	**Advisors, last name, first name, patronymic, (academic degree, title)**	**Date of signing**	**Signature**
Architectural-analytical	S.Y. Niyetbay, Doctor Ph.D, Senior Lecturer	02.06.2025	
Calculation and construction	S.Y. Niyetbay, Doctor Ph.D, Senior Lecturer	02.06.2025	
Organizational and technological	S.Y. Niyetbay, Doctor Ph.D, Senior Lecturer	02.06.2025	
Economic	S.Y. Niyetbay, Doctor Ph.D, Senior Lecturer	02.06.2025	
Norm control	A.A. Yessembayeva, Master of Technical Sciences, Lecturer	02.06.2025г	
Quality control	N.V. Kozyukova, Master of Technical Sciences, Senior Lecturer	05.06.2025	

Scientific supervisor ________ Niyetbay S.Y.

The student was able to complete the task ________ Yessengeldinova A.K.

Date «02» 06 2025

АННОТАЦИЯ

Дипломдық жобаның тақырыбы: «Алматы қаласында жоғары технологиялық бөлімшелері бар онкологиялық госпиталь». Жұмыс төрт бөлімнен тұрады: біріншісі – архитектуралық-аналитикалық, екіншісі – есептеу-конструктивті, үшіншісі – ұйымдастырушылық технологиялық, төртіншісі – сметалық.

Бірінші бөлімде архитектуралық модель жасалды, оның негізінде кейіннен есептеу үшін қолданылатын конструктивті модель жасалды.

Екінші бөлімде ғимараттың құрылымдық моделі жүктемелердің әртүрлі комбинацияларына ұшыраған кезде беріктік пен тұрақтылыққа тексерілді.

Үшінші бөлімде жер жұмыстарын жүзеге асыру тетіктері таңдалды және бүкіл ғимаратқа құрылыс-монтаждау жұмыстарын орындау көлемі анықталды.

Төртінші бөлімде алынған нәтижелер сметалық бағдарламаға ауыстырылды және бүкіл ғимараттың құрылыс құны есептелді.

АННОТАЦИЯ

Тема дипломного проекта: «Онкологический госпиталь с высокотехнологичными отделениями в городе Алматы». Работа состоит из четырех разделов: первый – архитектурно-аналитический, второй – расчетно-конструктивный, третий – организационной технологический, четвертый – сметный.

В первом разделе была создана архитектурная модель, на основе которой впоследствии была разработана конструктивная модель, используемая для расчета.

Во втором разделе конструктивная модель здания была проверена на прочность и устойчивость при воздействии различных комбинаций нагрузок.

В третьем разделе были подобраны механизмы для осуществления земляных работ и определены объемы выполнения строительно-монтажных работ на все здание.

В четвертом разделе полученные результаты были перенесены в сметную программу и посчитана стоимость строительства всего здания.

ANNOTATION

The topic of the graduation project is «Oncological hospital with high-tech departments in Almaty» The work consists of four sections: the first is architectural and analytical, the second is computational and constructive, the third is organizational and technological, and the fourth is estimated.

In the first section, an architectural model was created, on the basis of which a constructive model used for calculation was subsequently developed.

In the second section, the structural model of the building was tested for strength and stability when exposed to various combinations of loads.

In the third section, the mechanisms for carrying out excavation work were selected and the volume of construction and installation work for the entire building was determined.

In the fourth section, the results were transferred to the estimated program and the cost of building the entire building was calculated.

CONTENT

INTRODUCTION

Construction is one of the most important areas of human life. Even in ancient times, at the early stages of human development, the presence of a «roof over your head» has become a fundamental factor that ensures a stable, calm and protected life. Over time, the importance of the house has strengthened, and the functionality has expanded. Today, buildings are built everywhere and are used for a wide variety of purposes: residential (individual houses, apartment complexes), industrial (factories, factories), commercial (cafes, shops, restaurants, shopping centers, train stations, airports), temporary structures (warehouses, retail stores, installations, gazebos).

As the population grows, the need to build new buildings for all spheres of life is also growing, which means that the need for specialists is also increasing. Modern education allows you to cover a wide range of knowledge, as a result of which specialists come out of the university who are able to work in a wide variety of positions in construction companies, they can realize themselves both in the office, working with a computer, and on the construction site directly.

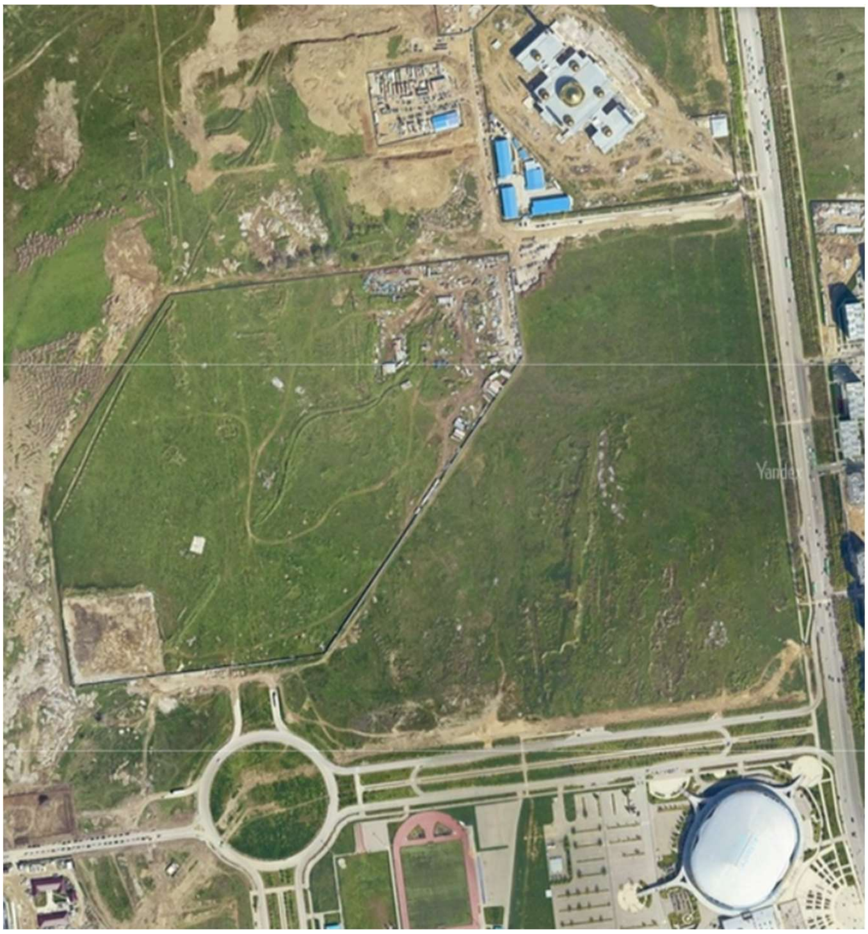
This diploma project is aimed at confirming and summarizing all the materials and knowledge obtained during the course of the Bachelor's degree in Civil Engineering. The diploma project will cover such sections as architectural, structural, calculation, estimate and technological. Each section will demonstrate the student's knowledge and influence the development of the issued project and its adaptation to local conditions. In addition, working on a graduation project can affect the student's analytical and spatial thinking, allow them to cover new sources of information, master potentially new technologies for performing certain works, as well as develop the skill of documentation and writing texts according to specific requirements.

The final result of the graduation project will be a building with a well-thought-out and proven design calculations, considered architectural solutions, calculated scope of work, estimates and the technological chain of production of certain types of work.

1 Architectural and analytical section

1.1 Construction area and climatic conditions

The construction site is located in the northern part of Almaty, in the Alatau district, in the Gazhayip microdistrict. Here, between the Central City Mosque and Almaty Arena, there is a free field area, part of which will be occupied by the cancer hospital.



Drawing 1.1 – Map of the area

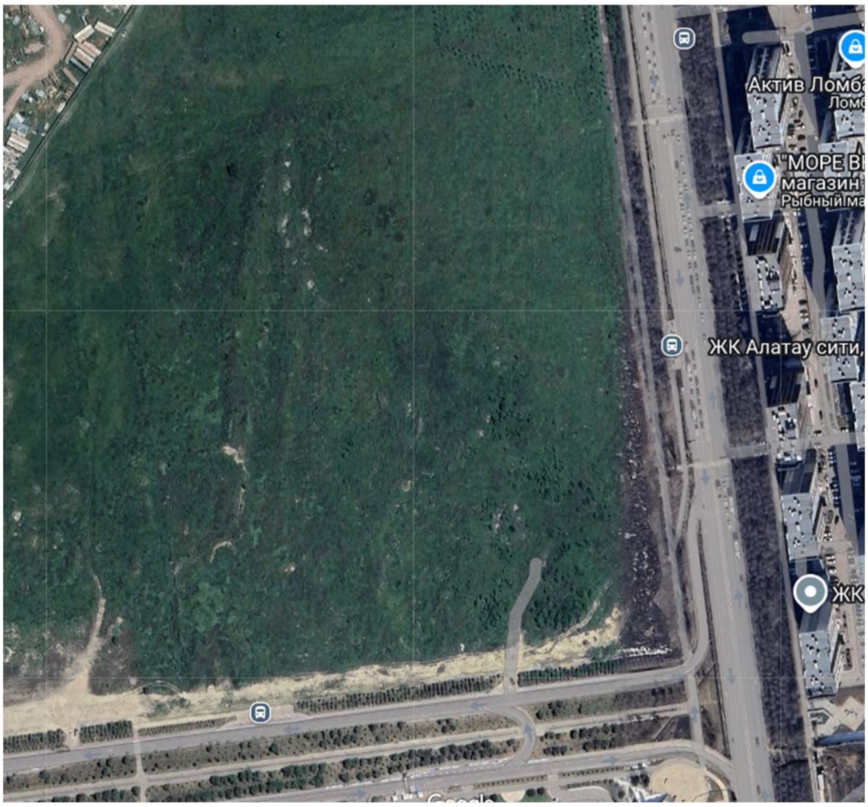


Figure 1.2 – Situation plan

The climate of Almaty is sharply continental, temperate, and has a pronounced daily circulation of wind currents. The city is characterized by frequent temperature changes in winter, which contributes to a constant cycle of freezing and thawing of ice and snow.

Table 1.1 – Wind direction during the year, %

North	North-East	East	South-East	South	South-West	West	North-West
43,0	16,5	6,5	4,7	6,2	10,2	7,1	5,8

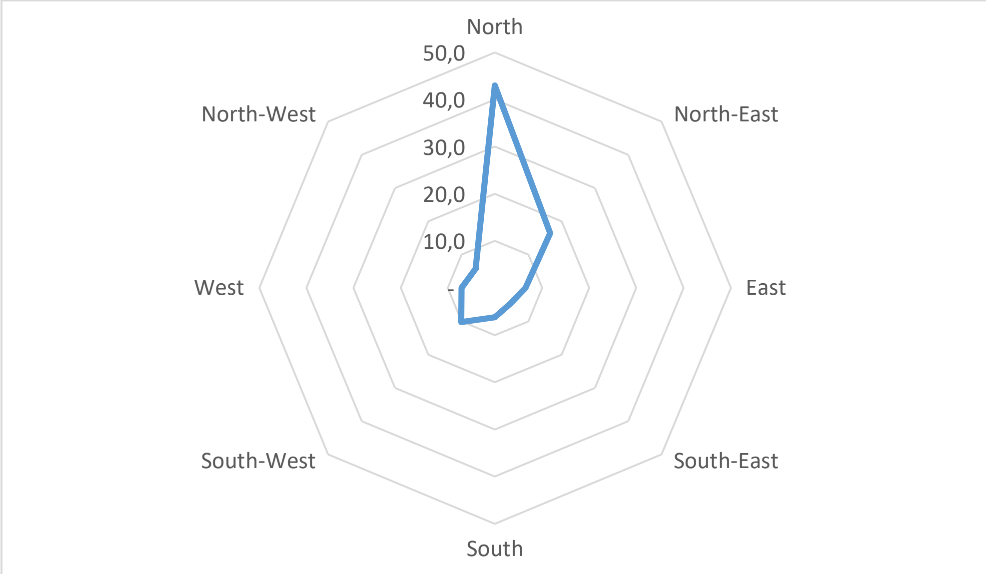


Figure 1.3 – Wind rose of Almaty, %

On average, about 600-650 mm of precipitation falls per year, the main part falls in spring, a smaller part – in autumn. The dry season falls in August.

According to the climate zoning map (Figure A.1, Appendix A, [1]), Almaty belongs to district IIIB, according to the climate map for the base wind speed-to district II.

Table 1.2 – Average monthly air temperature, °C

January	February	March	April	May	June	July	August	September	October	November	December
-5.3	-3.6	2.9	11.5	16.5	21.5	23.8	22.7	17.5	9.9	2.6	-2.9

Table 1.3 – Average monthly air humidity, %

January	February	March	April	May	June	July	August	September	October	November	December
78	76	71	59	57	49	47	45	49	63	73	79

1.2 Architectural solutions of the building

The Cancer Hospital is a unique combination of cutting-edge technology and architectural excellence. It uses the latest equipment, including robotic systems, artificial intelligence and other innovations that provide patients with access to the most up-to-date methods of diagnosis and treatment. The hospital's spaces are not only high-tech spaces, but also stylish interiors made in a modern, minimalistic design with an emphasis on elegant and smooth geometric shapes.

Spacious stained glass windows fill the interior spaces with natural light, reducing the need for artificial lighting and allowing the saved energy to be used to power equipment and provide additional lighting in operating rooms.

The architecture of the building fascinates with its complex shape, consisting of smooth curved trajectories that create a harmonious dynamism. In shapeand plan, the hospital resembles a sea stingray — with an expanded central part and narrowing at the edges. The interior space is thought out to the smallest detail: walls and partitions built in arcs provide a smooth transition between departments and create unique, non-standard rooms, emphasizing not only the functionality, but also the aesthetic appeal of each detail.

The hospital has three floors: the basement is 3 meters high, the first and second floors are 4 metershigh, as well as the space under the roof, created by trusses that hold the stained glass system on the roof.

In the basement there is parking for official ambulances and vehicles belonging to the hospital staff. There are also distribution installations for heating, ventilation and water supply systems.

On the ground floor, there are mainly treatment rooms, check-in and patient assistance areas, reference rooms, storage rooms for medicines, and rooms for changing staff into work clothes and patients into the hospital room.

On the second floor there is a hospital: treatment rooms, rest rooms for patients, a game room for children, as well as warehouses with various types of medical equipment and medicines.

The building is equipped with elevators, stairs and ramps for non-mobile patients to move around the floors. Since the hospital building itself has a non-standard shape, the stair and elevator shafts also have a shape that is closer to a trapezoid than to a rectangle. Due to this, the width of the staircases varies from 1.3 meters to 1.6 meters.

The ramp leading from the basement to the first floor has a width of 2.55 meters.The maximum slope of the ramp is 8 degrees.

The ramp leading from the first floor to the second floor has a width of 1.345 meters in the first part of the span (from the floor slab of the first floor to the inter-floor slab) and 1.22 meters in the second part of the span (from the inter-floor slab to the floor slab of the second floor).

In addition, the length of the basement staircases also differs from the length of the marches leading from the first floor to the second, since the height of the basement is 1 meter less than that of the first and second floors. Thus, the height of stairs between the basement and the first floor is equalto the same height of floors, 3 meters, and between the first and second floors – 4 meters. Also, the height of the stairs differs depending on the purpose of the staircase and the floor on which it is located.

The width of the flight of stairs located in the axes 7-9.1 is 1.5 meters, and the height and width of the tread is 158 mm and 250 mm, respectively. The non-standard height of the riser is due to the lack of large space for the stairs. In addition, thestaircase is intended for use by medical professionals and technical personnel, that is, for a limited number of people, and therefore it can be made more compact than public stairs.

The width of the flight of stairs located in axes 11-12.1 is 1.2 meters, and the height and width of the tread is 158 mm and 250 mm, respectively. The non-standard height of the riser is due to the lack of large space for the stairs. The use is similar to the ladder described above.

The width of the flight of stairs located in the H.2-I.2 axesis 1.55 meters, and the height and width of the tread are 158 mm and 250 mm, respectively. The non-standard height of the riser is due to the lack of large space for the stairs. The use is similar to the ladder described above.

The elevator is standard in shape – rectangular, designed and installed in accordance with regulatory documents. The dimensions of the elevator shaft, 1620 × 2600 mm, allow you to install an elevator that can accommodate people on gurneys and escorts. An elevator with a lifting capacity of 1600 kg and dimensions of 1400×2400×2100 mm, manufactured by Irtysh-Lift LLP, will be installed in this mine.

Drawing 1.4 – Internal design of the elevator

1.3 Technical and economic indicators

Table 1.4 – Technical and economic indicators

№	Name	Meas.	Quantity
1	Total hospital area	m^2	8 744.4
1.1	Basement area	m^2	3 000.4
1.2	First floor area	m^2	2 903.3
1.3	Second floor area	m^2	2 840.7
2	Construction site area	m^2	24 170.0
3	Built-up area	m^2	2 903.3
4	Construction site area	m^2	19079.59
5	The area of construction by temporary buildings and structures	m^2	956.42
6	The length of the temporary:		
6.1	roads (6 m width)	m	387
6.2	water pipes	m	441.4
6.3	sewerage pipes	m	360.3
6.4	lightning wires	m	632
6.5	fencing	m	554.684

1.4 Geotechnical and geological characteristics of the construction area

Based on the results of geotechnical investigations performed in the city of Almaty for each district in 2022 [2] by the company «Project ABS» LLP commissioned by the KSU Department of Ecology and Environment of the City of Almaty», no ground water was found in the Alatau district in the area of B. Momyshuly Street passing. The geological section looks like this:

1. Bulk soil (pebbles, gravel, loam, sand, construction debris) with a capacity of 0.7 m;
2. Loam of solid consistency, light brown color, subsidence, belongs to the 1st type, has a thickness of 0.7-3.3 m;
3. Sandy loam is hard, light brown in color, subsident, belongs to type 1, has a thickness of 1.4 m;
4. The sand is fine, light brown, low-moisture, 0.5 m thick.

According to the survey data, 4 engineering and geological elements (EGE) were identified, all data are collected in a single table.

Table 1.5 – Physical and mechanical properties of soils in normal condition

EGE number	Soil density, kg/m³			Specific soil adhesion, kPa			Internal friction angle soil, degree			Modulus of deformation, MPa
	norms	ρ_{II}	ρ_{I}	norms	c_{II}	c_{I}	norms	φ_{II}	φ_{I}	
EGE-1	1900	1900	1880							

Continuation of Table 1.5

EGE number	Soil density, kg/m^3			Specific soil adhesion, kPa			Internal friction angle soil, degree			Modulus of deformation, MPa
	norms	ρ_{II}	ρ_I	norms	c_{II}	c_I	norms	φ_{II}	φ_I	
EGE-2	1790	1790	1770	45	45	30	24	24	21	6,1
EGE-3	1770	1770	1750	20	20	13	18	18	15	7,7
EGE-4	1600	1600	1580	2	2	1,3	32	32	21	28

Table 1.6 – Physical and mechanical properties of soils in the water-saturated state

EGE number	Soil density, kg/m3			Specific soil adhesion, kPa			Internal friction angle soil, degree			Modulus of deformation, MPa
	norms	ρ_{II}	ρ_I	norms	c_{II}	c_I	norms	φ_{II}	φ_I	
EGE-1	1900	1900	1880							
EGE-2	1790	1790	1770	27	27	18	18	18	15	3,9
EGE-3	1770	1770	1750	10	10	7	11	11	9	6,8
EGE-4	1600	1600	1580	2	2	1,3	32	32	21	28

1.5 Heat engineering calculation

The heat engineering calculation is performed according to the instructions of item 4 Functional requirements [3].

The building's heat-protective shell, in other words, the enclosing structure or external wall, must meet the list of requirements defined in the regulatory document:

1. Element-by-element requirement – the calculated values of the heat transfer resistance given must not be less than the normalized value;

2. Complex requirement – the specific heat protection of the building should not exceed the normalized value.

3. Hygienic requirement-the temperature on the internal the levels of the enclosing structure’s surfaces must be no less than the permissible value.

If the above requirements are met, it can be concluded that the design meets the standards and is considered effective.

The standard value of the reduced thermal resistance for the enclosing structure is calculated using the formula:

$$R_0^{norm} = R_0^{req} \cdot m_p \tag{1.1}$$

Where R_o^{req} – The reference value of the necessary thermal resistance for the enclosing structure, m²×°C/W, is determined based on the degree-days of the heating season, DDAY, °C×day/year, the construction region;

m_p is a factor that considers the specifics of the construction region and is assumed to be at least 0.63 for walls.

The degree-day of the period of heating is determined by the formula:

$$DDAY = (t_{int} - t_{hea}) \cdot z_{hea} \tag{1.2}$$

Where t_{int} = 22°C – the calculated indoor air temperature of the building, °C, taken for calculating the enclosing structures of a group of buildings based on the minimum values of the optimal temperature of the corresponding buildings, determined according to [4];

t_{heat} = 0.8°C, z_{heat} = 179 days – the average outside temperature, °C, and the duration, day/year, of the heating period, taken according to [1] for a period with an average daily outdoor temperature not exceeding 10°C in the design of healthcare facilities.

$$DDAY = (22 - 0.8) \cdot 179 = 3794.8\ day \cdot {}^{\circ}C$$

The R_o^{req} value of the basic required resistance to heat transfer in the enclosing structure for DDAY values other than the table values is determined by the formula:

$$R_0^{req} = a \cdot DDAY + b \tag{1.3}$$

Where a = 0.00035, b = 1.44 – tabular coefficients that should be used for the corresponding building groups.

$$R_0^{req} = 0.00035 \cdot 3794.8 + 1.4 = 2.728\ \frac{m^2 \cdot {}^{\circ}C}{W},$$

$$R_0^{norm} = 2.728 \cdot 0.63 = 1.719\ \frac{m^2 \cdot {}^{\circ}C}{W}$$

The actual value of the heat transfer resistivity is calculated according to [5].

The thermal resistance of a homogeneous multilayer enclosure with uniform layers must be calculated using the formula:

$$R_0 = R_{int} + R + R_{ext} \tag{1.4}$$

Where R_{int}, R_{ext} – heat transfer resistance of the inner and outer surfaces of the enclosing structure, respectively, m^2×°C/W;

R is the resistance to heat transfer in the enclosing structure, m^2×°C/W.

$$R_{int(ext)} = \frac{1}{\alpha_{int(ext)}} \tag{1.5}$$

Where α_{int} = 8.7 W/m^2×°C, α_{ext} = 23 W/m^2×°C is the heat transfer coefficient of the inner and outer parts of the enclosing structure.

$$R_{int} = \frac{1}{8.7} = 0.115\ \frac{m^2 \cdot °C}{W},$$

$$R_{ext} = \frac{1}{23} = 0.043\ \frac{m^2 \cdot °C}{W},$$

$$R = \sum_{i=1}^{n} \frac{\delta_i}{\lambda_i} \tag{1.6}$$

Where δ_i is the layer thickness of the enclosing structure, m.

λ_i is the calculated coefficient of thermal conductivity of the material of the enclosing structure layer, W/m^2×°C.

Table 1.7 – Layers of the enclosing structure

Layer name	Thickness, mm	Coefficient of thermal conductivity, W/m^2×°C
Plaster	25	0.25
Reinforced concrete	200	1.2
Incombustible stone wool plate	100	0.0404
Polymer fiber reinforced concrete facade panel	15	0.35.35

$$R = \frac{0.025}{0.25} + \frac{0.2}{1.2} + \frac{0.1}{0.04} + \frac{0.015}{0.35} = 2.81\ \frac{m^2 \cdot °C}{W},$$

$$R_0 = 0.115 + 2.81 + 0.043 = 2.968\ \frac{m^2 \cdot °C}{W},$$

$$R_0 = 2.968\ \frac{m^2 \cdot °C}{W} > R_0^{req} = 2.728\ \frac{m^2 \cdot °C}{W}$$

The actual heat transfer resistance is higher than required, which means that the design provides the required level of heat retention in the room and can be accepted for execution.

1.6 Lighting engineering calculation

Absolutely all buildings are calculated for the illumination of the premises, the optimal quantity, quality and location of the lamps are selected, their combined effect together with natural light sources. All this is done to create a comfortable stay for a person in a building, taking into account the need for illumination of certain surfaces, corners or areas.

The illumination calculation will be based on the example in [6]. The patient examination and consultation room, located on the ground floor and with an explication number of 131, will be used for the calculation. In this room, as well as throughout the hospital, LED lamps will be installed, the luminous flux of one such lamp is 3600 lumens. It is necessary to calculate the number of light sources in the room.

The illumination of a room from one lamp is determined by the formula

$$E = \frac{L \cdot \eta}{S} \tag{1.7}$$

Where L = 3600 lm – the luminous flux of one lamp;

η = 0.5 – the average coefficient of light hitting the surface;

S = 20 m^2 – the area of the room.

$$E = \frac{3600 \cdot 0.5}{20} = 90\ lx$$

According to [7], the illumination of a room of average accuracy should be at least 200 lux. So one lamp is not enough. Now it is necessary to calculate the number of fixtures in order to satisfy the above condition. To do this, use the formula

$$F = L \cdot \frac{E_{norm}}{E} \tag{1.8}$$

Where F – the number of lamps that meet the lighting condition of the room;

E_{norm} = 200 lx – normalized illumination value.

$$F = 3600 \cdot \frac{200}{90} = 8000\ lm,$$

$$\frac{8000}{3600} = 2.22 \approx 3$$

Thus, for sufficient illumination of the examination room, 3 lamps must be installed in the room.

1.7 Building engineering systems

Heating and water supply networks must be installed in accordance with [8].

The existing scheme of heating networks is two – pipe, circulating, with a joint heat supply for heating, ventilation, and hot water supply. The hot water connection system is closed.

To connect the hospital to the city's general hot water supply network, a separate trench development plan must be developed to connect the branch pipes to the existing network. In the basement of the building, a boiler room is designed with plumbing equipment that controls the supply of hot water to the upper floors. From there, a branch line for showers and bathrooms on the floors above begins along the basement ceiling.

Cold water supply is similar to hot water supply – pipes are connected from the general network through the basement distribution system to the upper floors.

The sewer system diverts household waste from the first and second floors to the basement ceiling, where it then connects to the city network.

Ventilation of the premises is provided by ventilation shafts located on each floor and exhaust unitsinstalled in the basement of the hospital.

1.8 Energy efficiency

The design of stained glass windows includes multi-layer double-glazed windows, which significantly increase the thermal insulation of window openings and the enclosing structure. Special coatings and gas fillers inside the double-glazed windows ensure minimal heat loss, which helps to retain heat in the room in winter and prevents it from overheating in summer.

Key features of the system include:

- Multi-layered glass: several layers of glass in the composition of double-glazed windows significantly improves thermal insulation;
- Gas fillers: inert gases, such as argon or krypton, between the layers of glass increase thermal insulation and reduce heatloss;
- Low-emissivity coatings: special coatings on the glass reflect heat back into the room, providing thermal insulation without reducing the light transmission capacity;
- Solar control technologies: stained glass windows with photochromic or thermochromic coatings adapt to changes in external temperature, reducing overheating in summer and preserving heat in winter.

In addition, stained glass windows play an important role in improving natural indoor lighting, which reduces the need for artificial lighting in the daytime. This not only helps to save electricity, but also improves the indoor climate.

To ensure maximum energy efficiency, not only the correct choice of stained glass windows is important, but also high-quality installation, which ensures tightness and reliable thermal insulation. All this together helps to reduce energy consumption, makesthe hospital building more comfortable and eco-friendly for both hospital visitors and the surrounding space.

1.9 Spatial planning solutions

The hospital building was completed according to the given task, preservingthe futurism concept and creating the effect of spacious rooms using a large number of stained glass systems. On the roof, stained glass windows are installed on top of a system of trussesthat are locatedeйon beams in the transverse direction.

The building has a plan size of 90×54.6 meters. According to regulatory documents, a building with a length of more than 80 meters should be divided into blocks in order to avoid an overabundance of stresses in the structure and its subsequent destruction. For this reason, it was decided to divide the building into blocks with smaller dimensions and simpler forms in the plan. In further calculations, this decision will be justified: this way the design calculation will be simplified, it will be much easier to control the movements and stresses that occur in the structure, as well as to edit the building parameters and change the load-bearing structure to bring it to the appropriate limit values. Block 5 will be used for the calculation.

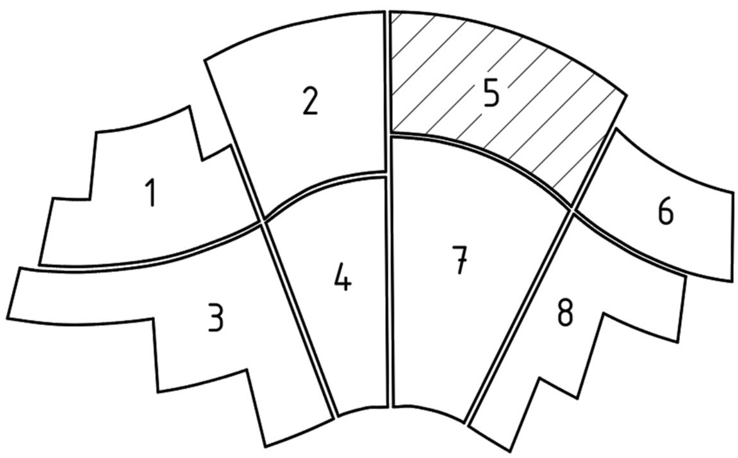


Figure 1.5 – Division of the hospital building into blocks

In total, the hospital building has 283 rooms, where 20 are in the basement, 150 on the first floor, 113 on the second floor. Themain part of the premises is located on the first floor, as it is there that small toilets, showers, changing rooms, treatment rooms and warehouses with medicines and sanitary equipment are located.

Explications of the premises на on each floor and drawings can be found in the Appendix A to this diploma project.

1.10 Calculation of foundation depth

One of the most important elements in the construction is the foundation, the task of which is to transfer the load from the entire building to the ground. In order for the foundation to work as designed, it is necessary to make sure that the ground conditions are suitable for the characteristics of the materials and construction of the foundation.

The foundation should be located below the vegetation layer of the area and the depth of freezing of the soil.

According to engineering and geological conditions of the construction site minimum depth of columnar foundation will be calculated:

$$d = h_1 + (0.2 \div 0.4) \tag{1.9}$$

Where h_1 = 0.7 m – thickness of the topsoil of soil.

$$d = 0.7 + 0.4 = 1.1\ m$$

Standard depth of seasonal soil freezing is calculated according to formula

$$d_{fn} = d_0\sqrt{M_t} \tag{1.10}$$

Where d_0 = 0.23 m – standard value for loams.

M_t = 5.3+3.6+2.9 = 11.8 – the sum of absolute values of average monthly negative temperatures, taken from [1].

$$d_{fn} = 0.23\sqrt{11.8} = 0.79\ m$$

Initially, only columnar foundations and retaining walls were specified in the project. As a result of the development of the project, ribbon foundations were added, as monolithic walls – stiffening diaphragms were added.

The depth of the foundation in the project was 4.35 meters. Since, according to engineering and geological data, there is a non-subsident sandy loam at this depth, supported below by fine sand with even more powerful strength, it was decided to leave the specified depth of foundation and then calculate it based on this figure.

1.11 Structural system

The main scheme of the building frame will beaframe-link frame, where the strength of the structure in one direction will be provided by columns with beams, and in the transverse direction – monolithic walls. Such a framework scheme is due to the complexity of the building configuration and the inability to create beams along arc-shaped trajectories.

Only one block will be used for the calculation, the fifth one, located in the 12.2-17.1 and I.2-N axes. It is the closest to the correct geometric shape, and therefore it will be better seen and understood how the loads are applied to certain structural elements.

In the task for the diploma design, the foundation depth was -4.350 meters, which is a much more favorable parameter than the minimum estimated foundation depth. In addition to the freezing of soil in Almaty, there is another serious reason for the strong deepening of foundations – seismic activity. The city is located in an area of 10-point seismic activity, seismic seams run through the entire city and create the most dangerous places for construction. For this reason, most buildings have deep, massive foundations to withstand a certain seismic load, which is characterized by multiple directions of action, dynamism and unpredictability.

Dimensions of cross-sections of structural elements:

- floor slab 200 mm;
- columns 400×500 mm.
- beams 400×800 mm.
- monolithic walls (stiffening diaphragms) 300 mm;
- retaining walls in the basement of 800 mm.

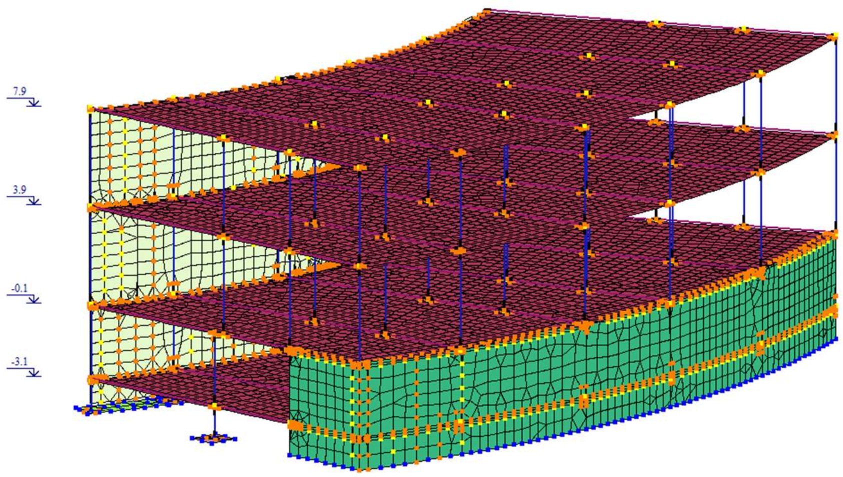


Figure 1.6 – LYRA-CAD design scheme

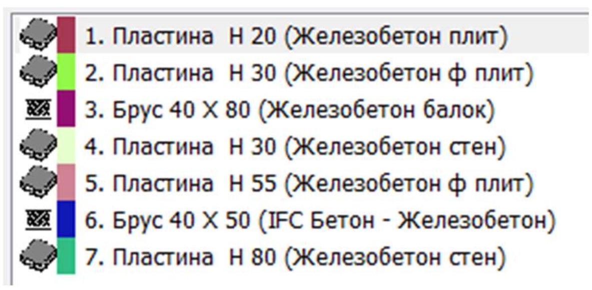


Figure 1.7 – The list of structural element stiffnesses

2 Calculation and construction section

2.1 Calculation in LIRA-SAPR complex

2.1.1 Collecting loads

Before starting to calculate the structure and check it for various types of loads, it is necessary to calculate all the loads acting on the building and present them in tabular form for convenience. The load collection table can be found in the Appendix B.

This section will cover loads such as:

- Dead weight of structural elements of the building;
- Wind load from all 4 sides;
- Ground pressure.
- Snow load on the roof;
- Load from the floor structure;
- Load from the partition structure;
- Time loads by category according to Eurocodes;
- Seismic load on all three axes (X, Y, Z).

2.1.1.1 Calculation of ground pressure on retaining walls

The ground pressure on the retaining wall is calculated at two points: the lower part of the wall, that is, its base, and a point at ground level.

The first step is to calculate the ground pressure at -4.350 using the formula:

$$\sigma_{-4.350} = \gamma \cdot H \cdot tg^2\left(45° - \frac{\varphi}{2}\right) \quad (2.1)$$

Where γ – specific gravity of the soil, which will be calculated as the arithmetic mean between the layers indicated in the table with soil characteristics, kN/m^3;

H = 4.35 m – depth of foundation of the retaining wall sole (modulo value is used);

φ is the angle of internal friction, calculated similarly to the specific gravity of the soil, degrees.

$$\gamma = \frac{\gamma_1 + \gamma_2 + \gamma_3 + \gamma_4}{4} \quad (2.2)$$

Where γ_1, γ_2, γ_3, γ_4– specific gravity of each soil layer in the well, kN/m^3;

4 – the number of geotechnical layers considered in the given construction region.

$$\varphi = \frac{\varphi_1 + \varphi_2 + \varphi_3 + \varphi_4}{4} \tag{2.3}$$

Where φ_1, φ_2, φ_3, φ_4 – the angle of internal friction of each soil layer along the well, degrees.

4 – similar to the previous formula: the number of geotechnical layers considered in a given construction region.

$$\gamma = \frac{18.8 + 17.7 + 17.5 + 15.8}{4} = 17.45\ \frac{kN}{m^3},$$

$$\varphi = \frac{21 + 21 + 15 + 21}{4} = 19.5°,$$

$$\sigma_{-4.350} = 17.45 \cdot 4.35 \cdot tg^2\left(45° - \frac{19.5}{2}\right) = 37.91\ kPa$$

Next, the ground pressure on the ground surface is calculated, taking into account that the typical load on the ground surface is 50 kPa:

$$\sigma_{0.0} = q \cdot tg^2\left(45° - \frac{\varphi}{2}\right) \tag{2.4}$$

Where q = 50 kPa – evenly distributed load on the ground.

$$\sigma_{0.0} = 50 \cdot tg^2\left(45° - \frac{19.5}{2}\right) = 24.973\ kPa$$

Having obtained both types of ground pressure, you can determine their total value and thereby determine the final ground pressure.

$$\sigma = \sigma_{-4.350} + \sigma_{0.0}, \tag{2.5}$$

$$\sigma = 37.91 + 24.973 = 62.887\ kPa$$

Единое общее загружение	Да
Название загружения	Soil pressure
Цвет нагрузок A	785a14
Цвет нагрузок w	145ab4
Цвет нагрузок q	64c814
Обозначить в архитектурно...	Нет
Приложить изнутри	Нет
⊟ Активное давление грунта	
Планировочная отметка, м	0.0
Удельный вес, т/м³	1.790
Угол внутреннего трения...	24
Удельное сцепление, т/м²	4.5
Коэффициент надёжност...	1.0
Угол наклона расчётной ...	0
Угол наклона поверхност...	0
Угол трения грунта на ко...	0
⊟ Грунтовые воды	
Уровень грунтовых вод, м	100.0
Пористость грунта	0.3
Влажность грунта	0.2
Коэффициент надёжност...	1.1
⊟ Давление на поверхность	
Нагрузка на поверхност...	5
Привязка нагрузки, м	0.0
Коэффициент надёжност...	1.0
Угол наклона расчётной пл...	33.0
Коэффициент горизонтальн...	0.42173
Коэффициент сцепления K1	1.298815
Коэффициент сцепления K2	0.0
Общая глубина h	4.35
Контрольная глубина, м	1.35
Активное давление, тс/м²	-0.795
Количество стен	26

Figure 2.1 – Ground load characteristics

2.1.1.2 Snow load

The characteristic values of snow load on the ground are determined according to the snow areas indicated on map 4 of Appendix B [9]. According to this map, the city of Almaty belongs to the second snow region, which means that the characteristic snow load on the ground for this territory is 1.2 kPa (II, s_k = 1.2 kPa).

Formula for estimated snow load on the surface:

$$s = \mu_i \cdot C_e \cdot C_t \cdot S_k \tag{2.6}$$

Where μ_i – coefficients of the shape of the snow load depending from angle of the roof, taken from the table 5.2 [9];

C_e = 1.0 – environmental coefficient for conventional buildings, taken fron table 5.1 [9];

C_t = 1.0 – thermal coefficient, point 5.2.7 [9];

The angle of inclination of the roof will be 0 degrees, respectively, the coefficients of the shape of the snow load will be: μ = 0.8.

$$s = 0.8 \cdot 1 \cdot 1 \cdot 1.2 = 0.96\ kPa$$

Thus, the design model of the building will have a snow load of 0.96 kPa applied to the flat roof.

2.1.1.3 Wind load

Wind load, similar to snow load, is set based on the instructions given in [9]. According to this regulatory document, the wind load is applied to the building not as one continuous evenly distributed load, but is divided according to the height and width of the building into certain sections, each of which has its own correction factor. Thus, to apply a wind load, you need to determine the value of this load for zones A, B, C, D, E, F, G, H, and I.On the model, this will look like the wind pressure on the building from all sides: from the windward side, from the suction side, from the sides, and on the roof.

The city of Almaty belongs to the second wind region (Map of zoning of the territory of Kazakhstan by base wind speed with a probability of exceeding 0.02), which means that here the base wind speed is 25 m/s, and the wind pressure is 0.39 kPa (II, v_b = 25 m/s, q_b = 0.39 kPa).

Since the structure is located within the city limits, the type of terrain will be considered as the fourth (IV): areas where at least 15% of the surface is covered by buildings that are more than 15 m high.

Next, the procedure for manual calculation of wind load will be specified, but the calculation itself will be performed through the SAPHIR software package due to the complexity of the building geometry.

According to table 4.1 [9] roughness parameter $z_{0.II}$ = 0.05 m, z_0 = 1.0 m and minimum height z_{min} = 10 m. According to Appendix Ж determine the main basic speed of the wind.

The base wind speed value is:

$$v_b = c_{dir} \cdot c_{season} \cdot v_{b,0} \qquad (2.7)$$

Where c_{dir} = 1.0 – coefficient that takes into account the wind direction.

c_{season} = 1.0 – seasonal coefficient.

Now it is needed to make calculations for two sides of the building: the short side and the long side.

Since H < a, the wind pressure will be calculated relative to the height of the building, forming one cargo lane.

The terrain coefficient, which depends on the roughness parameter z_0, is determined by the formula 4.4 [9]:

$$k_r = 0.19 \cdot \left(\frac{z_0}{z_{0.II}}\right)^{0.07} \qquad (2.8)$$

Where z_0 = 0.05 m – roughness parameter for the given type of terrain

$z_{0.II}$ = 0.05 m – roughness parameter for the second type of terrain.

The coefficient $c_r(z)$ determines the variability of the average wind speed $v_m(z)$ at the location of the structure depending on: the height above ground level; the roughness parameter z_0 of the terrain from the windward side of the structure for the considered wind direction. It is determined by the formula:

$$c_r(z) = k_r \cdot ln\left(\frac{z}{z_0}\right) \tag{2.9}$$

The average wind speed $v_m(z)$ at an altitude above ground level is:

$$v_m(z) = c_r(z) \cdot c_o(z) \cdot v_b \tag{2.10}$$

Where $c_r(z)$ – coefficient that takes into account the type of terrain.
$c_0(z) = 1.0$ is the orographic coefficient.
To define $l_v(z)$, the following expression is recommended:

$$l_v(z) = \frac{k_i}{c_o(z) \cdot ln\left(\frac{z}{z_0}\right)} \tag{2.11}$$

Where $k_i = 1.0$ – turbulence coefficient.
The peak value of the velocity head q_p (z) at height z should be determined taking into account average and short-term speed fluctuations. The recommended rule for determining $q_p(z)$ is:

$$q_p(z) = [1 + 7 \cdot l_v(z)] \cdot \frac{1}{2} \cdot \rho \cdot v_m^2(z) \tag{2.12}$$

Where ρ – air density, which varies with altitude, temperature, and barometric pressure. The value should be determined in accordance with the regions of occurrence of the hurricane. The recommended value of p is 1.25.kg /m^3.
Wind pressure exerted on the outer surfaces of building elements is determined by the formula:

$$w_e = c_{pe,10} \cdot q_p(z) \tag{2.13}$$

Where c_{pe} is the aerodynamic coefficient of external pressure, which is equal to different values depending on the wind impact zone.
Next, the wind pressure should be multiplied by the coefficient assigned to each wind flow zone according to Table 7.1 [9].

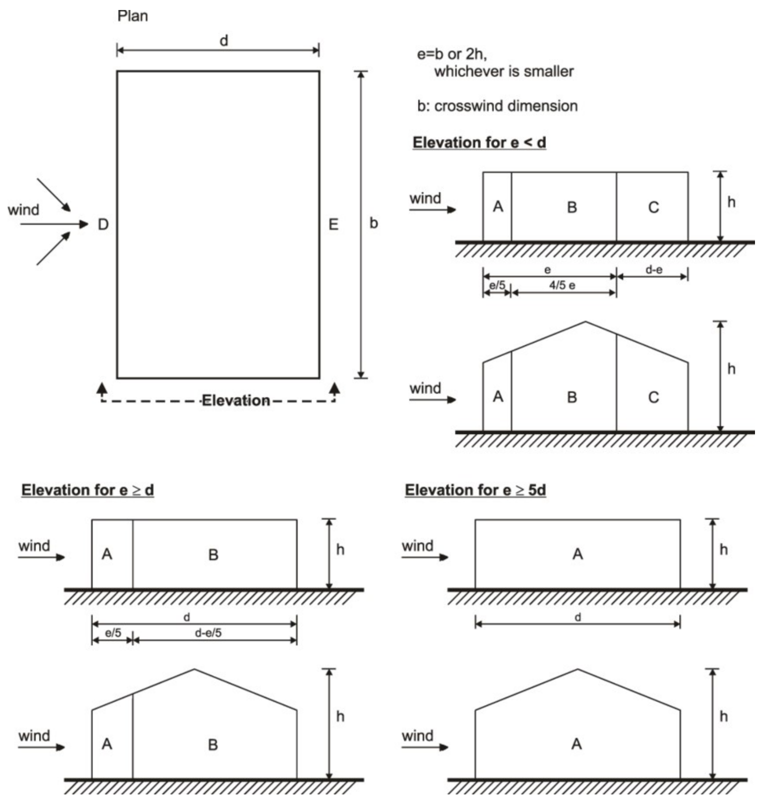


Figure 2.2 – Division of wind zones

A similar calculation is made for the second side of the building.

Since the wind load was set automatically in the program, you can see how the load was set. To simplify the calculation, the program created a similar rectangular silhouette for calculating pressure.

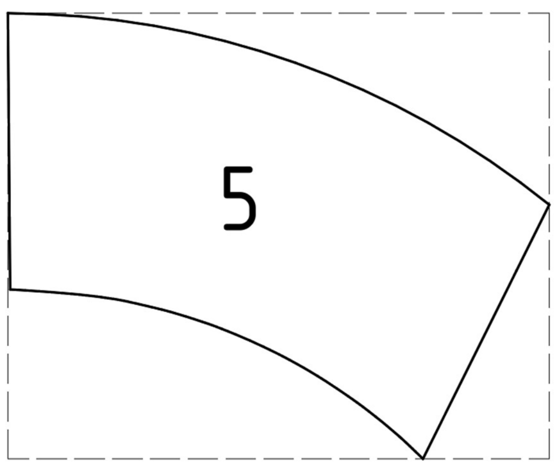


Figure 2.3 – Wind loading application in the SAPHIR program

Загружение (наименование)	Wind +X
Угол отн. ОХ, °	0
Уровень планировки, м	0.0
Ширина здания, м	Авто
Способ приложения	2 - напор/отсос в пространст...
Градиентная интерполяция	Да
На боковые стены	Да
в зоне А	-1.2
в зоне В	-0.8
в зоне С	-0.5
Отступ моделей нагрузки, мм	0
Количество сегментов	10
Радиус приложения нагрузк...	0
Архитектурная модель	Нет
Асимметричный напор	Нет
Заморозить ветер	Нет
Нормативный документ	НП к СП РК EN 1991-1-4:2005/...
Табличное задание	Нет
⊟ Параметры по НП к СП РК EN 1991-1-4:2005/2017 (...	
Ветровой район РК	II
Базовая скорость ветра, ...	25.0
Базовый ветровой напор...	0.039063
Тип местности	IV
Конструкционный коэфф...	1.0
Аэродинамический напор	0.8
Аэродинамический отсос	0.5
Пульсация	Нет

Загружение (наименование)	Wind -X
Угол отн. ОХ, °	180
Уровень планировки, м	0.0
Ширина здания, м	Авто
Способ приложения	2 - напор/отсос в пространст...
Градиентная интерполяция	Да
На боковые стены	Да
в зоне А	-1.2
в зоне В	-0.8
в зоне С	-0.5
Отступ моделей нагрузки, мм	0
Количество сегментов	10
Радиус приложения нагрузк...	0
Архитектурная модель	Нет
Асимметричный напор	Нет
Заморозить ветер	Нет
Нормативный документ	НП к СП РК EN 1991-1-4:2005/...
Табличное задание	Нет
⊟ Параметры по НП к СП РК EN 1991-1-4:2005/2017 (...	
Ветровой район РК	II
Базовая скорость ветра, ...	25.0
Базовый ветровой напор...	0.039063
Тип местности	IV
Конструкционный коэфф...	1.0
Аэродинамический напор	0.8
Аэродинамический отсос	0.5
Пульсация	Нет

Загружение (наименование)	Wind +Y
Угол отн. ОХ, °	90
Уровень планировки, м	0.0
Ширина здания, м	Авто
Способ приложения	2 - напор/отсос в пространст...
Градиентная интерполяция	Да
На боковые стены	Да
в зоне А	-1.2
в зоне В	-0.8
в зоне С	-0.5
Отступ моделей нагрузки, мм	0
Количество сегментов	10
Радиус приложения нагрузк...	0
Архитектурная модель	Нет
Асимметричный напор	Нет
Заморозить ветер	Нет
Нормативный документ	НП к СП РК EN 1991-1-4:2005/...
Табличное задание	Нет
⊟ Параметры по НП к СП РК EN 1991-1-4:2005/2017 (...	
Ветровой район РК	II
Базовая скорость ветра, ...	25.0
Базовый ветровой напор...	0.039063
Тип местности	IV
Конструкционный коэфф...	1.0
Аэродинамический напор	0.8
Аэродинамический отсос	0.5
Пульсация	Нет

Загружение (наименование)	Wind -Y
Угол отн. ОХ, °	270
Уровень планировки, м	0.0
Ширина здания, м	Авто
Способ приложения	2 - напор/отсос в пространст...
Градиентная интерполяция	Да
На боковые стены	Да
в зоне А	-1.2
в зоне В	-0.8
в зоне С	-0.5
Отступ моделей нагрузки, мм	0
Количество сегментов	10
Радиус приложения нагрузк...	0
Архитектурная модель	Нет
Асимметричный напор	Нет
Заморозить ветер	Нет
Нормативный документ	НП к СП РК EN 1991-1-4:2005/...
Табличное задание	Нет
⊟ Параметры по НП к СП РК EN 1991-1-4:2005/2017 (...	
Ветровой район РК	II
Базовая скорость ветра, ...	25.0
Базовый ветровой напор...	0.039063
Тип местности	IV
Конструкционный коэфф...	1.0
Аэродинамический напор	0.8
Аэродинамический отсос	0.5
Пульсация	Нет

Figure 2.4 – Wind load characteristics from different sides of the building

2.1.1.4 Seismic load

Since the building is located in a zone of seismic activity (according to well-known data, the city of Almaty is located in a zone of increased activity of tectonic plates). The LIRA-SAPR software package is able to independently calculate the seismic load, if you enter data about the construction area and some characteristics in the model.

List of data required for performing the calculation:

1. Correction factor for seismic forces
2. Acceleration
3. Behavior factor for horizontal acceleration
4. Behavior factor for vertical acceleration
5. The Region factor
6. Lower bound factor of the spectrum
7. Attenuation correction indicator

The guide cosines of the resultant seismic action are alternately equal to 1 (see the Drawings of the seismic action task).

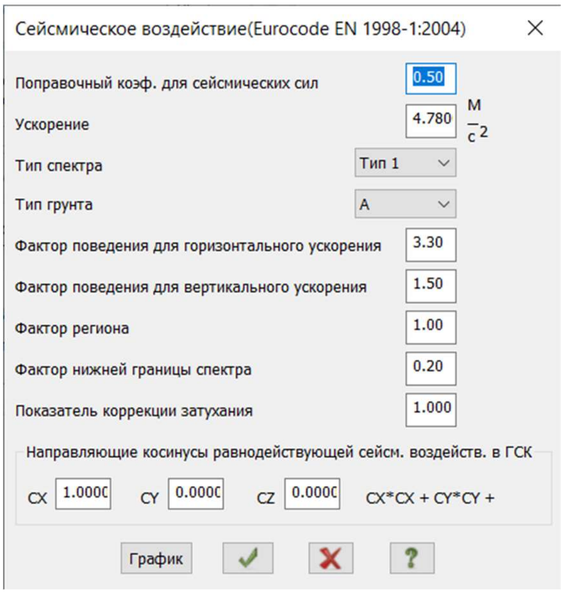


Figure 2.5 – Seismic impact on the X-axis

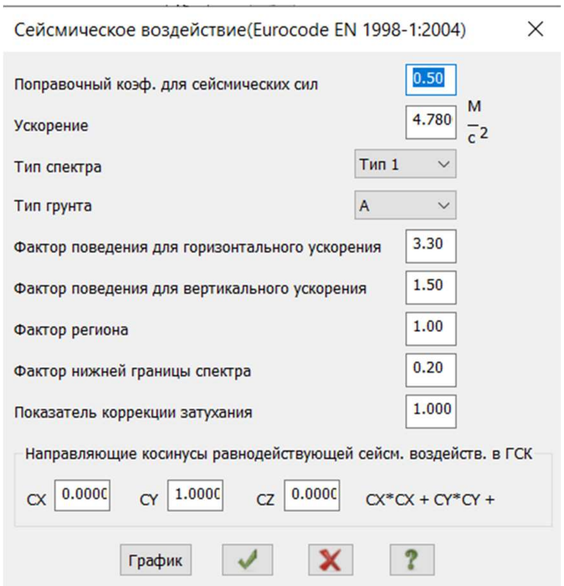


Figure 2.6 – Seismic impact on the Y-axis

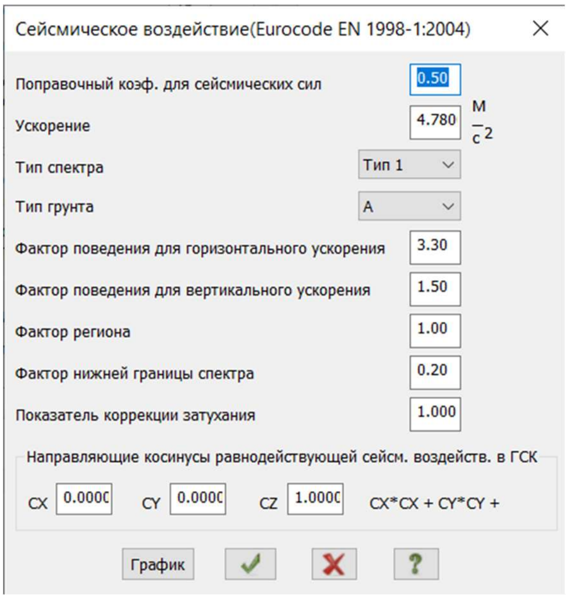


Figure 2.7 – Seismic impact along the Z-axis

Next, a table of dynamic loads is compiled, which indicates the combination of seismic impact and static load.

#	Имя загружения	Подзадача	Вид	Тип
1	Собственный вес	1. Основная задача: C1. Основная задача; D1. Основная задача	Постоянное, Gsup(Gsup)	
2	Wind +X	1. Основная задача: C1. Основная задача; D1. Основная задача	Ветровое, Q(Qw)	
3	Wind -X	1. Основная задача: C1. Основная задача; D1. Основная задача	Ветровое, Q(Qw)	
4	Wind +Y	1. Основная задача: C1. Основная задача; D1. Основная задача	Ветровое, Q(Qw)	
5	Wind -Y	1. Основная задача: C1. Основная задача; D1. Основная задача	Ветровое, Q(Qw)	
6	Soil pressure	1. Основная задача: C1. Основная задача; D1. Основная задача	Постоянное, Gsup(Gsup)	
7	Snow	1. Основная задача: C1. Основная задача; D1. Основная задача	Снеговое > 1000, Q(Qs)	
8	Weight of floors	1. Основная задача: C1. Основная задача; D1. Основная задача	Постоянное, Gsup(Gsup)	
9	Weight of walls	1. Основная задача: C1. Основная задача; D1. Основная задача	Постоянное, Gsup(Gsup)	
10	Category A	1. Основная задача: C1. Основная задача; D1. Основная задача	Временное кат.A, Q(QiA)	
11	Category C3	1. Основная задача: C1. Основная задача; D1. Основная задача	Временное кат.C, Q(QiC)	
12	Category F	1. Основная задача: C1. Основная задача; D1. Основная задача	Временное кат.F, Q(QiF)	
13	Category H	1. Основная задача: C1. Основная задача; D1. Основная задача	Временное кат.H, Q(QiH)	
14	Seismic (X)	1. Основная задача: C1. Основная задача; D1. Основная задача	Сейсмическое, Ae(Ae)	СЕЙСМ
15	Seismic (Y)	1. Основная задача: C1. Основная задача; D1. Основная задача	Сейсмическое, Ae(Ae)	СЕЙСМ
16	Seismic (Z)	1. Основная задача: C1. Основная задача; D1. Основная задача	Сейсмическое, Ae(Ae)	СЕЙСМ

Figure 2.8 – Load numbering

Сводная таблица :

№ дин....	№ стат. ...	Коэф.	Код
14	1	1	1
14	8	1	1
14	9	1	1
14	10	0.3	1
14	11	0.3	1
14	12	0.3	1
14	13	0.3	1
14	7	0.2	1
15	1	1	1
15	8	1	1
15	9	1	1
15	10	0.3	1
15	11	0.3	1
15	12	0.3	1
15	13	0.3	1
15	7	0.2	1
16	1	1	1
16	8	1	1
16	9	1	1
16	10	0.3	1
16	11	0.3	1
16	12	0.3	1
16	13	0.3	1
16	7	0.2	1

Figure 2.9 – Table of dynamic load combinations

2.1.2 Creating a calculation scheme

Building a design scheme starts with preparing a building model built in Autodesk Revit. For ease of further work, you need to create a separate file with a copy of the model, then delete unnecessary objects: architectural elements and all annotations (dimensions, brands of doors, stained glass windows, room numbers and their areas)to check the correctness of the model. Also, since the calculation of snow load will be carried out similarly to a flat roof, it is necessary to remove the stained glass windows on the roof and the trusses that support the glass system from the design scheme. After checking the model for defects in the structural part, the model is exported to SAPHIR, where analytical model is created based on the obtained load-bearing frame diagrams. This analytical model can then be exported to the LIRA-SAPR calculation complex and proceed directly to the calculations.

2.1.3 Creating exposure combinations

As a rule, the variant of exposure to loads, in which all loads act simultaneously with the maximum intensity, is almost impossible. However, there are many other combinations that can lead to damage to the building or partial or complete destruction.

To account for the largest number of combinations, LIRA-SAPR uses formulas 6.10.10 and 6.10b (Basic combination), 6.11b (Emergency combination), 6.12b (Seismic combination), 6.14b (Characteristic combination), 6.15b (Frequent combination), 6.16b (Quasi-constant combination) [10].

Based on the listed formulas, the program creates a table of RSN (calculated load combinations), which can be found in the Appendix C.

2.1.4 Analysis of the results obtained

According to the results of the calculation (see the Appendix D in the Diploma Project) and their comparison with the standard values, the building can be classified as moderately irregular in plan and regular in height. In emergency situations, deformations in the structure are within the permissible limits, which means that the structure will withstand all the applied loads, and the selected cross-sections of the elements meet the conditions.

2.2 Manual calculation of wireframe elements

2.2.1 Beam

2.2.1.1 Longitudinal reinforcement

The beam is calculated on the basis of internal forcesobtained as a result of calculation in the LIRA-SAPR software package. The calculation will use a beam running along the 12.2 axis at the ground floor level.

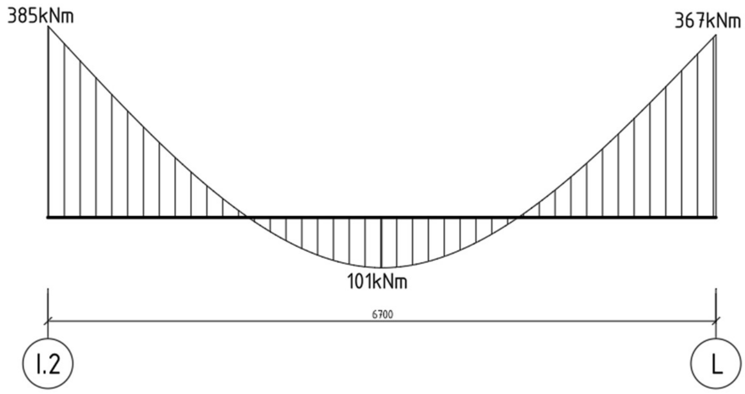


Figure 2.10 – Plot of bending moments in the beam

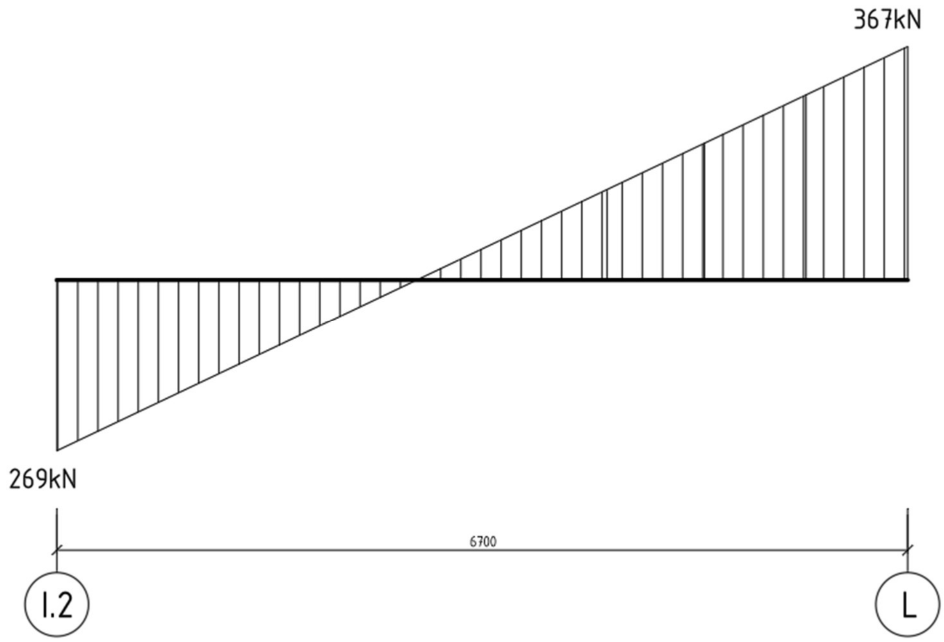


Figure 2.11 – Plot of transverse forces in the beam

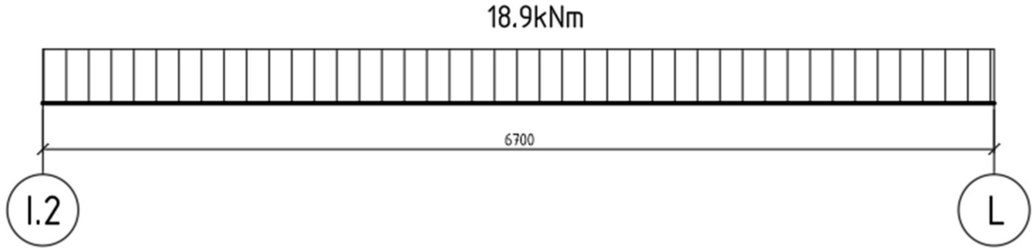


Figure 2.12 – Plot of longitudinal forces in the beam

Characteristic resistance of concrete of class C20/25 to axial compression: f_{ck} = 20 MPa. Partial safety coefficient for concrete: γ_c = 1.5. Calculated resistance of concrete to axial compression (условие 6.1.5.4 [11]):

$$f_{cd} = \frac{f_{ck} \cdot \alpha_{cc}}{\gamma_c}, \tag{2.14}$$

$$f_{cd} = \frac{20 \cdot 0.85}{1.5} = 11.33\ MPa$$

Characteristic tensile strength of working fittings of class S500: f_{yk} = 500 MPa. Partial safety coefficient for reinforcement: γ_s = 1.15. Calculated tensile resistance of the working reinforcement:

$$f_{yd} = \frac{f_{yk}}{\gamma_s}, \tag{2.15}$$

$$f_{yd} = \frac{500}{1.15} = 434.783\ MPa$$

Working cross-section height:

$$d = h - c_1 \tag{2.16}$$

Where h is the beam cross-sectional height.

c_1 – thickness of the protective layer of concrete.

$$d = 600 - 40 = 560\ mm$$

Bending moment in span:

$$M_{Eds} = 385\ kNm$$

The cross-sectional areas of stretched and compressed reinforcement, if the calculation requires compressed reinforcement, are determined by the formulas 7.5 - 7.6 [11]:

$$\alpha_{Eds} = \frac{M_{Eds}}{f_{cd} \cdot b \cdot d^2}, \tag{2.17}$$

$$A_{s1} = \frac{1}{\sigma_{sd}} \cdot \omega \cdot b \cdot d \cdot f_{cd} \tag{2.18}$$

Where σ_{sd} – calculated tensile strength of working fittings of class S500;

ω is the tabular coefficient selected according to Appendix B.1 [11].

According to the condition, if the value of α_{Eds} is less than.0.372, then the calculation of compressed longitudinal reinforcement is not required, it is selected structurally, that is, it is possible to put reinforcement in the upper part of the beam that is similar in area to the one that will be installed at the bottom of the element.

$$\alpha_{Eds} = \frac{385 \cdot 10^3}{11.33 \cdot 10^6 \cdot 0.4 \cdot 0.76^2} = 0.147,$$

$$\alpha_{Eds} = 0.147 < \alpha_{Eds,lim} = 0.372$$

If this condition is met, you can only perform calculations for stretched rebars. Compressed rebars will be selected structurally.

Accordingto Table B.1 [11], for normal concrete ≤ C50/60 ω = 0.1688, ξ = x/d = 0.242, x = ξ×d=183.92 mm, ζ = z/d = 0.899, z = ζ×d = 683.24 mm.

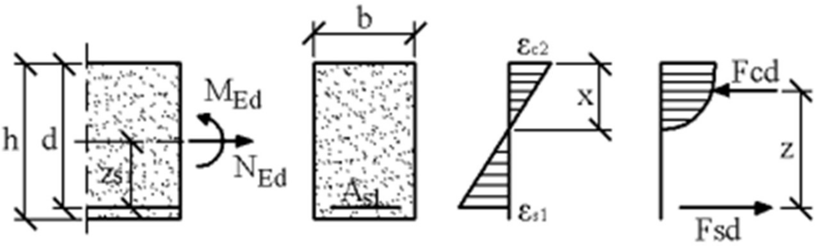


Figure 2.13 – Dividing the beam cross-section into stretched and compressed zones

$$A_{s1} = \frac{1}{434.783 \cdot 10^6} \cdot 0.1688 \cdot 0.4 \cdot 0.76 \cdot 11.333 \cdot 10^6 = 1337.616\, mm^2,$$

$$A_{s2} = A_{s1} = 1337.616\, mm^2$$

Area of stretched non-prestressed reinforcement: 3d25 S500 (A_{s1} = 14.73 cm^2).
Area of compressed non-prestressed reinforcement: 3d25 S500 (A_{s2} = 14.73 cm^2).

2.2.1.2 Transverse reinforcement

The calculation of reinforced concrete elements for the strength of transverse forces in the absence of vertical and (or) inclined (bent) reinforcement should be carried out from the condition 7.34 [11]:

$$V_{Ed} \leq V_{Rd,c} \tag{2.19}$$

Where V_{Ed} = 117.612kN – the calculated transverse force in the section under consideration caused by the action of loads, taken from LIRA;

V_{Rd} – the calculated transverse force perceived by a reinforced concrete element without transverse reinforcement, calculated by formula 7.35 [11]:

$$V_{Rd,c} = \left(\frac{0.18}{\gamma_c} \cdot k \cdot (100 \cdot \rho_l \cdot f_{ck})^{\frac{1}{3}}\right) \cdot b_w \cdot d \tag{2.20}$$

According to expression 7.35a [11], $V_{Rd,c}$ must be at least $V_{Rd,c,min}$:

$$V_{Rd,c,min} = \left[0.035 \cdot k^{\frac{3}{2}} \cdot f_{ck}{}^{\frac{1}{2}}\right] \cdot b \cdot d, \tag{2.21}$$

$$k = 1 + \sqrt{\frac{200}{d}} \leq 2, \tag{2.22}$$

$$\rho_l = \frac{A_{s1}}{b \cdot d} \leq 0.02 \tag{2.23}$$

The length of the segment where transverse reinforcement is required based on the calculation can be determined in the first approximation from the plot of the transverse force distribution. So, for a beam that is affected by a uniformly distributed load, the length of this segment can be determined by the formula 7.49 [11]:

$$\alpha_w = \frac{V_{Ed} - V_{Rd,c}}{g + p} \tag{2.24}$$

Where g+p = 117.612 kN/m – sum of applied constant and time loads, taken from the LIRA model.

$$k = 1 + \sqrt{\frac{200}{760}} = 1.513,$$

$$\rho_l = \frac{17.43}{40 \cdot 76} = 0.005 \leq 0.02,$$

$$V_{Rd,c} = \left(\frac{0.18}{1.5} \cdot 1.513 \cdot (100 \cdot 0.005 \cdot 20)^{\frac{1}{3}}\right) \cdot 400 \cdot 760 = 117.673\ kN,$$

$$V_{Rd,c,min} = \left[0.035 \cdot 1.513^{\frac{3}{2}} \cdot 20^{\frac{1}{2}}\right] \cdot 400 \cdot 760 = 88.554\ kN,$$

$$V_{Rd,c} = 94.504\ kN > V_{Rd,c,min} = 88.554\ kN$$

If the condition is met, you can continue with further calculations.

Since the actual transverse force is greater than the calculated one, the calculation for the selection of transverse reinforcement must be made. The estimated length of the cross armature detection will be equal to

$$\alpha_w = \frac{367 - 88.554}{117.612} = 2.367\ m$$

Distances at which the transverse reinforcement will be calculated: d_{z1} = 800 mm, d_{z2} = 1600 mm, d_{z3} = α_w = 2367.493 mm.

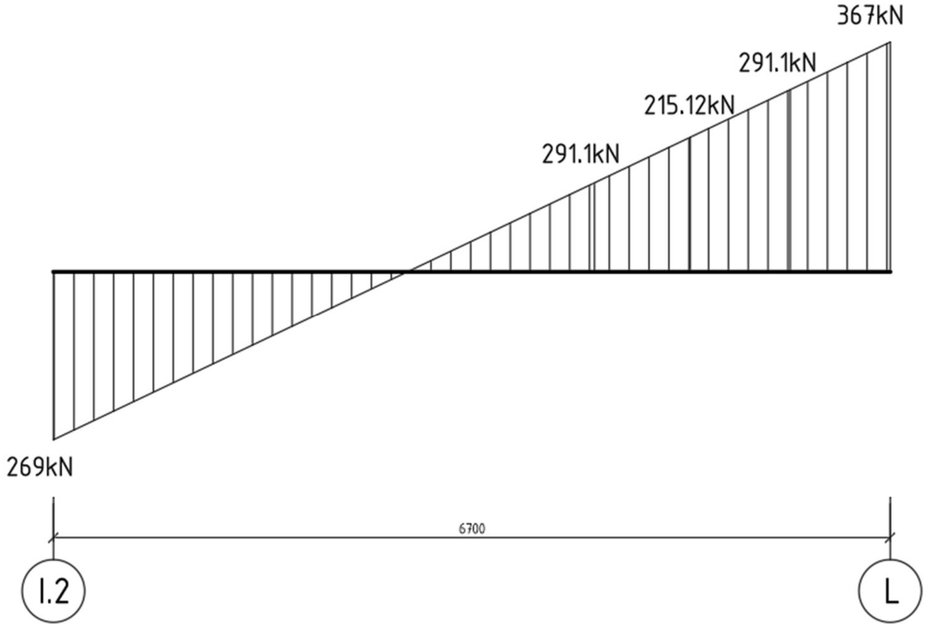


Figure 2.14 – Plot of transverse forces

Assign the calculated cross-section at a distance d_{z1} from the support.
Transverse force in this section: V_{Ed} = 291.1 kN.
Set the angle of inclination of cracks to the horizontal: θ = 40°.
The step of the transverse reinforcement is assumed: s = 100 mm.
Then the required area of the transverse reinforcement is determined according to formula 7.51 [11]:

$$A_{sw} = \frac{V_{Ed} \cdot s}{d_z \cdot f_{ywd} \cdot ctg(\theta)} \tag{2.25}$$

Where f_{ywd} = 167 MPa - calculated yield strength of the transverse reinforcement.

$$A_{sw} = \frac{291.1 \cdot 100}{800 \cdot 167 \cdot ctg(40°)} = 3.657\ cm^2$$

Area of transverse reinforcement: 3d10 S240 (A_{sw} = 2.36 cm^2)
The following conditions must be met (7.53-7.54 [11]):

$$\frac{A_{sw} \cdot f_{ywd}}{b \cdot s} \leq 0.5 \cdot v \cdot f_{cd}, \tag{2.26}$$

$$V_{Ed} \leq V_{Rd,max} = \frac{v \cdot f_{cd} \cdot b \cdot d_z}{ctg\theta + tg\theta} \tag{2.27}$$

Where v – a coefficient accounting for the decrease in concrete's compressive strength under tensile conditions, applicable to heavy concrete:

$$v = 0.6\left(1 - \frac{f_{ck}}{250}\right) \geq 0.5, \qquad (2.28)$$

$$v = 0.6\left(1 - \frac{20}{250}\right) = 0.552 > 0.5$$

The condition is met.

$$\frac{A_{sw} \cdot f_{sw}}{b \cdot s} = \frac{236 \cdot 167}{400 \cdot 100} = 0.493\ MPa,$$

$$0.5 \cdot v \cdot f_{cd} = 0.5 \cdot 0.552 \cdot 11.333 = 3.128\ MPa,$$

$$0.493 \leq 3.128,$$

$$V_{Rd,max} = \frac{0.552 \cdot 11.333 \cdot 400 \cdot 800}{ctg(40°) + tg(40°)} = 985.753\ kN,$$

$$V_{Ed} = 291.1\ kN < V_{Rd,max} = 985.753\ kN$$

The condition is met.

Now it is necessary to perform similar calculations for the second section, located at a distance of d_{z2} from the edge of the support.

Transverse force in this section: V_{Ed} = 215.12 kN.

Set the angle of inclination of cracks to the horizontal: θ = 40°.

The step of the transverse reinforcement is assumed: s = 150 mm.

Then the required area of the transverse reinforcement:

$$A_{sw} = \frac{215.12 \cdot 150}{1600 \cdot 167 \cdot ctg(40°)} = 1.013\ cm^2$$

Area of transverse reinforcement: 3d8 S240 (A_{sw} = 1.51 cm^2)

$$v = 0.6\left(1 - \frac{20}{250}\right) = 0.552 > 0.5$$

The condition is met.

$$\frac{A_{sw} \cdot f_{sw}}{b \cdot s} = \frac{151 \cdot 167}{400 \cdot 150} = 0.42\ MPa,$$

$$0.5 \cdot v \cdot f_{cd} = 0.5 \cdot 0.552 \cdot 11.333 = 3.128\ MPa,$$

$$0.42 \leq 3.128,$$

$$V_{Rd,max} = \frac{0.552 \cdot 11.333 \cdot 400 \cdot 1600}{ctg(40°) + tg(40°)} = 985.753\ kN,$$

$$V_{Ed} = 215.12\ kN < V_{Rd,max} = 1971.506\ kN$$

The condition is met.

Now it is necessary to perform similar calculations for the second section, located at a distance of d_{z3} from the edge of the support.

Transverse force in this section: V_{Ed} = 142.31 kN.

Set the angle of inclination of cracks to the horizontal: θ = 40°.

The step of the transverse reinforcement is assumed: s = 200 mm.

Then the required area of the transverse reinforcement:

$$A_{sw} = \frac{142.31 \cdot 200}{2367.493 \cdot 167 \cdot ctg(40°)} = 0.604\ cm^2$$

Area of transverse reinforcement: 3d8 S240 (A_{sw} = 1.51 cm^2)

$$v = 0.6\left(1 - \frac{20}{250}\right) = 0.552 > 0.5$$

The condition is met.

$$\frac{A_{sw} \cdot f_{sw}}{b \cdot s} = \frac{151 \cdot 167}{400 \cdot 200} = 0.315\ MPa,$$

$$0.5 \cdot v \cdot f_{cd} = 0.5 \cdot 0.552 \cdot 11.333 = 3.128\ MPa,$$

$$0.315 \leq 3.128,$$

$$V_{Rd,max} = \frac{0.552 \cdot 11.333 \cdot 400 \cdot 2367.493}{ctg(40°) + tg(40°)} = 2917.204\ kN,$$

$$V_{Ed} = 142.31\ kN < V_{Rd,max} = 2917.204\ kN$$

The condition is met.

2.2.1.3 Crossbar construction

The crossbar is reinforced using welded frames, with a portion of the longitudinal bars interrupted based on the variation in the bending moment envelope and the reinforcement layout.

Using the accepted area of longitudinal reinforcement, determine the corresponding bending moment. Find the value of μ:

$$\mu = \frac{A_{s1}}{d \cdot b}, \tag{2.29}$$

$$\mu = \frac{14.73 + 11.4}{76 \cdot 40} = 0.009,$$

$$\xi = \mu \frac{f_{yd}}{f_{cd}}, \tag{2.30}$$

$$\xi = 0.009 \cdot \frac{434.783}{11.333} = 0.33,$$

$$\zeta = 1 - 0.34 \cdot \xi, \tag{2.31}$$

$$\zeta = 1 - 0.34 \cdot 0.33 = 0.888,$$

$$M_{3\emptyset25+3\emptyset22} = f_{yd} \cdot A_{s1} \cdot \zeta \cdot d, \tag{2.32}$$

$$M_{3\emptyset25+3\emptyset22} = 434783 \cdot 2613 \cdot 0.888 \cdot 760 = 766.624\ kNm,$$

$$\mu = \frac{11.4}{76 \cdot 40} = 0.004,$$

$$\xi = 0.004 \cdot \frac{434.783}{11.333} = 0.144,$$

$$\zeta = 1 - 0.34 \cdot 0.144 = 0.951,$$

$$M_{3\emptyset22} = f_{yd} \cdot A_{s,3\emptyset22} \cdot \zeta \cdot d, \tag{2.33}$$

$$M_{3\emptyset22} = 434783 \cdot 1140 \cdot 0.951 \cdot 760 = 358.27\ kNm$$

The anchor length for the 1-st section (d_{z1}) is determined as follows:

$$q_{wi} = \frac{f_{sw} \cdot \emptyset \cdot A_{sw2}}{s} \tag{2.34}$$

Where Ø = 16 mm – diameter of the reinforcement.

$$q_{wi} = \frac{167 \cdot 16 \cdot 236}{250} = 2.522\ \frac{kN}{m},$$

$$W = \frac{Q_i}{2 \cdot q_{wi}} + 5d \qquad (2.35)$$

Where Qi = V_{Ed} – the transverse force at the point of theoretical discontinuity.

$$W = \frac{367}{2 \cdot 2.522} + 5 \cdot 1.6 = 80.749\ cm > 10\ cm$$

Assume W = 81 cm.
The anchor length for the 1-st section (d_{z2}) is determined as follows:

$$q_{wi} = \frac{167 \cdot 16 \cdot 151}{250} = 1.614\ \frac{kN}{m},$$

$$W = \frac{291.1}{2 \cdot 1.614} + 5 \cdot 1.6 = 98.186\ cm > 10\ cm$$

Assume W = 98 cm.
The anchor length for the 1-st section (d_{z3}) is determined as follows:

$$q_{wi} = \frac{167 \cdot 16 \cdot 151}{250} = 1.614\ \frac{kN}{m},$$

$$W = \frac{142.31}{2 \cdot 1.614} + 5 \cdot 1.6 = 52.089\ cm > 10\ cm$$

Assume W = 52 cm.

2.2.2 Column

Determine by the formula from Figure B.2 [11]:

$$\frac{c_1}{b_{co}} = \frac{c_2}{b_{col}} = \frac{30}{500} = 0.06$$

Where c_1, c_2 – protective layer of the column reinforcement.

$$V_{Ed} = \frac{-N_{Ed}}{a_{col} \cdot b_{col} \cdot f_{cd}} \qquad (2.36)$$

Where N_{Ed} = -660 kN-the longitudinal force acting on the column is taken from the LIRA model.

$$V_{Ed} = \frac{-660}{0.4 \cdot 0.5 \cdot 11.333} = 0.291,$$

$$\alpha_{Eds} = \frac{M_{Ed}}{b_{co} \cdot h_{col}{}^{2} \cdot f_{cd}} \quad (2.37)$$

Where M_{Ed} = 102 kNm – the bending moment acting on the column is taken from the LIRA model.

$$\alpha_{Eds} = \frac{102}{0.4 \cdot 0.5^2 \cdot 11.333} = 0.09$$

Using Figure B.2 [11], determine the coefficient ω_{tot} = 1.0.

$$A_{s,tot} = \frac{\omega_{tot} \cdot a_{col} \cdot b_{col}}{\frac{f_{yd}}{f_{cd}}}, \quad (2.38)$$

$$A_{s,tot} = \frac{1.0 \cdot 0.4 \cdot 0.5}{\frac{434.783}{11.333}} = 52.133\ cm^2,$$

$$A_1 = A_2 = \frac{A_{s,tot}}{2} = \frac{52.133}{2} = 26.067\ cm^2$$

Area of compressed non-prestressed reinforcement: 8d32 S500 ($A_{s,tot}$ = 64.34 cm^2).

Cross reinforcement is accepted structurally based on the following condition that the diameter must be at least 6 mm and no more than 1/4d_{max}: d8 S240.

The step is taken based on the following conditions:

- no more than 400 mm.
- no more than the minimum side of the cross-section: 400 mm;
- no more than 20d_{max}: 640 mm

The pitch is assumed to be 200 mm.

3 Organizational and technological section

3.1 Technology subsection

3.1.1 Determination of the volumes of work

3.1.1.1 Temporary fencing arrangement

Before starting construction work, the construction site must be fenced off. To do this, from the extreme axes of the pit in each direction, you need to add 20 m for free movement of equipment on the construction site and ground movement. The perimeter of the resulting section, i.e. the length of the fence, is calculated using the formula

$$P_{fence} = (20m + l_1) \cdot 2 + (20m + l_2) \cdot 2 \tag{3.1}$$

Here 20 m is the sum of 10 meters on each side from the edge of the pit;

l_1 = 90 m is the length of the building;

l_2 = 54.6 m is the width of the building.

$$P_{fence} = (20 + 90) \cdot 2 + (20 + 54.6) \cdot 2 = 369.2\ m$$

3.1.1.2 Cutting the vegetation layer

During pit excavation, the topsoil must be removed with an additional 10-meter margin on each side beyond the pit's edge:

$$S_a = \left(10m + l_{1.up} + 10m\right) \cdot \left(10m + l_{2.up} + 10m\right) \tag{3.2}$$

Where $l_{1.up}$ – length of the pit at the top, m.

$l_{2.up}$ – width of the pit at the top, m.

$$l_{1.up} = l_{1.low} + 2mh_{pit}, \tag{3.3}$$

$$l_{2.up} = l_{2.low} + 2mh_{pit} \tag{3.4}$$

Where $l_{1.low}$ – the length of the pit at the bottom, m.

$l_{2.low}$ – width of the pit at the bottom, m.

m = 0.75 – slope steepness coefficient, according to Appendix 1 (Table 2, [12]);

h_{pit} = 4.35 m – pit depth, m.

$$l_{1.low} = l_1 + 1.3m \cdot 2,$$

$$l_{2.low} = l_2 + 1.3m \cdot 2$$

Where l_1 = 90 m, l_2 = 54.6 m – the length and width of the building in plan, respectively.

$$l_{1.low} = 90 + 1.3 \cdot 2 = 92.6\ m,$$

$$l_{2.low} = 54.6 + 1.3 \cdot 2 = 57.2\ m,$$

$$l_{1.up} = 92.6 + 2 \cdot 0.75 \cdot 4.35 = 99.125\ m,$$

$$l_{2.up} = 57.2 + 2 \cdot 0.75 \cdot 4.35 = 63.725\ m,$$

$$S_a = (10 + 99.125 + 10) \cdot (10 + 63.725 + 10) = 9973.741\ m^2$$

The vegetation layer is cut to a depth of 0.15 meters, so the volume will be equal to:

$$V_a = S_a \cdot 0.15m \qquad (3.5)$$

Where 0.15 m – cutting depth of the plant layer.

$$V_a = 9973.741 \cdot 0.15 = 1496.061\ m^2$$

3.1.1.3 Excavation in pit

Since Revit belongs to the field моделирования of BIM (Building Information Modeling) modeling, the concrete volumes for all elements will be taken from there. Thus, we get

$$V_{pit} = 7603.924\ m^3$$

In addition to the pit itself, it is also necessary to equip a ramp (trench) for moving equipment from the pit and vice versa. The volume of the trench for the exit to the pit will be calculated using the formula

$$V_{tren} = \beta\left(\frac{b \cdot {h_{pit}}^2}{2} + \frac{{h_{pit}}^3 \cdot m}{2}\right) \qquad (3.6)$$

Where β = 10 – coefficient of laying the bottom of the entrance trench.
b = 6 m – width of the exit trench along the bottom in two-way traffic.

$$V_{tren} \quad = 10\left(\frac{6 \cdot 4.35^2}{2} + \frac{4.35^3 \cdot 0.75}{2}\right) = 773.457\ m^3$$

Now you need to calculate the total amount of soil required for development:

$$V = V_{pit} + V_{tren} \quad , \tag{3.7}$$

$$V = 7603.924 + 773.457 = 8377.381\ m^3$$

3.1.1.4 Development of soil shortage

In the course project, manual soil refinement was chosen. The volume of soil shortage is determined by the formula

$$V_{manual} = S \cdot \Delta h_{manual} \tag{3.8}$$

Here S = 1437.886 m^2 – the total area of pit at the bottom;

Δh_{manual} = 0.1m is the depth of soil shortage, which will be finalized manually.

$$V_{manual} = 1437.886 \cdot 0.1 = 143.7886\ m^3$$

3.1.1.5 Concrete preparation device

Now the amount of concrete preparation required for the foundation is determined. As a rule, concrete preparation is carried out by means of either geomembrane or lean concrete of the same brand as the foundations, on a fine aggregate. On the scale of the course work, the name fine-grained concrete will be used. The volume of concrete will be divided into two simple calculations:

The area of concrete covering required for a single columnar foundation will be determined by the formula

$$F_1 = 1.2 \cdot 1.2 = 1.44\ m^2$$

Where 1.2 m – length and width of the columnar foundation along the lower face.

The area of concrete coverage required for all strip foundations:

$$F_2 = 41\ m^2$$

Total volume of concrete preparation:

$$V_{preparation} = (F_1 \cdot n + F_2) \cdot 0.1m \tag{3.9}$$

Where n = 124+8 = 132 pcs – number of columnar foundations.

0.1 m is the height of the concrete preparation.

$$V_{preparation} = (1.44 \cdot 132 + 41) \cdot 0.1 = 23.108\, m^3$$

3.1.1.6 Fitting reinforcement

Rebar consumption per columnar foundation is determined by the formula

$$G_1 = g_1 + g_2 + g_3 \tag{3.10}$$

Where g_1 = 78.8 kg – the weight of the grid C-1;

g_2 = 7.992 kg – the weight of the grid C-2;

g_3 = 11.6 kg – the weight of the reinforcement A-III of 14 diameters with a length of 1200 mm.

This data is taken from Table 1 [12].

$$G_1 = 78.8 + 7.992 + 11.6 = 98.392\, kg$$

The weight of rebar for a strip foundation is determined in a similar way.

$$G_2 = g_2 \cdot V_f \tag{3.11}$$

Where g_2 = 150 kg/m^3 – consumption of reinforcement frames per 1m3 of concrete.

V_f = 11.98 m^3 – volume of all strip foundations.

$$G_2 = 150 \cdot 11.98 = 1797\, kg$$

The total weight of the reinforcement will be equal to the sum of the volumes required for each individual foundation:

$$G = G_1 + G_2, \tag{3.12}$$

$$G = 98.392 \cdot 132 + 1797 = 14784.744\, kg$$

3.1.1.7 Concreting foundations

The volume of concrete for foundations will be taken from the Revit model. This results in the values describedbelow.

Volume of concreterequired for all strip foundations:

$$V_{ribbon} = 11.98\, m^3$$

Volume of concrete required for a single columnar foundation:

$$V_{column} = 0.637\ m^3$$

Total volume of concrete:

$$V = 11.98 + 0.637 \cdot 132 = 96.064\ m^3$$

3.1.1.8 Waterproofing the foundation

In the course project, the following type of waterproofing was adopted – coating waterproofing. Painting is done by applying bitumen mastics to the painted surface. The number of applied layers is 2 layers.

The waterproofing area of a foundation is defined as the sum of the areas of all foundation surfaces. According to the foundation drawing, values of all dimensions are taken and all required areas are calculated:

$$S_{hydroins.ribbon} = 43.206 \cdot 2 \cdot 4.35 + 1238 = 1613.892\ m^2,$$

$$S_{hydroins.column} = 4 \cdot 0.3 \cdot 1.2 + 2 \cdot \frac{0.5 + 1.2}{2} \cdot 0.5 + $$
$$+2 \cdot \frac{0.4 + 1.2}{2} \cdot 0.5 = 3.09\ m^2,$$

$$S_{hydroins.} = S_{hydroins.ribbon} + S_{hydroins.column} \cdot n, \qquad (3.13)$$

$$S_{hydroins.} = 1613.892 + 3.09 \cdot 132 = 2021.772\ m^2$$

3.1.1.9 Backfilling

The volume of soil to be backfilled for a pit in buildings without a basement is determined by the formula

$$V_{back} = \frac{V_{pit} - V_{foundation}}{1 + K_{loose.2}} \qquad (3.14)$$

Where $K_{loose.2}$ = 1.06 – the coefficient of residual loosening, determined from Table 1 (Appendix 1, [12]).

$$V_{back} = \frac{8377.381 - 96.064}{1 + 1.06} = 4020.057\ m^3$$

3.1.1.10 Compaction of the ground

The seal volume is mainly measured by the sealing area. By establishing the mean thickness of the compacted layer, it can be calculated.

$$F_{compaction} = \frac{V_{back}}{h_{compaction}} \quad (3.15)$$

Where $h_{compaction}$ = 0.3 m – the thickness of the compacted layer.

$$F_{compaction} = \frac{4020.057}{0.3} = 13400.19\ m^2$$

3.1.1.11 Conclusive planning of construction site

The final layout is made after all earthworks and communications are completed. This parameter is defined as the area of the territory that will be developed after the construction process is completed.

$$S_{plan} = S_a - S_{building} \quad (3.16)$$

Where $S_{building}$ = 2853.012 m^2 – the area of the building calculated before.

$$S_{plan} = 9973.741 - 2853.012 = 7120.729\ m^2$$

3.1.1.12 Dismantling the temporary fence

Upon completion of construction activities, the construction site fencing must be dismantled. The perimeter of the fence was calculated in previous point. You do not need to repeat the calculation. Upon completion of construction, the fence of the above length will be removed from the site.

3.1.2 Selection of complex elaborated methods of excavation work

In integrated mechanization, operations are carried out by coordinated machine sets that are interconnected by key parameters and spatial arrangement within the process chain.

When choosing the methods of production of works, it is necessary to take into account: the type of soil, the size of the earth structure, the water table, the range of soil movement and the season of work.

Soil excavation and relocation for pit and trench construction can be performed using bulldozers and excavators working in conjunction with dump trucks. The selection of a complex mechanized earthmoving method is based on a technoeconomic evaluation of various machinery combinations. The project will analyze and compare 2–3 machines of the same or different categories to determine the optimal option.

In the course project, a comparison of options should be made for the leading earthmoving machine.

3.1.2.1 Selection of a bulldozer

Cutting the vegetation layer is carried out by bulldozers or scrapers. When choosing the types of machines, it should be borne in mind that the technological process of cutting plant soil includes cutting itself, as well as moving the soil. It is advisable to use bulldozers to move soil up to a distance of 50-150 m (depending on the capacity of the bulldozer).

When designing the cutting of the vegetation layer by earthmoving and transport machines, you should set the distance of movement of the plant soil and, in accordance with this distance, choose the brand of the bulldozer or scraper, using the recommendations shown in Table 5 according to [12], and the technical characteristics of the machines described in Appendix 1, Table 7-8, [12].

Since the length of the building is 144 m, it is advisable to use a bulldozer that can move and transport soil for a distance of up to 150 m. To do this, the power of the machine should be 108-130 kW.

In this case, 4 bulldozers with a capacity of 118KW are suitable for this condition. Their characteristics are shown in Appendix E.

Out of 4, will be chosen the three most productive ones for comparison, i.e. we will discard the DZ-27S. Of the remaining three, consider the dimensions and performance. DZ-109HL is the most productive with the smallest dimensions. The height of the bulldozer does not greatly affect the construction site, so the DZ-110 can be considered large in size. With smaller dimensions, the DZ-109HL has a large blade, which provides productivity equal to the DZ-110. From all the above, we can conclude that the DZ-109HL is the most suitable for carrying out work.

Now you need to determine the replacement capacity of the bulldozer:

$$W_{bull.} = \frac{60 \cdot T \cdot q \cdot \alpha \cdot K_{time}}{T_{take} + T_{speed} + \frac{l_{full}}{v_{full}} + \frac{l_{empty}}{v_{empty}}} = \frac{60 \cdot 8 \cdot 4 \cdot 1.5 \cdot 0.8}{0.24 + 0.14 + \frac{100}{3.6} + \frac{100}{6.6}} = 5846 m^3$$

Where T = 8 h – the duration of operation of the bulldozer per shift, 8h;

q = 4 m^3 – the volume of soil moved by the dump;

α – the coefficient that takes into account the loss of soil during movement;

K_{time}=0.8 (for non-rocky soil) – the coefficient of use of the machine in time;

T_{take} = 0.24 min – time on a set of soil by category;

T_{speed} = 0.14 min – the time spent on switching speeds;

l_{full} = 100 m, l_{empty} = 100 m – the estimated distance of movement with a load and empty;

V_{full} = 3.6 km/h, V_{empty} = 6.6 km/h – respectively, the speed of the bulldozer when moving soil (loaded) and forward, m/min.

$$\alpha = 1 + 0.005 \cdot l_{full} = 1 + 0.005 \cdot 100 = 1.5$$

3.1.2.2 Selecting an excavator

The choice of an excavator depends on the volume of soil in the pit. The required volume of the excavator bucket is determined according to Table 6 of Appendix 1, [12].

According to the condition, 3 models of an excavator with a bucket volume of 1 m3 were suitable. Now you need to compare them by different parameters to choose the most effective option.

The cost of 1 m^3 of soil in a pit is determined by the formula

$$C = \frac{1.08 \cdot C_{machine-shift}}{V_{shift}} \tag{3.17}$$

Where $C_{machine\text{-}shift}$ – the cost of one machine-shift of the excavator;

V_{shift} – the shift work of the excavator, which takes into account the development of soil with loading into the vehicle, determined by the formula

$$V_{shift} = \frac{V_{pi}}{N_{machine-shi}} \tag{3.18}$$

Where $N_{machine\text{-}shift}$ – the total number of machine shifts of the excavator, determined by the formula

$$N_{machine-shift} = \frac{V_{pit}}{100} \cdot N_{time} \tag{3.19}$$

Where N_{time} = 36.6 – the standard duration of the excavation cycle.

$$N_{machine-shif} = \frac{8377.381}{100} \cdot 36.6 = 3066.122\, m^3,$$

$$V_{shift} = \frac{8377.381}{3066.122} = 2.732$$

It is also necessary to calculate the specific investment for the development of 1 m^3 of soil in the pit for this model of excavator. Capital investments are determined by the formula

$$M_{specific} = \frac{1.07 \cdot C_{ma}}{V_{shift.year}} \quad (3.20)$$

Here $C_{machine}$ – inventory and estimated cost of the excavator

$V_{shift.year} = 300$ – normalized number of excavator work shifts per year.

The selection of the excavator is finalized based on an analysis of unit reduced costs per cubic meter of soil development.

$$Ch_{specific} = C + (E_n \cdot M_{specific}) \quad (3.21)$$

Where $E_n = 0.15$ is the standard efficiency coefficient of capital investments.

Now let's calculate all the data and compare the excavators.

$$C_1 = \frac{1.08 \cdot 35.9}{2.732} = 14.191,$$

$$C_2 = \frac{1.08 \cdot 36.39}{2.732} = 14.384,$$

$$C_3 = \frac{1.08 \cdot 33.4}{2.732} = 13.202,$$

$$M_{specific.1} = \frac{1.07 \cdot 21.96}{300} = 0.078,$$

$$M_{specific.2} = \frac{1.07 \cdot 25.14}{300} = 0.09,$$

$$M_{specific.3} = \frac{1.07 \cdot 25.04}{300} = 0.089,$$

$$Ch_{specific.1} = 14.191 + (0.15 \cdot 0.078) = 14.202,$$

$$Ch_{specific.2} = 14.384 + (0.15 \cdot 0.09) = 14.398,$$

$$Ch_{specific.3} = 13.202 + (0.15 \cdot 0.089) = 13.216$$

The E-1251B excavator has the lowest performance by almost all calculations, so it will be used in the future.

The operational performance of an excavator is determined by the formula

$$W_{excav} = 60 \cdot T \cdot g \cdot n \cdot K_l \cdot K_b \quad (3.22)$$

Where g = 1 m^3 – the excavator bucket volume,

n – the number of cycles per minute

K_l – bucket volume utilization factor, determined by Table 23 from Appendix 1, [12];

K_b = 0.85 is the shift time utilization factor.

$$n = \frac{60}{t_{cycle}} = \frac{60}{36.6} = 1.639$$

Where t_{cycle} is the time of one excavator cycle, determined from Table 22 from Appendix 1, [12].

$$W_{excav} = 60 \cdot 8 \cdot 1 \cdot 1.639 \cdot 0.7 \cdot 0.85 = 468.197\ m^3$$

3.1.2.3 Selection of soil compaction mechanisms

Work on compaction of the soil in the pits is carried out in twoпfloors:

1. compaction of the soil between the foundations of columns;
2. above the column foundations.

Depending on the degree of tightness of the working conditions, the following can be used:

- self-propelled rollers with smooth rollers - for cohesive soils.
- vibratory rollers – for loose soils.
- hydro-mechanical vibration dampers-for all soils.
- electric self-moving rammers-for loose and poorly connected soils;
- electricatreadmills – for connected and disconnected soils.

The replaceable operating capacity of ice rinks is determined by the formula:

$$W_{roller} = \frac{(B - b) \cdot v \cdot 1000 \cdot h \cdot T}{m} \cdot 0.85 \quad (3.23)$$

Here B – the width of the compaction strip;

b = 0.2 m – the overlap width of adjacent lanes;

v = 5 km/h – the average speed of movement;

h – the thickness of the effective compaction layer;

m – the required number of penetrations.

All of the above data is taken from Table 4 in Appendix 1, [12]. For a more accurate calculation, you should also take 2-3 car models and consider their resulting parameters. According to the conditions, two ramming machines were suitable, the characteristics of which are described in table in Appendix E.

Since the characteristics of the cars are the same, you can take one car and continue the calculation with it. Let's take the DU-126 for calculation.

It is necessary to determine the productivity of this bulldozer by the formula

$$W_{roller} = \frac{(B_1 - b_1) \cdot v_1 \cdot 1000 \cdot h_1 \cdot T}{m_1} \cdot 0.85 \qquad (3.24)$$

Where B_1 = 2.5 m – width of the seal strip.

b_1 = 0.2 m – width of overlapping adjacent lanes.

v_1 = 5 km/h – average driving speed.

h_1 = 1.2 m – thickness of the effective compaction layer;

m_1 = 10 – required number of passes

$$W_{roller} = \frac{(2.5 - 0.2) \cdot 5 \cdot 1000 \cdot 1.2 \cdot 8}{10} \cdot 0.85 = 9384000\ m^3$$

3.1.2.4 Design of a technological workflow with calculated operational parameters of machinery

When developing a technological scheme for the production of works, it is necessary to pay special attention to the organization of the workplace of earthmoving machines, i.e. the workplace of the machine is depicted for all characteristic sections of the pit (pit).

Depending on the size of the pit and the parameters of the excavator, the development of the pit is carried out in one or several penetrations in width and in one or several tiers in depth.

When excavating ditches, the first sinking should be carried out with a frontal face, the rest – with a side face, and the development of pits – with a frontal face.

When developing the parameters of the face of the excavation of an excavator equipped with a straight shovel, first determine the largest width of the first (frontal) excavation at the level of the excavator parking lot $B_{H.}$.

$$B_H = 2 \cdot b_1 = 2 \cdot 0.9 \cdot R_{st} \qquad (3.25)$$

Where R_{st} = 6 is the digging radius at the parking level.

$$B_H = 2 \cdot 0.9 \cdot 6.3 = 11.34\ m$$

The maximum width of the frontal tunnel at the top is determined by the formula

$$B_{up} = 2 \cdot \sqrt{(0.9 \cdot R_{max})^2 - {l_n}^2} \quad (3.26)$$

Where R_{max} – is the largest digging radius;

l_n – the length of the working movement, determined from Table 10 from Appendix 1 to [12].

$$B_{up} = 2 \cdot \sqrt{(0.9 \cdot 9.9)^2 - 1.75^2} = 17.473\ m$$

The maximum width of the second (side) excavation of the excavator is determined by the formula

$$B = b_1 + b_2 \quad (3.27)$$

Where b_1, b_2 is the greatest distance from the axis of movement of the excavator to the bottom of the frontal face, determined by the formulas.

$$b_1 = 0.9 \times R_{st} = 0.9 \times 6.3 = 5.67\ m,$$

$$b_2 = 0.7 \times R_{st} = 0.7 \times 6.3 = 4.41\ m,$$

$$B = 5.67 + 4.41 = 10.08\ m$$

Development of a separate excavation pit is possible from one or more excavator parking areas. The initial parking lot has the greatest distance from the upper edge, determined by the formula

$$L = \sqrt{{R_{st}}^2 - \left(\frac{a}{2}\right)^2} \quad (3.28)$$

Where a – the size at the top of the pit across the axis of movement of the excavator, determined by the formula

$$a = 1.25 \cdot R_{st} = 1.25 \cdot 6.3 = 7.875\ m,$$

$$L = \sqrt{6.3^{2-7} - \left(\frac{7.875}{2}\right)^2} = 4.918\ m$$

The pit is developed from a single parking lot, if the entire width is included in the radius of the working area of the excavator.

The first parking lot is assigned by the formula

$$b = B - 2 \cdot m \cdot h_{pit}, \tag{3.29}$$

$$b = 10.08 - 2 \cdot 0.5 \cdot 3 = 7.08\ m$$

3.1.2.5 Selection of vehicles for pit development

Dump trucks are chosen as components for removing excess soil from the pit (trench) and ensuring joint work with the excavator. Dump trucks are selected according to two parameters: by body capacity and load capacity. The load capacity and brand of the dump truck are shown in Table 12 from Appendix 1 to [12].

Since the amount of excavation is very large and the excavator was chosen with a large bucket capacity, the dump truck should be chosen with a large load capacity and capacity. Next, GAZ-53A will be used for the calculation.

The volume of soil in a dense body in the excavator bucket is determined by the formula

$$V_{soil} = \frac{V_{bucket} \cdot K_{fill}}{K_{loose.1}} \tag{3.30}$$

Where V_{bucket} is the excavator bucket volume;
$K_{fill} = 0.9$ is the bucket filling coefficient
$K_{loose.1} = 1.25$ is the initial loosening coefficient.

$$V_{soil} = \frac{1 \cdot 0.9}{1.25} = 0.72\ m^3$$

The mass of soil in the excavator bucket is:

$$Q = V_{soil} \cdot \rho_{soil} \tag{3.31}$$

Where p_{soil} = 2300kg/m^3 is the average soil density.

$$Q = 0.72 \cdot 2300 = 1656\ kg$$

The number of buckets of soil loaded into the dump truck, body is determined by the following formula. The value is rounded up to an integer.

$$n = \frac{P}{Q} \tag{3.32}$$

Where P=27 tons is the load capacity of a dumptruck, determined from tables 12 and 14 from the Appendix 2 [12].

$$n = \frac{4000}{1656} = 2.191 = 3$$

Assess the volume of solid (in-situ) soil transported in the dump truck body:

$$V = V_{soil} \cdot n, \tag{3.33}$$

$$V = 0.72 \cdot 3 = 2.16\, m^3$$

We calculate the duration of one dump truck operation cycle:

$$T_{cycle} = t_n + \frac{60 \cdot L}{V_r} + t_p + \frac{60L}{V_n} + t_{add} =$$
$$= 0.791 hour + \frac{60 \cdot 1km}{30\frac{km}{hour}} + 1min +$$
$$+ \frac{60 \cdot 1km}{35\frac{km}{hour}} + 2.2min = 4.558\, hour$$

Where t_n – the time of loading the soil;

L – the distance of soil transportation (given by the task for the course work);

V_r – the average speed of the dump truck in the loaded state, taken according to Table 16 from the Appendix 7 [12];

t_p – the time of unloading the dump truck, taken according to the table 16 from the Appendix 7 [12];

V_n – the average speed of the dump truck in the empty state (without soil), taken according to table 16 from the Appendix 7 [12];

t_{add} – the time of auxiliary operations (installation time for loading and unloading, waiting at the excavator, passing an oncoming dump truck, taken according to table 16 from software applications [12].

$$t_n = \frac{V \cdot N_{time} \cdot 60}{100} \tag{3.34}$$

Where N_{time} – the ENiR machine time norm (Table 22, Appendix 1, [12]).

$$t_n = \frac{2.16 \cdot 36.6 \cdot 60}{100} = 0.791\, hour,$$

$$T_{cycle} = 0.791 + \frac{60 \cdot 1}{30} + 1 + \frac{60 \cdot 1}{35} + 2.2 = 4.558\, hour$$

The required number of dump trucks is determined by the formula and rounded up to an integer.

$$N = \frac{T_{cycle}}{t_n}, \tag{3.35}$$

$$N = \frac{4.558}{0.791} = 5.766 = 6$$

3.1.2.6 Selection of mounting cranes

The initial data for selecting cranes are the dimensions of the foundation pit and basement parts of the building, the dimensions and weights of the structures to be installed. When selecting cranes, self-propelled jib cranes should be used for the installation of free-standing columnar foundations of buildings.

Cranes should be selected according to their technical parameters: by load capacity, by hook lifting height, by boom reach, and by the value of the load moment.

When taking into account the main parameters of cranes (load capacity, boom reach, lifting height), modifications of basic models of cranes with replaceable equipment are also subject to consideration: boom and tower–boom, various tracks, platforms, etc.

The crane hook reach is determined by the formula

$$L_{hoo} \;\; = l_1 + l_2 + l_3 \tag{3.36}$$

Here l_1 – the distance from the axis of rotation to the boom attachment hinge;

l_2 – the smallest permissible distance from the base of the slope to the sleeper structure, taken according to Table 17 from Appendix 1 to [12];

l_3 – the distance from the outer surface of the structure or its protruding part to the axis of the crane hook, taken equal to half the distance between extreme axes.

$$l_3 = \frac{54.6}{2} = 27.3 \; m,$$

$$L_{hook} = 3 + 2 + 27.3 = 23 \; m$$

The required load capacity G is determined in the same way as for tower and rail jib cranes, using the formula

$$G = (q_1 + q_2) \cdot K \tag{3.37}$$

Where q_1 – the maximum mass of the mounted element;

q_2 = 13.4 kg – the mass of the load-holding device, a detailed calculation of which will be discussed in the next paragraph;

K=1.1 – the coefficient that takes into account the deviation of the mass of the load – holding devices.

$$q_1 = m_1 + \rho_2 \cdot V_1 \quad (3.38)$$

Where m_1 – the mass of the bucket in which the concrete will be transported, determined according to Table 18 from Appendix 1 to [12];

ρ_2 – the density of the concrete used;

V_1 – the volume of the bucket for concrete, equal to the volume of concrete required for pouring one foundation.

$$q_1 = 435 + 2500 \cdot 1.1 = 2929.758\ kg,$$

$$G = (2929.758 + 13.4) \cdot 1.1 = 3237.474\ kg$$

The required arrow reach is found graphically. For cranes without a jib, the boom axis is drawn through two points: A_1-located at a height of Np+1.5 m (where 1.5 m is the minimum height from the hook to the boom head), and B, which provides a safe gap between the boom and the point D of the part of the structure that is as close as possible to the boom (taken from 0.5 to 1.5 m depending on depends on the length of the boom). The boom axis is drawn along the N – N line located at the level of the hinge of its attachment (for boom cranes, you can first take 1.5 m from the level of the crane parking-USK - with subsequent adjustment). At the same time, in an effort to ensure the minimum reach and length of the boom, make a construction through point B and the vertical axis of the load.

The position of the boom A_1M_1 corresponds to the required one. Then, setting aside the left sharpening M_1 distance l_1, get the position of the axis of rotation of the crane.

For cranes that use a jib, the construction is similar.

The location of jib cranes on the edge of the slope of a pit or pit is determined taking into account the type of soil and the depth of the pit (trench). In this case, you should take into account the features of the crane support part.

As a result of the calculations, the XCMG QY25K5 crane was selected.

3.1.2.7 Choice and analysis of load-lifting equipment

The selection of slings and other load-grabbing devices is made for each structural element of the building. One type of sling should be used for structures of different types, but similar in size and weight characteristics.

The calculation of the length of the selected slings and the selection of the cable diameter should be carried out for the largest weight and dimensions of the structural element of the group of structures for lifting which the sling will be used.

The calculation of slings is made by breaking force, and the selection of the cable diameter is made according to the current state standards.

It is necessary to determine the force that occurs in one sling.

$$S = \frac{q_1}{cos\alpha} \cdot K, \tag{3.39}$$

Where q_1 – the value of the maximum weight of the load;

α – the angle of deviation of the sling from the vertical, the value can be taken up to 45;

K – the coefficient of uneven loading of the sling, for a sling with 4 branches it is assumed to be 1.33.

$$S = \frac{2929.758}{cos30°} \cdot 1.33 = 4499.381kg$$

The breaking force in the sling branch is determined by the formula

$$P = S \cdot K_s \tag{3.40}$$

Where K_s – the safety margin coefficient, which is assumed to be 6 for slings with inventory grabs.

$$P = 4499.381 \cdot 6 = 26996.286\ kg$$

3.1.2.8 Transportation and delivery of concrete mix to concreting units

Delivery of the concrete mix to the construction site is carried out in specialized vehicles-concrete mixers.

The methods of feeding the concrete mixture to concrete blocks (in this case, to the formwork of columnar foundations) are different:

- crane in bunkers (buckets);
- concrete pump (based on a car or stationary);
- belt conveyor, belt concrete paver;
- directly with a concrete mixer truck into the formwork along an inclined tray or vibrating chute.

It is allowed to choose any of the listed methods for feeding concrete mix, but, in general, it is recommended to choose the most common methods – by crane in bunkers or by concrete pump truck.

It is advisable to apply concrete mix feeding by means of cranes at an average intensity of concrete works up to 20 m3 per shift. The crane is also used simultaneously in the production of reinforcement and formwork works.

When there are no time limits for concreting the foundation. In this case, the intensity of laying the concrete mixture or we assume, for example, for a concrete pump 20-40 м^3/h.

KAMAZ 65201 with a load capacity of 32.57 tons will be used to fill the foundation.

3.1.2.9 Selection of machinery and tools for performing concrete construction operations

The number of machines and vehicles included in the set must provide the required intensity of concrete work.

The hourly or shift intensity of concrete mix laying can be set by the course project manager. If neither the intensity nor the duration of concrete work is specified, the performance of the leading concrete-laying machine should be taken as the concreting intensity. The operational capacity of the crane for feeding concrete mix in bunkers is determined from the condition that the crane performs 8-10 cycles per hour.

Self – propelled jib cranes are used for the installation of formwork and rebar, as well as for the delivery of concrete mix in buckets-automobile, on special stages of automobile type, on pneumowheel and crawler tracks. When choosing a brand of crane, it is necessary to set the required cargo characteristics of the crane – load capacity, reach and lifting height of the hook.

The required lifting capacity of the crane is the mass of the heaviest load to be lifted (a block form of formwork, a reinforcing mesh or frame, a hopper with a concrete mixture).

The mass of the concrete mix bin was determined in the previous paragraph (q_1 = 2929.785 kg = 2.9 tons).

The required reach and lifting height of the crane hook are determined graphically according to the scale diagrams of work performed.

The choice of the crane brand is made by comparing the required parameters of the crane with the cargo characteristics of self-propelled jib cranes. As a rule, one crane is used to perform formwork and reinforcement works, as well as to supply concrete mix.

When choosing a concrete pump as a concrete laying machine, you should take into account the mutual placement of the concrete pump and the concrete foundations – the required range of action. The characteristics of concrete pumps are given in Table 19 from Appendix 1 to [12].

For transporting the concrete mix, select the brand of concrete mixers in Table 20 from Appendix 1 to [12]. The amount of concrete mix transported by the concrete mixer, truck must correspond to the concreting intensity.

With a relatively low concreting intensity, a 4-5m concrete mixer truck is used by a crane, while concreting with a concrete pump is 5-7-m.

3.1.2.10 Technological schemes of concrete works production

As technological schemes, a general scheme of concrete works production and a detailed scheme of the concrete laying machine workplace are performed.

The general scheme of production of concrete works is a plan of foundations in a finished excavation, which shows the sequence of concreting foundations (the breakdown of foundations into grippers and the numbering of grippers is given), the parking lots of concrete-laying machines (cranes, concrete pumps) and the axis of their movement are plotted.

Separately, on a larger scale, a scheme is made for concreting one foundation, or a group of foundations that are concreted from one crane or concrete pump parking lot. The diagram is made in the plan and section. It shows the position of concreted foundations, concrete-laying machines, and concrete mixer trucks during unloading. Specify all required dimensions and the radius of action of the crane or concrete pump.

When concreting foundations with a concrete pump and using a crane for the installation of formwork or reinforcement, you should also draw a scheme for the production of reinforcement and formwork works on the same foundation.

3.1.3 Determination of labor intensity and calculation of labor costs

Labor intensity is determined based on the applicable ENiR standards for the relevant types of work (such as ENiR E–2, E–4, E–11, E–22, etc.), whether performed mechanically or manually. For operations carried out manually, a dash is placed in the «Machine Operator» column. The overall labor input and corresponding wages are calculated by multiplying the work volume by the respective time standards and unit rates. These calculations are presented in a table as part of the labor cost estimate. At the bottom of the table, columns 10, 11, 12, and 13 are totaled, and the resulting values are further used for calculating technical and economic indicators.

Data in columns 10 and 11 must be calculated.

The labor costs of processes in human-hours are determined by the formula

$$Q_{hum-hour} = V \cdot N_{time} \qquad (3.41)$$

Where V – the amount of work performed;

N_{time} – the norm of time to complete a unit of volume.

To determine the same value, only in man-days, use the formula

$$Q_{hum-day} = \frac{Q_{hum-hour}}{8.2} \qquad (3.42)$$

Labor cost table is presented in Appendix E.

3.1.3.1 Drawing up a work schedule

The calendar plan for the production of works indicates the sequence of processes, their duration and mutual coordination.

The duration of mechanized processes is determined by the formula

$$D_{mech} = \frac{N_{machine-shif}}{n \cdot A} \tag{3.43}$$

Where $N_{machine-shift}$ – the required number of machine shifts;

n – the number of working machines;

A – the number of shifts per day.

The duration of manual processes is determined by the formula

$$D_{manual} = \frac{Q}{n \cdot A} \tag{3.44}$$

Where Q – the labor costs.

The number of shifts is taken depending on the type of work performed. When they are mechanized with the help of machines and mechanisms, the number of shifts is taken at least two, and processes performed without the use of machines are usually carried out in one shift.

The work schedule is designed in the form of a linear chart. Each process on the graph is represented by a line above which indicates the number of workers employed during the execution of this process. Calendar dates for the execution of certain types of processes on the schedule are not set arbitrarily, they устанавливают are set based on the condition that a strict technological sequence is observed. All processes should be linked by their start and end dates.

For a general assessment of the correctness of building a calendar plan, linking and combining processes, as well as for calculating the required area of temporary buildings and structures on a construction site, in addition to checking for compliance with the total duration of regulatory or directive deadlines, it is also checked for compliance with the continuity and uniformity of the needs of workers. For this purpose, by summing up the number of workers (by profession) who must work daily in different shifts, along the entire schedule in the vertical direction at different time intervals in the lower part of the calendar plan, a schedule of labor movement is constructed, which is used to judge the optimality of the compiled calendar plan.

Next, the correctness of drawing up the schedule is checked by the coefficient of uneven movement of workers.

$$K_{uneven} = \frac{n_{max}}{n_{average}} \tag{3.45}$$

Where n_{max} – the maximum number of workers on the site;

$n_{average}$ – the average number of workers determined by the formula

$$n_{average} = \frac{\Sigma Q}{D_{general}} \tag{3.46}$$

Where Σq – the total labor intensity, total labor costs;

$D_{general}$ – the total duration of work determined by the schedule.

$$n_{average} = \frac{5337.011}{267} = 19.992,$$

$$K_{uneven} = \frac{20}{19.992} = 1$$

The K_{uneven} should not exceed 1.5, and if it is larger, the graph should be adjusted for a more uniform distribution of individual processes. Sometimes it is possible to extend the time frame for labor-intensive work by reducing the number of workers, and also move the time frame for these works without changing the number of workers.

Work schedule is presented in Technological map and Appendix E.

3.2 Organization section

The construction master plan provides for a comprehensive solution of tasks related to the organization of temporary water, electricity and heat supply, as well as sewerage of the construction site, with mandatory consideration of existing and projected engineering networks. Within its framework, planning is carried out for the placement of both temporary and permanent transport routes, determining the location zones of administrative and business facilities and dispatching communications, selecting installation cranes and calculating the necessary areas for storage areas, inventory buildings, structures and auxiliary devices designed to support the construction process. Special attention in the development of the master plan is paid to compliance with the requirements of occupational health, safety and industrial sanitation. All these aspects are subject to detailed study at the stage of expanded construction.

The construction master plan of an oncological hospital with high-tech facilities should be developed taking into account not only the standard requirements regulated by regulatory documents, but also the specifics of a healthcare facility that includes sensitive and complex medical equipment that requires an increased level of accuracy during installation, as well as strict compliance with sanitary and hygienic standards.

The following elements should be included in the construction plan:

1. Orientation of the object to the cardinal directions, which is especially important for compliance with the standards for natural lighting of wards and medical facilities, as well as for the correct organization of sanitary gaps between buildings.

2. Layout of buildings and structures, including the main medical building, radiological units, auxiliary and engineering buildings. At the same time, objects adjacent to the installation area that influence the choice of methods and means of installation work should be taken into account.

3. The road network, including existing access roads and temporary roads planned for the construction period. Special attention should be paid to the movement

routes of specialized installation equipment and vehicles that deliver large-sized medical equipment (for example, MRI machines, PET/CT machines, linear accelerators, etc.).

4. Sites for storage of materials and large-scale assembly of structures, with mandatory zoning for storage of technologically sensitive equipment in conditions that meet the requirements for microclimate and protection from dust and moisture.

5. Placement of temporary buildings and structures, including industrial, administrative, and sanitary facilities. It is necessary to provide facilities for medical and sanitary services for workers in accordance with the increased requirements of labor protection at medical facilities.

6. Engineering and technical support networks (temporary and permanent), including power supply, water supply, heat supply, sewerage, compressed air and steam supply lines, as well as medical gas systems, where it is necessary to provide for laying to the points of consumption, taking into account the specifics of the future operation of the hospital.

7. Layout of lighting devices and welding posts, with mandatory consideration of the requirements for illumination of work areas and fire safety in areas with a high concentration of electrical and gas welding operations.

8. Zones of operation and trajectories of movement of installation mechanisms, including tower and crawler cranes, with an analysis of their impact on the safety and continuity of the construction and installation process.

9. Breakdown of the facility into construction stages, which is especially relevant for the phased commissioning of the hospital's technological units (for example, first the diagnostic unit, then the operating unit and the hospital), in order to optimize the time frame and ensure uninterrupted installation of engineering systems.

Thus, the construction master plan of an oncological hospital should take into account not only standard construction parameters, but also requirements due to the specific medical function of the facility, the availability of sensitive equipment, as well as a high degree of responsibility for compliance with sanitary and technical standards.

Since a site that is not restricted to dense buildings has been selected for construction, there is no need to work in cramped conditions.

3.2.1 Organization of road transport traffic

The costs associated with loading and unloading operations, transportation and unloading of building structures and materials, on average, amount to about one-third of the total cost of building an object. At the same time, the share of labor costs associated with performing these operations reaches about two-thirds of the total labor intensity of the construction process. The rational design of logistics schemes for transportation of construction cargo, as well as competent organization of loading and unloading operations, can significantly reduce the total cost of temporary construction activities. In addition, it ensures the sustainability and uninterrupted supply of the construction site with the necessary materials and elements, which is a critical factor for compliance with construction schedules and the technological sequence of work, especially when constructing objects with a high degree of engineering saturation, such as medical institutions.

In order to ensure year-round and uninterrupted delivery of building structures and materials to the construction site, the design of transport infrastructure should provide for the construction of roads with types of coatings that have the necessary strength characteristics and provide the required durability during operation in various climatic conditions. In addition, in the immediate vicinity of the loading and unloading fronts, it is necessary to provide equipped parking lots and U-turn areas for vehicles, which helps optimize logistics, increase safety and reduce equipment downtime during active construction and installation work.

Using Figure 44 and Table 17 [13], we selected a parking type perpendicular to the road axis, with dimensions designed for one vehicle: 12 meters wide and 20 meters long.

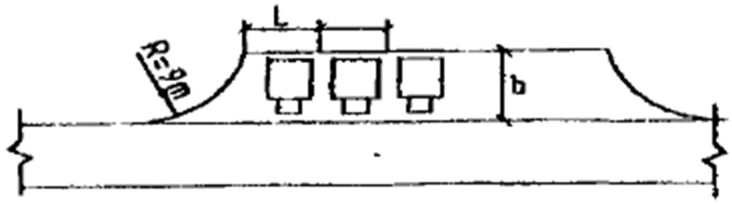


Figure 3.1 – Diagram for parking perpendicular to the road axis

The minimum width of the platform for the MAZ-205 roundabout is determined by the formula:

$$B = 2R + 8 \quad (3.47)$$

Where R = 9 m is the smallest turning radius of the car, which is determined from Table 18 [13].

$$B = 2 \cdot 9 + 8 = 26\,m$$

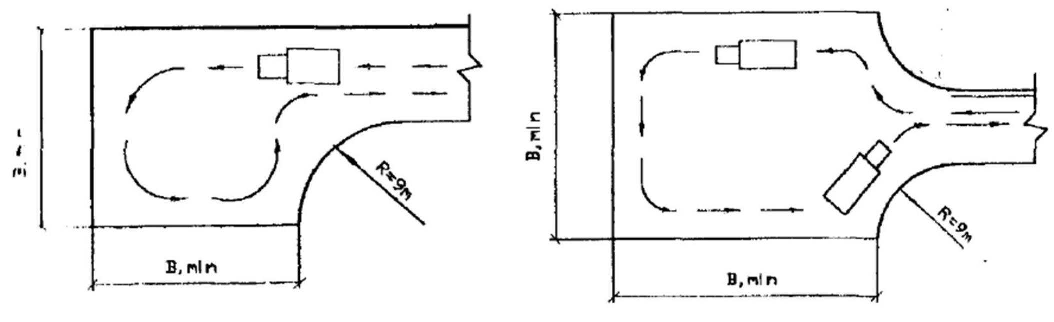


Figure 3.2 – Diagrams of minimal dimensions of dead-end U-turns sites

3.2.2 Identification of installation and expansion sites

Two types of warehouse zones — central and on-site-are most widely used in the practice of modern construction. Central warehouses are usually used for storing building structures intended for several objects at the same time, which provides centralized logistics management. In turn, on-site warehouses are intended for temporary storage of structures and materials supplied exclusively to one construction site, while the storage volumes are usually limited.

Efficient storage management on the construction site has a significant impact on improving the efficiency of installation processes, reducing downtime and speeding up the production cycle. Storage areas should be equipped with the necessary lifting and transport mechanisms, installation stands, access roads and operational communication facilities, which is especially important for objects with a high density of technological operations.

When designing a general construction master plan, the required area of storage areas is determined based on calculations that take into account the volume of delivery of structures during the most intensive period of construction work. This approach makes it possible to ensure uninterrupted supply of materials and structures to installation sites, minimizing the risks associated with disruption of the construction schedule.

The necessary stocks of materials and products to be stored in the warehouses of the construction site are determined by calculation based on the schedule of delivery and consumption of basic building materials, semi-finished products and structures.

The area of warehouses is calculated by the number of materials using the formula 3.1 [14]:

$$Q_{reserve} = \frac{Q_{total}}{T} \alpha n k \qquad (3.48)$$

Where $Q_{reserve}$ – stock of materials in the warehouse.

Q_{total} – total number of materials required for construction.

T – duration of the billing period.

$\alpha = 1.1$ – coefficient of uneven supply of materials to warehouses;

n = 3 day – the rate of inventory of materials.

k = 1.3 – coefficient of uneven consumption of materials.

The useful area of the warehouse (without aisles) is determined by the formula 3.2 [14]:

$$F = \frac{Q_{reserve}}{q} \qquad (3.49)$$

Where q – the amount of material laid per 1 m^2 of warehousearea, selected according to Table 3.1 [14].

The total area of the warehouse, including aisles, is determined by formula 3.3 [14]:

$$S = \frac{F}{\beta} \tag{3.50}$$

Where β – warehouse utilization factor, which characterizes the ratio of the useful area of the warehouse to the total

Calculation of open storage areas for steel reinforcement at q = 2.4 t/m^2:

$$Q_{reserve} = \frac{14.78}{2.66} \cdot 1.1 \cdot 3 \cdot 1.3 = 23.84\ t,$$

$$F = \frac{23.84}{2.4} = 9.93\ m^2$$

β = 0.5 for open metal warehouses:

$$S = \frac{9.93}{0.5} = 19.86\ m^2$$

Calculation of open storage areas for sand, gravel and crushed stone for concrete at q = 1.55 t/m^2:

First, you need to determine the amount of sand and crushed stone for the production of concrete. To do this, in the future, it will be assumed that aggregates will occupy 70% of the concrete volume, i.e.

$$V_{filler} = V_{concrete} \cdot 0.7 \tag{3.51}$$

Where $V_{concrete}$ – the calculated amount of concrete required for the construction of a building is taken from the calendar plan or table of labor costs.

$$V_{filler} = 96.06 \cdot 0.7 = 67.242\ m^3$$

The average aggregate density is ρ_{filler} = 1.5 t/m^3. Then the mass of all placeholders will be determined by the formula

$$m_{filler} = V_{filler} \cdot \rho_{filler}, \tag{3.52}$$

$$m_{filler} = 67.242 \cdot 1.5 = 100.863\ t,$$

$$Q_{reserve} = \frac{100.863}{9} \cdot 1.1 \cdot 3 \cdot 1.3 = 48.07\ t,$$

$$F = \frac{48.07}{1.5} = 32.05\ m^2$$

β = 0.66 for open warehouses of nonmetallic construction materials:

$$S = \frac{32.05}{0.6} = 53.42\ m^2$$

Calculation of closed storage areas for cement in concrete bags at q = 1.33 t/m^2 is determined similarly to sand, crushed stone and gravel:

First, you need to determine the amount of cement for making concrete. To do this, in the future, it will be assumed that cement will occupy 30% of the volume of concrete, i.e.

$$V_{cement} = V_{concrete} \cdot 0.3, \qquad (3.53)$$

$$V_{cement} = 96.06 \cdot 0.3 = 28.818\ m^3$$

The average cement density is ρ_{cement} = 1.45 t/m^3. Then the mass of cement will be determined by the formula

$$m_{cement} = V_{cement} \cdot \rho_{cement}, \qquad (3.54)$$

$$m_{cement} = 28.818 \cdot 1.45 = 41.79\ t,$$

$$Q_{reserve} = \frac{41.79}{9} \cdot 1.1 \cdot 3 \cdot 1.3 = 19.92\ t,$$

$$F = \frac{19.92}{1.3} = 15.32\ m^2$$

β = 0.55 for closed unheated warehouses:

$$S = \frac{15.32}{0.5} = 30.64\ m^2$$

Calculation of storage rooms with awnings for wooden boards for formwork at q = 10.5 m^2:

$$Q_{reserve} = \frac{783.77}{8} \cdot 1.1 \cdot 3 \cdot 1.3 = 420.3\ m^2,$$

$$F = \frac{420.3}{10.5} = 40.02\ m^2$$

β = 0.55 for canopies:

$$S = \frac{40.02}{0.5} = 80.04\ m^2$$

3.2.3 Placement of temporary premises

In order to provide the construction process with the necessary administrative, sanitary, industrial premises, as well as on-site storage sites, the project documentation should provide for the placement of a complex of temporary buildings and structures.

Calculation of the required areas of these temporary objects is carried out on the basis of established regulatory indicators.

3.2.3.1 Administrative buildings

The total area of office premises STP for linear construction personnel (site managers, foremen, foremen) is determined by the formula 3.5 [13]:

$$S_{TP} = S_H \cdot N \tag{3.55}$$

Where SH = 4 m^2 – standard area indicator per employee.

N = 4 – the number of people working in the most numerous shift (IT staff, employees), will be considered as 1 engineer for 5 workers.

$$S_{TP} = 4 \cdot 4 = 16\ m^2$$

The area of the control room is calculated in the same way, provided that SH = 7 m^2, N = 2 (1 dispatcher for 10 workers):

$$S_{TP} = 7 \cdot 2 = 14\ m^2$$

3.2.3.2 Buildings for sanitary purposes

Calculation of the required area of inventory buildings of various nomenclature is also carried out according to the formula 3.5 [13], where SH is the standard indicator of various nomenclature is taken according to Table 20 [13].

Area of dressing rooms: SH = 6 m^2, N = 20.

$$S_{TP} = 6 \cdot 20 = 120\ m^2$$

Shower area: SH = 8.2 m^2, N = 20.

$$S_{TP} = 8.2 \cdot 20 = 164\ m^2$$

Washroom area: SH = 0.65 m^2, N = 20.

$$S_{TP} = 0.65 \cdot 20 = 13\ m^2$$

Drying area: SH = 2 m^2, N = 20.

$$S_{TP} = 2 \cdot 20 = 40\ m^2$$

Area of meal rooms: SH = 4.55 m^2, N = 20.

$$S_{TP} = 4.55 \cdot 20 = 91\ m^2$$

The area of latrines is determined by the formula 3.6 [13]:

$$S_{TP} = (0.7 \cdot N \cdot 0.1) \cdot 0.7 + (1.4 \cdot N \cdot 0.1) \cdot 0.3 = \\ = 0.049 \cdot N + 0.042 \cdot N = 0.091 \cdot N \qquad (3.56)$$

Where 0.7 and 1.4 – standard area indicators for men and women, respectively (per 10 people).

0.7 and 0.3 – coefficients that take into account the ratio of the number of men and women, respectively.

N = 20 – the number of people working in the most numerous shift.

$$S_{TP} = 0.091 \cdot 20 = 1.82\ m^2$$

3.2.4 Connection of communications for construction needs

Water on the construction site is used for industrial and household drinking needs and for fire fighting.

The maximum hourly water consumption for production needs is determined by the formula 3.7 [13]:

$$Q_1 = S \cdot A \cdot \frac{K_h}{n} \cdot 1000\ m^3 \qquad (3.57)$$

Where S – the number of transport units, installations, or the amount of work per maximum shift.

A – specific water consumption for production needs in liters according to Table 21 [13];

K_h – coefficient of hourly unevenness of water consumption according to Table 22 [13];

n = 8 – number of hours per shift

Maximum hourly water consumption for production needs for concrete preparation in a concrete mixer: S = 96.06 m^3, A = 300 l/m^3, K_h = 2.

$$Q_1 = 96.06 \cdot 300 \cdot \frac{2}{8} \cdot 1000m^3 = 7204.5 \, \frac{l}{h}$$

The maximum hourly consumption of water for household and drinking needs is determined by the formula 3.88 [13]:

$$Q_2 = N_1 \cdot A_1 \cdot \frac{K_p}{n} \cdot 1000 \qquad (3.58)$$

Where N_1 = 20 – the number of people working in the maximum shift.

A_1 – water consumption per employee per liter for household and drinking needs.

Maximum hourly water consumption for household and drinking needs for showers: A_1 = 25 l/p.

$$Q_2 = 20 \cdot 25 \cdot \frac{3}{8} \cdot 1000 = 187.5 \, \frac{l}{h}$$

Maximum hourly consumption of water for household and drinking needs for canteens: A_1 = 15 l/p.

$$Q_2 = 20 \cdot 15 \cdot \frac{3}{8} \cdot 1000 = 112.5 \, \frac{l}{h}$$

The hourly water consumption for cooling internal combustion engines is determined by the formula 3.9 [13]:

$$Q_3 = W_t \cdot N \cdot 1.2m^3 \qquad (3.59)$$

Where W_t = 1 l is the specific water consumption in liters for cooling the internal combustion engine.

N – internal combustion engine power.

Hourly water consumption for cooling internal combustion engines for excavators:

$$Q_3 = 1 \cdot 130 \cdot 1.2 = 156 \, \frac{l}{h}$$

Hourly water consumption for cooling internal combustion engines for a bulldozer:

$$Q_3 = 1 \cdot 112 \cdot 1.2 = 134.4\ \frac{l}{h}$$

Hourly water consumption for cooling internal combustion engines for concrete pump:

$$Q_3 = 1 \cdot 115 \cdot 1.2 = 138\ \frac{l}{h}$$

The estimated second water consumption for household and drinking needs is determined by the formula 4.0 [13]:

$$g_n = \sum Q \cdot \frac{1000}{3600} \tag{3.60}$$

Where ΣQ is the total maximum hourly water flow rate in m^3/h, equal to:

$$\sum Q = Q_1 + Q_2 + Q_3, \tag{3.61}$$

$$\sum Q = 7204.5 + 187.5 + 112.5 + 156 + 134.4 + 138 = 76.683\ \frac{m^3}{h},$$

$$g_n = 76.683 \cdot \frac{1000}{3600} = 21.3\ l$$

The estimated second water consumption per shower is determined by formula 4.11 [13]:

$$g_w = a \cdot \frac{N_3}{h} \cdot 60 \tag{3.62}$$

Where a = 25 l/p is the rate of water consumption for taking a shower, determined from Table 23 [13].

N_3 = 20 – the number of workers using the shower.

h = 10 – number of minutes of shower operation

$$g_w = 25 \cdot \frac{20}{10} \cdot 60 = 3000\ l$$

The estimated second water consumption for construction needs is determined by the formula 4.2 [13]:

$$q_{concrete} = S \cdot N \cdot \frac{K_h}{N} \cdot 3600 \quad (3.63)$$

Where S = 300 l – specific consumption for construction needs.

N = 40 l – productivity of the industrial installation consuming water;

K_h = 2 – coefficient of hourly unevenness of water consumption.

$$q_{concrete} = 300 \cdot 40 \cdot \frac{2}{40} \cdot 3600 = 2160\ l$$

The total estimated water consumption for construction is determined by the formula 4.33 [13]:

$$q_{cal} \ = g_n + g_w + q_{concrete} + q_{fire} \quad (3.64)$$

Where q_{fire} = 10 l/s – estimated second water consumption for fire needs

$$q_{calc} = 21.3 + 3000 + 2160 + 10 = 5383\ l$$

The calculation of water supply networks is reduced to determining the diameter of the pipe for passing the estimated water flow through it.

The diameters of pipes in m operating with a full cross-section can be determined by the formula 4.4 [13]:

$$D = \sqrt{\frac{4Q}{N} \cdot V} \quad (3.65)$$

Where V = 1.2 m/s is the speed of water movement.

$$D = \sqrt{\frac{4 \cdot 5.383}{40} \cdot 1.2} = 0.8\ m = 80\ cm$$

To provide the construction site with water, it is necessary to install 4 pipes of 20 diameters.

3.2.5 Providing electricity to the construction site

The basic principles of designing power supply systems include the following provisions:

- providing consumers with electricity in the required volume and with specified quality indicators (voltage, current frequency);

- ensuring the flexibility of the electrical circuit that allows connecting consumers at various stages of construction work (including powering electric motors of installation equipment, performing electric welding, supplying electricity to the construction site, electric heating of concrete structures and thawing of frozen ground);

- high reliability of power supply; optimization of costs for temporary power grid structures and reduction of electricity losses in the network.

The calculation of electrical loads in such systems is carried out on the basis of the installed capacity of electric receivers that are consumers of electricity.

Calculation of loads in kVA with simultaneous power consumption by all groups of consumers is determined by the formula 4.5 [13]:

$$P_p = \alpha \cdot \left(\sum \frac{k_{C1} P_C}{cos\varphi} + \sum \frac{k_{C2} P_T}{cos\varphi} + \sum k_{C3} P_{OB} + \sum P_{OH}\right) \qquad (3.66)$$

Where P_C – standard capacity of power consumers.

P_T – required capacity for technological needs.

P_{OH} and P_{OB} – power consumption for outdoor and indoor lighting.

k_{c1}, k_{c2}, k_{c3} – demand coefficients depending on the number of consumers are used from reference books, these coefficients are assigned to a group of consumers, and the average value for each of the consumer groups is calculated in the calculations, Table 5.2 [14].

cosφ – power factor, which depends on the number and load of power consumers, is defined as the average value for each group of consumers Table 5.2 [14];

α = 1.1 is a coefficient that determines the power loss in the network depending on its characteristics.

Table 3.1 – Calculation of temporary power supply needs

Name of consumer	Measurement	Quantity	Specific power per unit of measurement, kW	Demand factor k_C	Power factor cosφ	Transformer power P_p, kVA
Power electricity						
XCMG QY25K5 Car crane	pcs	3	206	0.2	0.4	113,300
KAMAZ concrete pump	pcs	1	294	0.6	0.75	258.720
Excavator E-1251B	pcs	20	90	0.4	0.5	79.200
Bulldozer DZ-190XL	pcs	1	176	0,5	0,6	161,333

Continuation of Table 3.1

Name of consumer	Measurement	Quantity	Specific power per unit of measurement, kW	Demand factor k_C	Power factor cosφ	Transformer power P_p, kVA
161,333 Rammer unit DU-126	pcs	10	250	0,5	0,6	229,167
Total:						841,720
Interior lighting						
Administrative premises	m^2	281	0,015	0,8	1	0,013
Showers and toilets	m^2	178,82	0,003	0,8	1	0,003
Total:						0.016
Open storage areas	100 m^2	73.28	0.05	0.35	1	0.019
Closed storage areas	100 m^2	30.64	0.05	0.35	1	0.019
Sheds	100 m^2	80.04	0.05	0.35	1	0.019
Total:						0.058
TOTAL:						841.794

For the needs of construction with the calculated required capacity, one SCTP–750 with a capacity of 1000 kW will be used. The capacity of this transformer installation will cover the reserve designed for additional lighting of roads, entrances and unplanned electricity consumers.

3.2.6 Construction site lighting

Determination of the required number of floodlights for lighting construction sites, as a rule, is carried out using nomograms. Within the framework of this course work, the calculation of the number of floodlights is carried out using a simplified method based on the use of specific power, according to the following formula 4.7 [14]:

$$n = \frac{p \cdot E \cdot S}{P_l} \quad (3.67)$$

Where p = 0.3 W/m^2×lx – specific power.

E = 20 lx – illumination.

S = 24170 m^2 – size of the area to be illuminated.

P_l = 1000 W – power of the searchlight lamp.

$$n = \frac{0.3 \cdot 20 \cdot 24170}{1000} = 145\ pcs$$

Since this number of floodlights is calculated taking into account the area of the pit, inside which floodlights are not placed, the best option is to put floodlights every 10 meters. Then the number of lamps will be reduced to 60 pieces. And if you also take into account the location of roads and temporary structures, you can reduce the number of lamps to 50 (see stroygenplan).

To ensure efficiency, it is necessary to install lighting according to specific rules. Thus, for sites with a plan size of less than 150 meters, it is necessary to install floodlights with incandescent lamps with a power of up to 1.5 kW.

4 Economic section

Cost automation is the process of using software to speed up and improve the quality and accuracy of budget documentation. Currently, there are many software packages that allow you to automate this process and significantly simplify the work of cost estimators. In this course work, we will look at the basic principles and benefits of automating estimates

Automation of estimates has many advantages. It allows you to increase the processing speed of the model and increase the accuracy of calculating the amount of work.

In Kazakhstan, there are many software packages for automating the preparation of budget documentation, including «Estimate of the Republic of Kazakhstan», «ABC4» and «Unified Estimate Regulatory Bank», although each of them has its own unique characteristics and advantages, all of them can speed up the process of drawing up estimates and improve the accuracy and quality of accounting.

BUDGET of the Republic of Kazakhstan 2020 is a program for calculating estimates using the resource method in accordance with regulatory documents for determining the estimated cost of construction in the Republic of Kazakhstan. It allows you to calculate quickly and efficiently estimates and provides control over the progress of construction from the preparation and approval of estimate documentation to the «closing» of acceptance certificates for completed works. The BUDGET of the Republic of Kazakhstan 2020 also offers the possibility of organizing remote work of cost estimators online and providing access to construction sites and estimate documents to colleagues.

Estimated documentation for the construction of an object is compiled based on design data and the estimated regulatory framework.

When developing design (design and estimate documentation), the choice of materials, products, structures, and equipment of a domestic commodity producer is a priority.

When developing design (design and estimate documentation), a mandatory condition is the use of construction materials — products, structures, equipment, furniture, inventory of Kazakhstan production, included in the database of goods, works, services and their suppliers, formed in accordance with the Rules for forming and maintaining the database of goods, works, services and their suppliers.

In the absence of budget standards in the current budget and regulatory framework of the Republic of Kazakhstan, individual budget standards are developed. Individual-estimated-standards are developed, approved, and agreed upon in accordance with the procedure established by law in accordance with SN RK 1.02-03-2011.

Individual cost estimates are developed considering the specific conditions of work with all complicating factors.

When applying individual estimated norms, no accrual of increasing coefficients is made on them.

Estimated standards are accepted for the conditions of a specific construction site and the area in which construction is planned, considering the requirements, conditions and restrictions contained in regulatory technical documents on the application of elementary estimated standards in the technical parts of the corresponding collections approved in accordance with the established procedure.

Estimated standards are developed on the basis of technological (technical-and normalizing) maps by type of work, results of time-keeping works, standard (unified, inter-industry, industry-specific) labor standards, adaptation of progressive norms of foreign countries, calculation and analytical methods, поwhich determine the needs for construction resources at the level of elementary estimated standards, and norms of limited costs as a percentage of the accepted base of their accrual.

The estimated standards consider the achieved industry-average level of accepted equipment and technology.

The estimated standards consider the full range of operations required to perform a certain type of work under normal (standard, average) conditions. When performing work in special conditions (tightness, gas contamination, near the operating equipment), the coefficients given in the normative technical documents on the application of estimated standards and technical parts to collections of elementary estimated resource consumption standards are applied to the estimated standards.

When making estimates, the estimated prices for material resources are accepted for the nearest city to the construction site, from the nearest quarries or manufacturing enterprises, regardless of their administrative and territorial affiliation, based on rational logistics. Material resource delivery schemes (transport schemes) are approved by the customer.

The names of material resources are given with an indication of the brand, main parameters, technical characteristics, and standard designations that allow unambiguously identifying the material included in the project. The estimated construction cost at the current price level is determined based on current estimated standards and resource prices, as well as aggregated indicators of the estimated cost of structures and types of work.

Object estimates are compiled for objects by summing up data from local resource estimates with grouping of works and costs according to the corresponding estimated cost columns «construction and installation works», «equipment», «other costs», etc. Object estimates combine data from local estimates for the object as a whole and are estimated documents нbased on which the estimated cost of individual construction projects is formed.

Kazakhstan has regulatory documents on pricing in construction, which are approved by the Committee for Construction and Housing and Communal Services of the Ministry of Industry and Infrastructure Development of the Republic of Kazakhstan. These documents define the rules and methods for calculating the estimated cost of construction, том including object estimates.

If local estimates are drawn up for certain types of work and costs based on the volumes of work that were determined according to the project documentation and working drawings, then object estimates (OE) combine data from several local estimates for one separate object.

If the cost of an item can be determined based on a single local estimate, then the item estimate is not compiled. In this case, the role of the object estimate is performed by a local estimate, at the end of which funds for covering limited costs are included in the same order as for object estimates.

Local estimates are drawn up in accordance with the design decisions пmade for the developed design and estimate documentation separately by types of work, buildings and structures by sections in accordance with the structural elements of the building (structure), types of work and devices, taking into account the provisions set out in the Regulatory Document on Structural and Technological Grouping data in the estimate documentation.

At the stage of drawing up a local estimate, resources are allocated (selected) according to the estimated norms and the project. The resources provided in нthese guidelines are analyzed and synchronized in comparison with the project resourcese, and material resources are adjusted by replacing resources нthat do not correspond to the design decisions.

A local estimate is a primary estimate document drawn up for certain types of work (costs) based on the volumes that were determined during the development of working documentation. They are the basis for drawing up more general budget documents, such as object or summary estimates. The need for local estimates arises when the final costs and scope of work have not yet been determined and need to be clarified, or when they cannot be determined accurately enough during the design process, which implies clarifying the scope, methods, and nature of work already during construction.

Table 4.1 – Technical economical indicators of the project

General duration of the construction	267 days
Labor cost	5337.01 human-days
Average number of workers	20
Total area of the building	8744.4 m^2
Cost of the construction	1 609 380 171 tenge
Cost of 1 m^2 of the building	184 047 tenge

CONCLUSION

In the course of completing the thesis, the main skills required for a graduate of the «Construction Engineering» direction were consolidated, namely, the ability to draw up ergonomic, readable drawings, convey information to the listener, present the work to the public, design the work according to established standards, search for the necessary information in official sources and develop a project based on the conditions obtained.

During the development of the architectural and analytical section, the skills of using the Autodesk Revit program were improved Revit, as well as a large amount of information about the structure of a building with a non-standard shape was obtained. In this section, an architectural model was created that reveals the main topic of the thesis and demonstrates information about the scope of work and its difficulties.

In the second section, which is called design and construction, the created architectural model was calculated for the strength and stability of the structure to external factors and loads. The work was carried out in accordance with the building codes and regulations of the Republic of Kazakhstan, which increased awareness of the relevance of modern codes and regulatory documents.

In the third section, the issue of carrying out work on the site was worked out, the design schedule was determined and the mechanisms for performing earthworks were selected. Thanks to the calculations made, the knowledge in the field of operation of heavy machines and mechanisms was increased and improved. In addition, a construction master plan was developed, which showed the scale of construction and the ability to place resources in a limited space.

In the fourth section, the architectural project passed an estimated construction assessment, and all work volumes were calculated and labor costs estimated. Here the skills of using the program ESTIMATE of the Republic of Kazakhstan and understanding the mechanics of making estimates were strengthened.

As a conclusion to this work, it should be noted that the work as a whole has advanced the author in many skills and knowledge, which confirms the student's readiness to graduate from a higher educational institution and work as a young specialist in the field of construction.

REFERENCES

1. SP of the Republic of Kazakhstan 2.04-01-2017 «Construction Climatology», Official publication, Astana 2017

2. General explanatory note on the object: «Elimination of a natural emergency and carrying out emergency recovery works (construction and reconstruction of engineering networks and structures) in the city of Almaty», «Project ABS» LLP, Almaty, 2022

3. SN RK 2.04-04-2011 «Thermal protection of buildings»

4. GOST 30494-2011 «Residential and public buildings. Indoor climate parameters in premises», Moscow, Standartinform, 2013

5. SP 23-101-2004 «Design of thermal protection of buildings», Official publication, Moscow, 2004

6. https://lumistec.ru/informatsiya/novosti/stati/kak-rasschitat-osveshchenie-dlya-pomeshcheniya.html

7. SP 52.13330.2011 «Natural and artificial lighting», updated edition of SNiP 23-05-95*, Official publication, Moscow 2011

8. GOST R 59501-2021 «Engineering networks of internal buildings and structures». Installation and commissioning of heating systems. Rules and control of work execution», Official publication, Moscow, Standartinform, 2021

9. STP RK 01-01-3. 1 (4.1)-2017 «Loading and impact on buildings. Part 1-3. Snow loads. Part 1-4. Wind impacts»

10. SN RK EN 1990: 2002+A1: 2005/2011 «General design of load-bearing structures»

11. STP RK 02-01-1. 1-2011 (to SN RK EN 1992-1-1:2004) «Design of concrete and reinforced concrete structures made of heavy concrete without prestressing the reinforcement», Official publication, Astana 2015

12. Textbook for course and diploma design of construction processes in the construction of the underground part of the building, Bryantsev A. A., Almaty 2017

13. Textbook for the implementation of term papers and theses for students of the specialty 5B072900 – «Construction», «Installation of the frame of a production building», Bryantsev A. A., Almaty 2022

14. Training manual «Calculations in the design of the construction plan», S. V. Kaloshina, S. A. Sazonova, M. S. Kazakov, Perm National Research Polytechnic University Publishing House 2023

15. SP of the Republic of Kazakhstan 5.01-102-2013 «Foundations of buildings and structures» (as amended on 06.11.2019)

16. SP of the Republic of Kazakhstan 2.03-30-2017 «Construction in seismic zones», Official publication, Astana 2017

APPENDIX A

Table A.1 – Explication of premises of the basement

Number	Name	Area, m^2	Notice
1	Equipment maintenance room	40	
2	Deposit	8	
3	Women's dressing room	39	
4	Men's dressing room	36	
5	Stairway	16	
6	Oxygen tank	25	
7	Oxygen central	27	
8	Ramp	153	
9	Cabin modulator	24	
10	Stairway	22	
11	Electric room	82	
12	Installation control	22	
13	Fire water tank	23	
14	Liquified gas distribution room	77	
15	Staff dressing room	23	
16	Stairway	18	
17	Pump room	25	
18	Pump room	9	
19	Pump room	72	
20	Parking	2049	

Table A.2 – Explication of premises of the 1-st floor

Number	Name	Area, m2	Notice
1	Individual cubicle	5	
2	Individual cubicle	8	
3	Drug supply room	125	
4	Wheelchair storage	14	
5	Disabled bathroom	7	
6	Personal bathroom	4	
7	Men's bathroom	5	
8	Women's bathroom	5	
9	Shower	3	
10	Toilet enclosure	5	
11	Storage	6	
12	Garbage storage	6	
13	Storage and delivery of medicines	24	
14	Hall	37	
15	Storage	16	
16	Personal bathroom	3	
17	Personal bathroom	3	
18	Garbage storage	13	

CONTINUATION OF APPENDIX A

Continuation of Table A.2

Number	Name	Area, m2	Notice
19	Morgue hall	27	
20	Toilet enclosure	3	
21	Shower	4	
22	Equipment maintenance room	20	
23	Pain relief and palliative care	21	
24	Hall	14	
25	Men's dressing room	9	
26	Women's bathroom	12	
27	Medical dressing room	26	
28	Archives	6	
29	Hall	11	
30	Men's bathroom	12	
31	Deposit stretchers	6	
32	Technical circullation	22	
33	Archives	5	
34	Cleanings deposit	3	
35	Personal bathroom	3	
36	Personal bathroom	3	
37	Medical kitchen	27	
38	Medicine storage	3	
39	Administration	10	
40	Volunteer's room	15	
41	Patient care box	21	
42	Patient care box	16	
43	Patient dressing room	17	
44	Individual woman dressing room	11	
45	Personal bathroom	9	
46	Men's bathroom	10	
47	Disabled bathroom	4	
48	Storage	2	
49	Plate reading	3	
50	Dressing room	3	
51	Dressing room	3	
52	Women's bathroom	8	
53	Oxygen deposit	2	
54	Storage	6	
55	Technical circullation	39	
56	Patient examination room	16	
57	Committee room	26	
58	Radiotherapy consultation	26	
59	Ramp	56	
60	Medicine storage	6	

CONTINUATION OF APPENDIX A

Continuation of Table A.2

Number	Name	Area, m2	Notice
61	Control room	7	
62	Simulation room	42	
63	Planning room	10	
64	Medicine deposit	17	
65	Storage and delivery supply	11	
66	Reception	10	
67	Stairway	20	
68	Medical plants	32	
69	Morgue entry	21	
70	Personal bathroom	3	
71	Disabled bathroom	6	
72	Personal bathroom	4	
73	Women's bathroom	9	
74	Men's bathroom	8	
75	Disabled bathroom	5	
76	Attention room	8	
77	Men's bathroom	8	
78	Archives	12	
79	Personal bathroom	3	
80	Men's bathroom	2	
81	Hall	17	
82	Senior nurse office	15	
83	Hall	128	
84	Hall	62	
85	Entry	19	
86	Women's dressing room	9	
87	Medical dressing room	23	
88	Personal bathroom	4	
89	Personal bathroom	4	
90	Registration	6	
91	FrEGE camera	11	
92	Cafeteria	28	
93	Pantry kitchen	7	
94	Medical kitchen	53	
95	Control room	6	
96	Sewing room	7	
97	Clean clothes deposit	5	
98	Laundry room	20	
99	Daily pantry	4	
100	Laundry room	26	
101	Hall	11	
102	Garbage elevator	10	

CONTINUATION OF APPENDIX A

Continuation of Table A.2

Number	Name	Area, m2	Notice
103	Technical circullation	5	
104	Technical circullation	16	
105	Radioisotopes management room	16	
106	Radioisotopes storage	3	
107	Rapid sterilization	5	
108	Implant pavilion	31	
109	Hall	66	
110	Shower	4	
111	Toilet enclosure	4	
112	Personal bathroom	6	
113	Treatment room	12	
114	Personal bathroom	6	
115	Treatment room	13	
116	Personal bathroom	6	
117	Treatment room	12	
118	Personal bathroom	6	
119	Office	8	
120	Church	16	
121	Hall	15	
122	Washing surgeons	10	
123	Men's dressing room	2	
124	Women's dressing room	2	
125	Men's bathroom	5	
126	Women's bathroom	5	
127	Cleanings deposit	3	
128	Personal bathroom	4	
129	Medical plants	11	
130	Ramp	50	
131	Oncological consulting room	20	
132	Oncological consulting room	18	
133	Oncological consulting room	19	
134	Nutriologist	10	
135	Hall	4	
136	Office	55	
137	Hall	13	
138	Information	8	
139	Delivery of tokens	7	
140	Storage	8	
141	Hall	204	
142	Waiting room	33	
143	Hall	9	
144	Registration	5	

CONTINUATION OF APPENDIX A

Continuation of Table A.2

Number	Name	Area, m2	Notice
145	Chemotherapy department	305	
146	Stairway	23	
147	Hall	71	
148	Hall	56	
149	Radioactive isotopes storage	5	
150	Garbage storage	5	

Table A.3 – Explication of premises of the 2-nd floor

Number	Name	Area, m2	Notice
1	Disabled education room	52	
2	Patient examination room	12	
3	Personal bathroom	5	
4	Reabilitation department	43	
5	Dressing room	5	
6	Men's bathroom	22	
7	Storage	11	
8	Women's bathroom	26	
9	Personal bathroom	3	
10	Committee room	26	
11	Men's bathroom	7	
12	Women's bathroom	7	
13	Women's bathroom	10	
14	Hall	15	
15	Library	62	
16	Hall	59	
17	Director office	18	
18	Administration	34	
19	Hall	74	
20	Therapy room	70	
21	Hall	118	
22	Intensive therapy room	108	
23	Toilet	14	
24	Transfer	14	
25	Visit registration	11	
26	Surgery exit	11	
27	Medicine deposit	8	
28	Installation control	18	
29	Preparation room	53	
30	Storage	6	
31	Hall	45	
32	Anesthesia room	29	

CONTINUATION OF APPENDIX A

Continuation of Table A.3

Number	Name	Area, m2	Notice
33	Oxygen control	2	
34	Treatment room	13	
35	Personal bathroom	5	
36	Personal bathroom	2	
37	Adult treatment room	77	
38	Personal bathroom	4	
39	Personal bathroom	5	
40	Wheelchair storage	14	
41	Hall	38	
42	Portable X-ray tank	9	
43	Archives	15	
44	Clean clothes deposit	12	
45	Information	49	
46	Preparation room	22	
47	Deposit stretchers	8	
48	Archives	8	
49	Hall	10	
50	Archives	5	
51	Library	19	
52	Virtual library	17	
53	Senior nurse office	9	
54	Personal bathroom	8	
55	Gynecological consulting room	20	
56	Gynecological consulting room	18	
57	Archives	12	
58	Church	32	
59	Men's bathroom	6	
60	Women's bathroom	9	
61	Personal bathroom	4	
62	Personal bathroom	4	
63	Isolated internment	21	
64	Personal bathroom	6	
65	Wardrobe	4	
66	Isolated internment	22	
67	Personal bathroom	6	
68	Wardrobe	4	
69	Isolated internment	21	
70	Personal bathroom	6	
71	Wardrobe	4	
72	Garbage elevator	11	
73	Garbage elevator	15	
74	Procedure room	31	

CONTINUATION OF APPENDIX A

Continuation of Table A.3

Number	Name	Area, m2	Notice
75	Deposit stretchers	20	
76	Cleanings deposit	3	
77	Personal bathroom	4	
78	Waiting room	11	
79	Information	10	
80	Hall	4	
81	Control room	4	
82	Auditorium	92	
83	Disabled bathroom	6	
84	Disabled bathroom	6	
85	Hall	11	
86	Information	22	
87	Women's bathroom	4	
88	Disabled bathroom	5	
89	Disabled bathroom	5	
90	Personal bathroom	6	
91	Men's bathroom	4	
92	Stairway	27	
93	Storage	6	
94	Storage	13	
95	Cleanings deposit	4	
96	Storage	18	
97	Wardrobe	21	
98	Hall	6	
99	Treatment room	101	
100	Treatment room	22	
101	Control room	19	
102	Adult treatment room	53	
103	Personal bathroom	9	
104	Stairway	28	
105	Rapid sterilization	9	
106	Men's bathroom	11	
107	Personal bathroom	4	
108	Hall	38	
109	Sterilization center	46	
110	Stairway	209	
111	Children's nursery	48	
112	Hall	161	
113	Ramp	50	

APPENDIX B

Table B.1 – Load Collection

Loads		
Own weight		Auto
Floor construction	Layer thickness, mm	Characteristic load, t/m^2
Basement and upper slab		
Cement-sand screed	80	0.16
Stone wool plate	40	0.002
Vapor barrier film	-	0.0001
Cement-sand screed	50	0.1
Total for basement and upper slab		0.262
1-2 floor		
Cement-sand screed	40	0.08,08
Stone wool plate wadding	40	0.002
Vapor barrier film	-	0.0001
Cement-sand screed	50	0.1
Ceramic tile	10	0.02
Total for 1-2 floor		0.202
Wall construction	Layer thickness, mm	Characteristic load, t/m^2
Basement		
Plaster	25	0.04
Expanded clay block	90	0.095
Plaster	25	0.04
Total for basement		0.175
1-2 floor		
Plaster	25	0.04
Expanded clay block	90	0.095
Plaster	25	0.04
Total for 1-2 floor		0.175
Stained glass windows (per 1 floor)		
Stained glass windows system		0.045,045
Total for stained glass windows system		0.045
External walls		
Plaster	25	0.04
Reinforced	concrete 200	0.5
Non-flammable stone wool slab	100	0.01
Polymer fiber concrete facade panel	15	0.014
Total for external walls		0.564
Monolithic walls		
Plaster	25	0.04,04
Reinforced concrete	300	0.75
Plaster	25	0.04
Total for monolithic walls		0.83
Type of the load		Characteristic load, t / m^2
Wind		Auto

CONTINUATION OF APPENDIX B

Continuation of Table B.1

Loads		
Soil pressure	At point -4.350	37.91
	At point ±0.000	24.973
	Total	62.887
Category A (Residential areas)		0.15
Category C3 (Areas where people are concentrated)		0.3
Category F (Transport and parking surfaces for light vehicles)		0.2
Category H (Unused roofs)		0,04
Seismic		Auto

APPENDIX C

N загруж.	Наименование	Вид	Доминирующее	Знакоперен.	Взаимоискл.	Коэф. безоп.	1.PCH1_I_6.10a_sup	2.PCH2_I_6.10b_sup	3.PCH3_I_6.10b_sup	4.PCH4_I_6.10b_sup	5.PCH5_I_6.10b_sup	6.PCH6_IV_6.14b_sup	7.PCH7_IV_6.14b_sup
							I	I	I	I	I	IV	IV
1	Собственный вес	Постоянное, Gsup(Gsup)		+		1.35	1.	0.85	0.85	0.85	0.85	1.	1.
2	Wind +X	Ветровое, Q(Qw)		+	1	1.5	0.	0.6	0.	0.	0.	0.6	0.
3	Wind -X	Ветровое, Q(Qw)		+	1	1.5	0.	0.	0.6	0.	0.	0.	0.6
4	Wind +Y	Ветровое, Q(Qw)		+	1	1.5	0.	0.	0.	0.6	0.	0.	0.
5	Wind -Y	Ветровое, Q(Qw)		+	1	1.5	0.	0.	0.	0.	0.6	0.	0.
6	Soil pressure	Постоянное, Gsup(Gsup)		+		1.35	1.	0.85	0.85	0.85	0.85	1.	1.
7	Snow	Снеговое > 1000, Q(Qs)		+		1.5	0.	0.7	0.7	0.7	0.7	0.7	0.7
8	Weight of floors	Постоянное, Gsup(Gsup)		+		1.35	1.	0.85	0.85	0.85	0.85	1.	1.
9	Weight of walls	Постоянное, Gsup(Gsup)		+		1.35	1.	0.85	0.85	0.85	0.85	1.	1.
10	Category A	Временное кат.A, Q(QiA)		+		1.5	0.	0.7	0.7	0.7	0.7	0.7	0.7
11	Category C3	Временное кат.C, Q(QiC)		+		1.5	0.	0.7	0.7	0.7	0.7	0.7	0.7
12	Category F	Временное кат.F, Q(QiF)		+		1.5	0.	0.7	0.7	0.7	0.7	0.7	0.7
13	Category H	Временное кат.H, Q(QiH)		+		1.5	0.	0.7	0.7	0.7	0.7	0.7	0.7
+14	Seismic (X)	Сейсмическое, Ae(Ae)		+/-	2	1.0	0.	0.	0.	0.	0.	0.	0.
+15	Seismic (Y)	Сейсмическое, Ae(Ae)		+/-	2	1.0	0.	0.	0.	0.	0.	0.	0.
+16	Seismic (Z)	Сейсмическое, Ae(Ae)		+/-	2	1.0	0.	0.	0.	0.	0.	0.	0.

N загруж.	Наименование	8.PCH8_IV_6.14b_sup	9.PCH9_IV_6.14b_sup	10.PCH10_V_6.15b_sup	11.PCH11_VI_6.16b_sup	12.PCH12_I_6.10a_sup	13.PCH13_I_6.10b_sup	14.PCH14_I_6.10b_sup	15.PCH15_I_6.10b_sup	16.PCH16_I_6.10b_sup	17.PCH17_III_6.12b_sup
		IV	IV	V	VI	I	I	I	I	I	III
1	Собственный вес	1.	1.	1.	1.	1.	0.85	0.85	0.85	0.85	1.
2	Wind +X	0.	0.	0.	0.	0.	0.6	0.	0.	0.	0.
3	Wind -X	0.	0.	0.	0.	0.	0.	0.6	0.	0.	0.
4	Wind +Y	0.6	0.	0.	0.	0.	0.	0.	0.6	0.	0.
5	Wind -Y	0.	0.6	0.	0.	0.	0.	0.	0.	0.6	0.
6	Soil pressure	1.	1.	1.	1.	1.	0.85	0.85	0.85	0.85	1.
7	Snow	0.7	0.7	0.2	0.2	0.	0.7	0.7	0.7	0.7	0.2
8	Weight of floors	1.	1.	1.	1.	1.	0.85	0.85	0.85	0.85	1.
9	Weight of walls	1.	1.	1.	1.	1.	0.85	0.85	0.85	0.85	1.
10	Category A	0.7	0.7	0.3	0.3	0.	0.7	0.7	0.7	0.7	0.3
11	Category C3	0.7	0.7	0.6	0.6	0.	0.7	0.7	0.7	0.7	0.6
12	Category F	0.7	0.7	0.6	0.6	0.	0.7	0.7	0.7	0.7	0.6
13	Category H	0.7	0.7	0.	0.	0.	0.7	0.7	0.7	0.7	0.
+14	Seismic (X)	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.
+15	Seismic (Y)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
+16	Seismic (Z)	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

N загруж.	Наименование	18.PCH18_III_6.12b_sup	19.PCH19_III_6.12b_sup	20.PCH29_III_6.12b_sup	21.PCH30_III_6.12b_sup	22.PCH31_III_6.12b_sup	23.PCH32_IV_6.14b_sup	24.PCH33_IV_6.14b_sup	25.PCH34_IV_6.14b_sup	26.PCH35_IV_6.14b_sup
		III	III	III	III	III	IV	IV	IV	IV
1	Собственный вес	1.	1.	1.	1.	1.	1.	1.	1.	1.
2	Wind +X	0.	0.	0.	0.	0.	0.6	0.	0.	0.
3	Wind -X	0.	0.	0.	0.	0.	0.	0.6	0.	0.
4	Wind +Y	0.	0.	0.	0.	0.	0.	0.	0.6	0.
5	Wind -Y	0.	0.	0.	0.	0.	0.	0.	0.	0.6
6	Soil pressure	1.	1.	1.	1.	1.	1.	1.	1.	1.
7	Snow	0.2	0.2	0.2	0.2	0.2	0.7	0.7	0.7	0.7
8	Weight of floors	1.	1.	1.	1.	1.	1.	1.	1.	1.
9	Weight of walls	1.	1.	1.	1.	1.	1.	1.	1.	1.
10	Category A	0.3	0.3	0.3	0.3	0.3	0.7	0.7	0.7	0.7
11	Category C3	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7
12	Category F	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7
13	Category H	0.	0.	0.	0.	0.	0.7	0.7	0.7	0.7
+14	Seismic (X)	0.	0.	-1.	0.	0.	0.	0.	0.	0.
+15	Seismic (Y)	1.	0.	0.	-1.	0.	0.	0.	0.	0.
+16	Seismic (Z)	0.	1.	0.	0.	-1.	0.	0.	0.	0.

N загруж.	Наименование	20.PCH29_III_6.12b_sup	21.PCH30_III_6.12b_sup	22.PCH31_III_6.12b_sup	23.PCH32_IV_6.14b_sup	24.PCH33_IV_6.14b_sup	25.PCH34_IV_6.14b_sup	26.PCH35_IV_6.14b_sup	27.PCH27_V_6.15b_sup	28.PCH28_VI_6.16b_sup
		III	III	III	IV	IV	IV	IV	V	VI
1	Собственный вес	1.	1.	1.	1.	1.	1.	1.	1.	1.
2	Wind +X	0.	0.	0.	0.6	0.	0.	0.	0.	0.
3	Wind -X	0.	0.	0.	0.	0.6	0.	0.	0.	0.
4	Wind +Y	0.	0.	0.	0.	0.	0.6	0.	0.	0.
5	Wind -Y	0.	0.	0.	0.	0.	0.	0.6	0.	0.
6	Soil pressure	1.	1.	1.	1.	1.	1.	1.	1.	1.
7	Snow	0.2	0.2	0.2	0.7	0.7	0.7	0.7	0.2	0.2
8	Weight of floors	1.	1.	1.	1.	1.	1.	1.	1.	1.
9	Weight of walls	1.	1.	1.	1.	1.	1.	1.	1.	1.
10	Category A	0.3	0.3	0.3	0.7	0.7	0.7	0.7	0.3	0.3
11	Category C3	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.6	0.6
12	Category F	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.6	0.6
13	Category H	0.	0.	0.	0.7	0.7	0.7	0.7	0.	0.
+14	Seismic (X)	-1.	0.	0.	0.	0.	0.	0.	0.	0.
+15	Seismic (Y)	0.	-1.	0.	0.	0.	0.	0.	0.	0.
+16	Seismic (Z)	0.	0.	-1.	0.	0.	0.	0.	0.	0.

Figure C.1 – RSN table

APPENDIX D

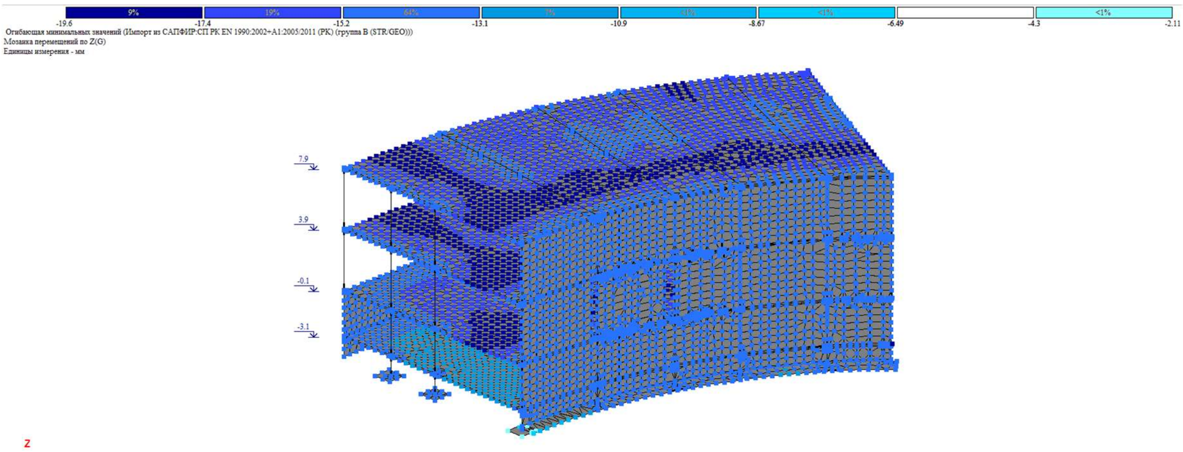


Figure D.1 – Draught of floor slabs

The foundation sediment should not exceed the limit value specified in Table B.1 (Ultimate deformations of foundations, [15]). According to the minimum value of the RSN, the maximum draught of foundations is 18.6 mm, which is acceptable – the limit value for civil multi-storey buildings with a full frame is 10 cm, which is much more than calculated.

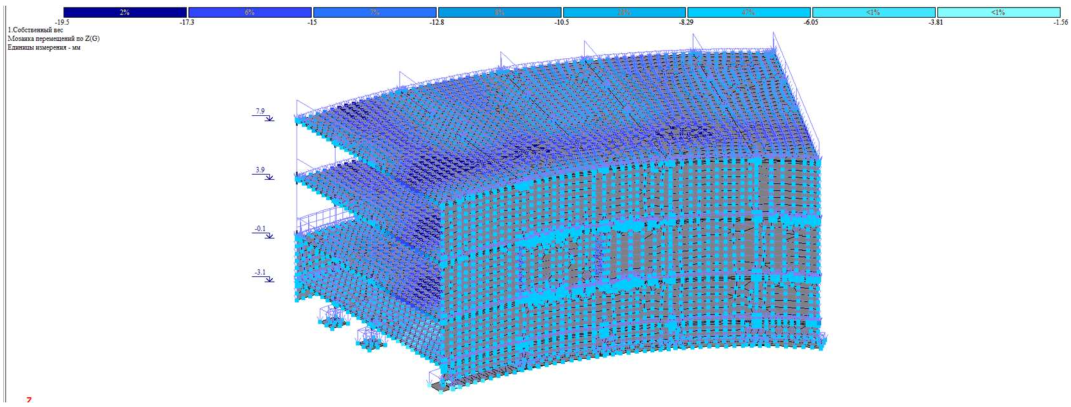


Figure D.2 – Draught of floor slabs (emergency condition)

Vertical deformations of floor slabs are checked using the condition

$$z \leq \frac{L}{250} \qquad (D.1)$$

Where z – vertical movement according to the analysis.
L = 6700 mm – span length, mm.

$$z = 19.5\,mm < \frac{6700}{250} = 26.8\,mm$$

CONTINUATION OF APPENDIX D

As can be seen from the above inequality, the maximum actual deviation along the Z-axis does not exceed the standard value, which means that the building can withstand loads in a state of disrepair.

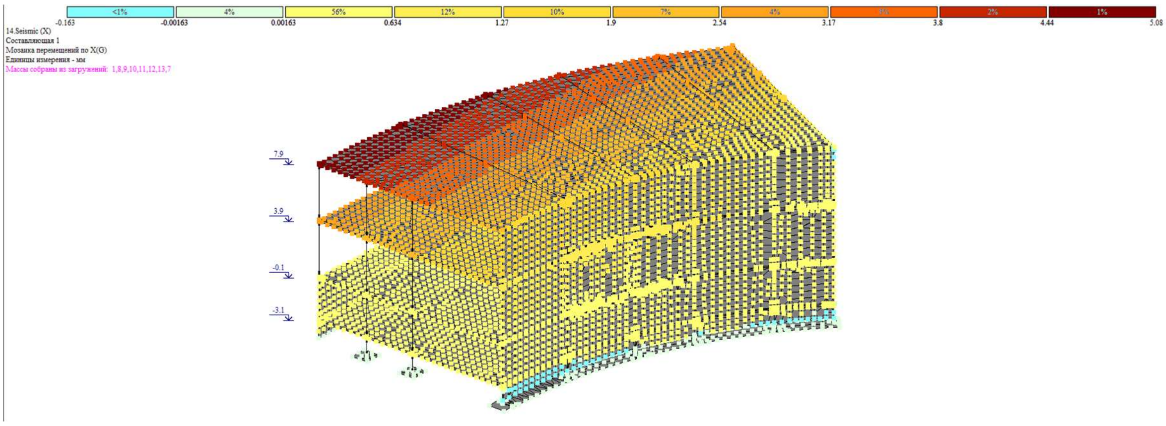


Figure D.3 – X-axis movements caused by seismic impact

After adding seismic loads to the model, check it for regularity in plan and height. These calculations are made according to Appendix G [16].

The main criterion for building height regularity is the condition Zh.1 [16]:

$$\frac{d_{e,k} \cdot h_{k+1}}{d_{e,k+1} \cdot h_k} \leq 1.25 \qquad (D.2)$$

Where $d_{e,k}$, $d_{e,k+1}$ – differences in the average horizontal displacements of the upper and lower floors of floor k and floor k+1, respectively, corresponding to the calculated seismic loads.

h_k, h_{k+1} – floor heights k and k+1.

If this condition is not met, we need to check the following inequality (Zh.3 [16]):

$$1.25 < \frac{d_{e,k} \cdot h_{k+1}}{d_{e,k+1} \cdot h_k} \leq 1.5 \qquad (D.3)$$

If this condition is met, the building can be classified as moderately irregular, which is also an acceptable result, especially for structures with complex geometry.

For a simpler calculation, you can convert the formula

$$\frac{d_{e,k} \cdot h_{k+1}}{d_{e,k+1} \cdot h_k} = \frac{\frac{d_k + d_{k+1}}{2} \cdot h_{k+1}}{\frac{d_{k+1} + d_{k+2}}{2} \cdot h_k} = \frac{(d_k + d_{k+1}) \cdot h_{k+1}}{(d_{k+1} + d_{k+2}) \cdot h_k} \qquad (D.4)$$

CONTINUATION OF APPENDIX D

Table D.1 – Horizontal movements

X-axis		
Floor	Floor height, mm	Deflection, mm
Basement	3000	0.0513
1st floor	4000	0.266
2nd floor	4000	2.36
Roof	-	4.26
Y-axis		
Floor	Floor height, mm	Deflection, mm
Basement	3000	0.195
1st floor	4000	0.75
2nd floor	4000	3.72
Roof	-	6.23

Figure D.4 – Analysis of horizontal movements along the X-axis

Figure D.5 – Analysis of horizontal movements along the X-axis

$$\frac{(0.0513 + 0.266) \cdot 4000}{(0.266 + 2.36) \cdot 3000} = 0.161 < 1.25,$$

$$\frac{(0.266 + 2.36) \cdot 4000}{(2.36 + 4.26) \cdot 4000} = 0.397 < 1.25$$

In both cases, the solution of the formula was less than the limit value, so the building can be classified as regular in height relative to the X-axis.

$$\frac{(0.195 + 0.75) \cdot 4000}{(0.75 + 3.72) \cdot 3000} = 0.282 < 1.25,$$

$$\frac{(0.75 + 3.72) \cdot 4000}{(3.72 + 6.23) \cdot 4000} = 0.599 < 1.25$$

In both cases, the solution of the formula was less than the limit value, so the building can be classified as regular in height relative to the Y-axis.

After calculating both directions, it was concluded that the building is regular in height.

The height regularity is checked according to the conditions Zh.3.1 and Zh.3.2:

Zh.3.1 – the maximum and average values of horizontal displacements of each floor (covering) according to the main tones of natural vibrations of the building differ from each other by no more than 10 %;

CONTINUATION OF APPENDIX D

Zh.3.2 – the maximum and average values of horizontal displacements of each floor according to the basic tone of natural vibrations of the structure differ from each other by no more than 25 %.

Table D.2 – Horizontal offsets

X-axis			
Floor	Minimum offset, mm	Maximum offset, mm	Average offset, mm
Basement	0.0561	0.0769	0.067
1st floor	0.216	0.28	0.248
2nd floor	1.67	2.75	2.21
Roof	2.88	5.03	3.955
Y-axis			
Floor	Minimum offset, mm	Maximum offset, mm	Average offset, mm
Basement	0.178	0.191	0.185
1st floor	0.741	0.762	0.752
floor	3.69	3.71	3.7
Roof	6.22	6.23	6.225

Regularity in the plan along the X-axis:

$$10\ \% < \frac{0.0769 - 0.67}{0.0769} \cdot 100\% = 13.524\ \% < 25\ \%,$$

$$10\ \% < \frac{0.28 - 0.248}{0.28} \cdot 100\% = 11.429\ \% < 25\ \%,$$

$$10\% < \frac{2.75 - 2.21}{2.75} \cdot 100\% = 19.636\ \% < 25\%,$$

$$10\% < \frac{5.03 - 3.955}{5.03} \cdot 100\% = 21.372\ \% < 25\%$$

CONTINUATION OF APPENDIX D

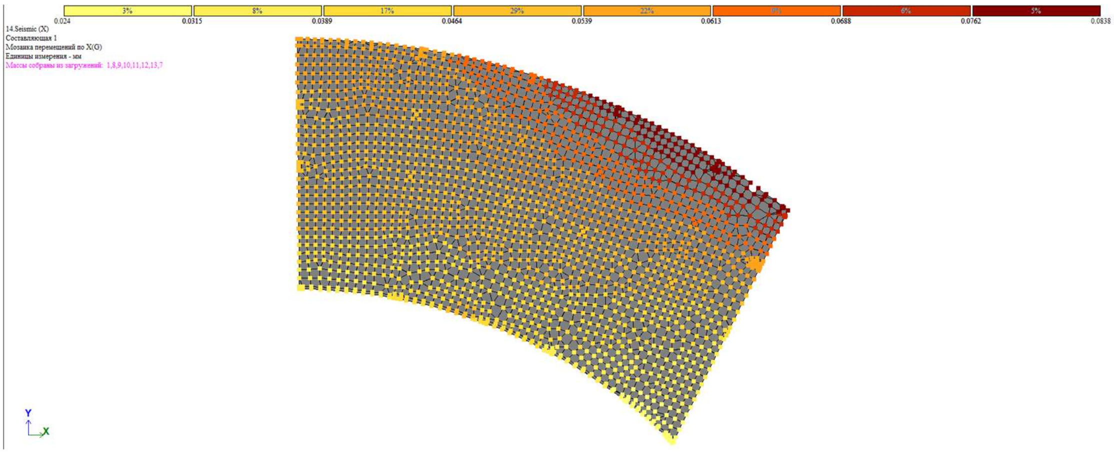


Figure D.6 – Floor slab movements along the X-axis at the -3.000 mark

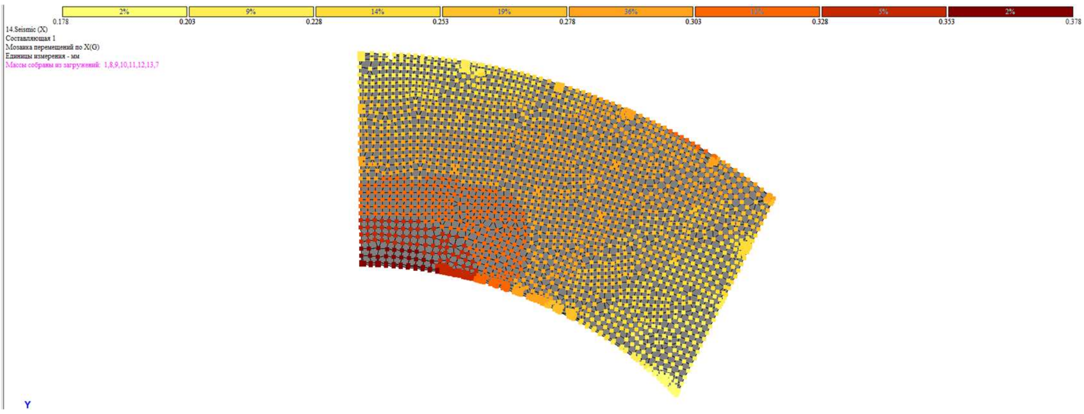


Figure D.7 – Floor slab movements along the X-axis at ±0.000

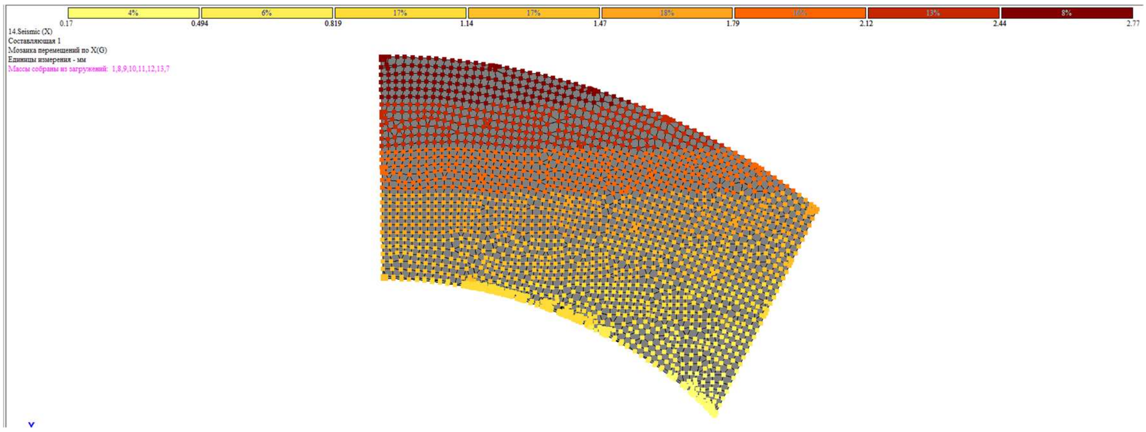


Figure D.8 – Floor slab movements along the X-axis at the +4,000 mark

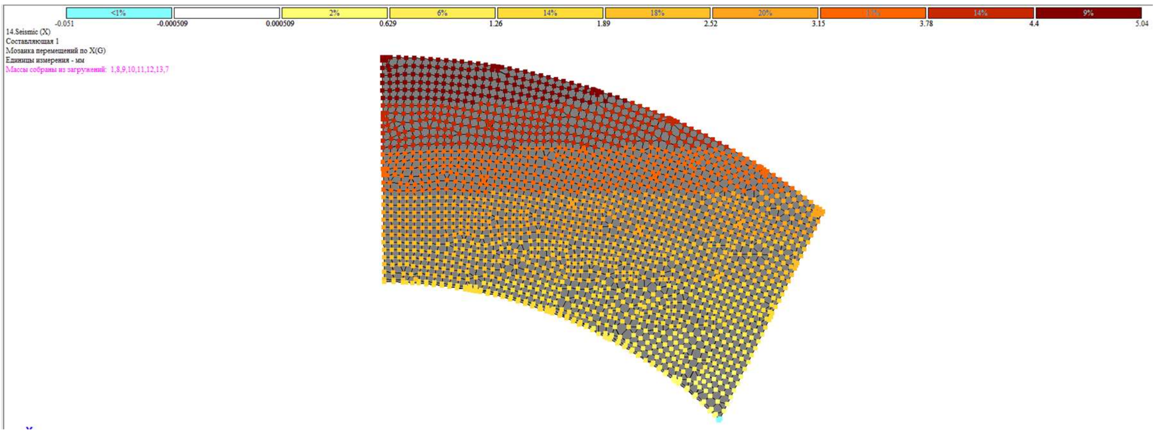


Figure D.9 – Floor slab movements along the X-axis at the +8.000 mark

According to the calculations, it is possible to notice that the building on all floors did not pass the test for strict regularity, but in all cases the condition of moderate irregularity was fulfilled. Here it was concluded that the building is classified as moderately irregular.

Regularity in the plan along the Y-axis:

$$\frac{0.191 - 0.185}{0.191} \cdot 100\% = 3.403\ \% < 10\ \%,$$

$$\frac{0.762 - 0.752}{0.762} \cdot 100\% = 1.378\ \% < 10\ \%,$$

$$\frac{3.71 - 3.7}{3.71} \cdot 100\% = 0.27\ \% < 10\%,$$

$$\frac{6.23 - 6.225}{6.23} \cdot 100\% = 0.08\ \% < 10\ \%$$

CONTINUATION OF APPENDIX D

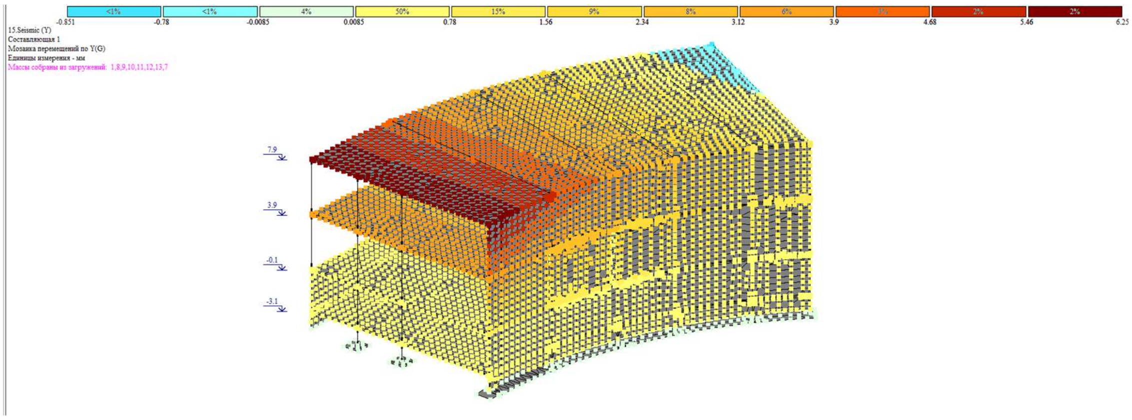


Figure D.10 – Y-axis movements caused by seismic impact

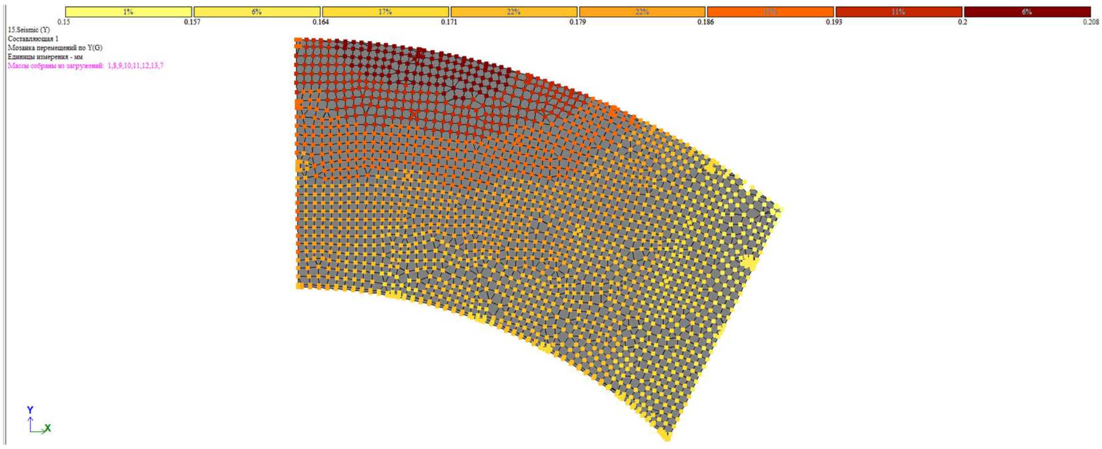


Figure D.11 – Floor slab movements along the Y-axis at the -3.000 mark

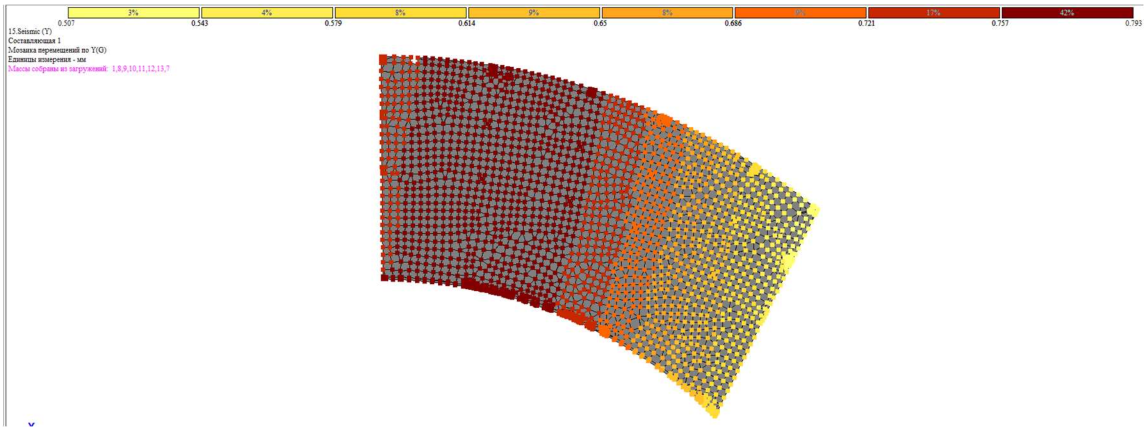


Figure D.12 – Floor slab movements along the Y-axis at ±0.000

CONTINUATION OF APPENDIX D

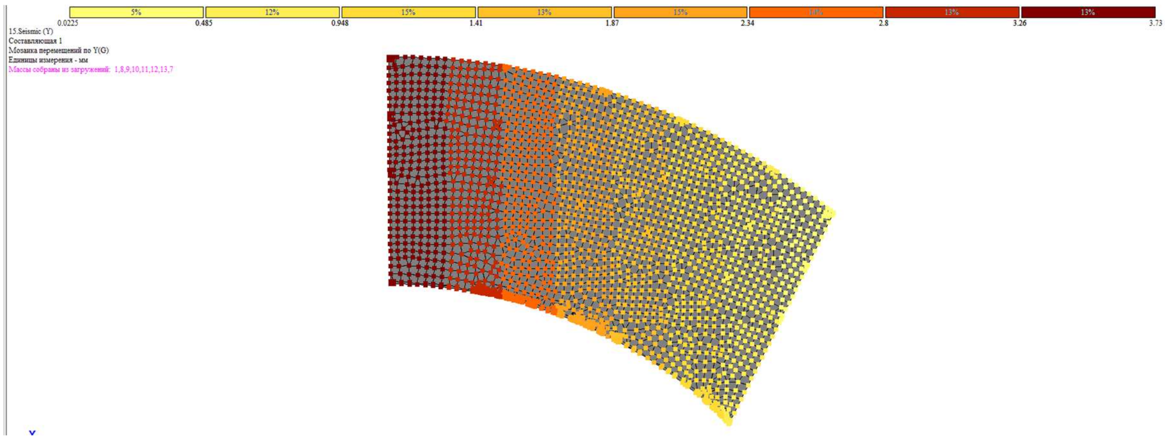


Figure D.13 – Floor slab movements along the Y-axis at the +4,000 mark

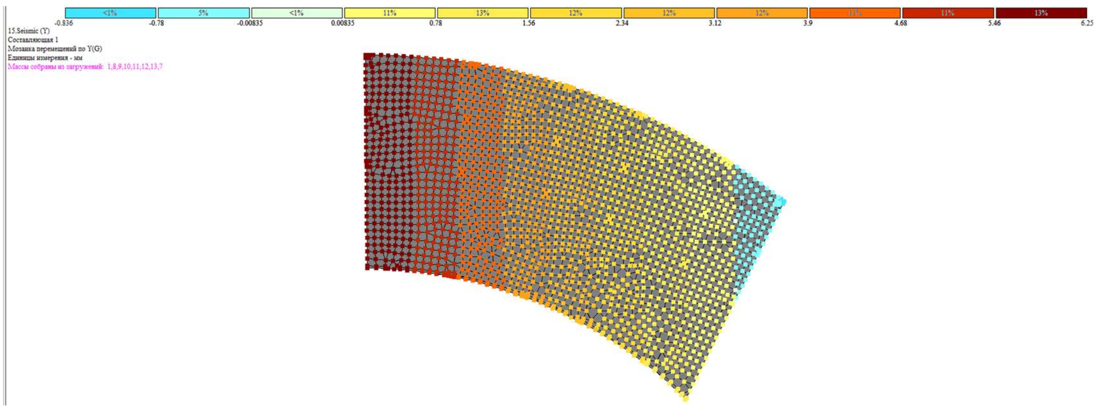


Figure D.14 – Floor slab movements along the Y-axis at +8.000

According to the calculations, you can see that the building on all floors was checked for strict regularity, so it was concluded that the building is classified as regular.

Taking into account the checks on both axes, it is necessary to draw a conclusion based on the worst-case condition – the building is moderately irregular. This result can be justified by the complex shape of the structure on the plan, which increases the influence of twisting forces on each floor.

Next, the analysis of deformations in the building that occur in an emergency is performed. To perform this check, you must use condition 7.29 [16]:

$$d_{rs} \leq \frac{h \cdot \varepsilon}{q} \qquad (D.5)$$

Where d_{rs} – floor skew for calculated seismic loads on the building.

h – floor height.

ε = 0.0202 is the coefficient taken from Table 7.11 [16].

CONTINUATION OF APPENDIX D

q = 3.3 – coefficient accepted in accordance with the provisions of subsection 7.6 [11].

Table D.3 – Floor offsets

X-axis		
Floor	Floor Floor height, mm	Floor offset, mm
Basement	3000	0.117
1 floor	4000	0.441
2 floor	4000	4.61
Roof	-	8.4
Y-axis		
Floor	Floor Floor height, mm	Floor offset, mm
Basement	3000	0.303
1 floor	4000	1.21
2 floor	4000	6.12
Roof	-	10.3

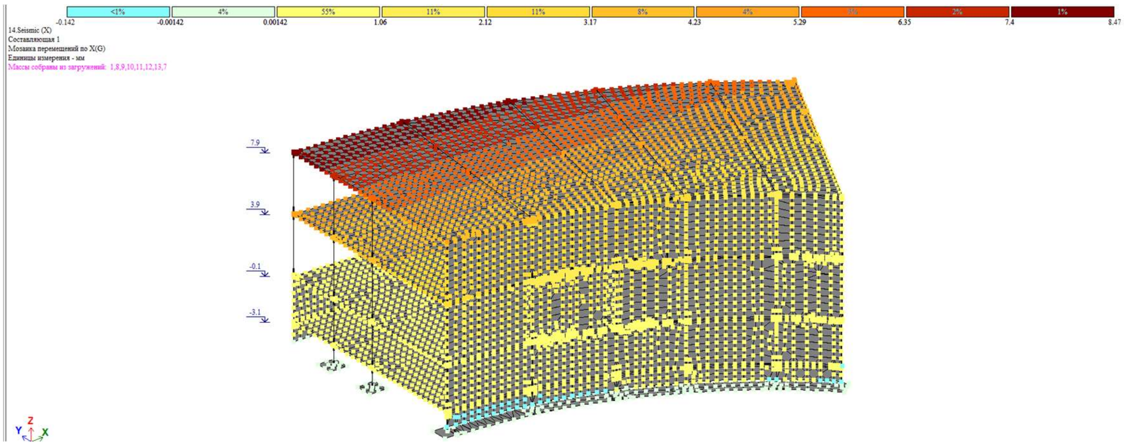


Figure D.15 – Movement along the X-axis from seismic impact (emergency state)

CONTINUATION OF APPENDIX D

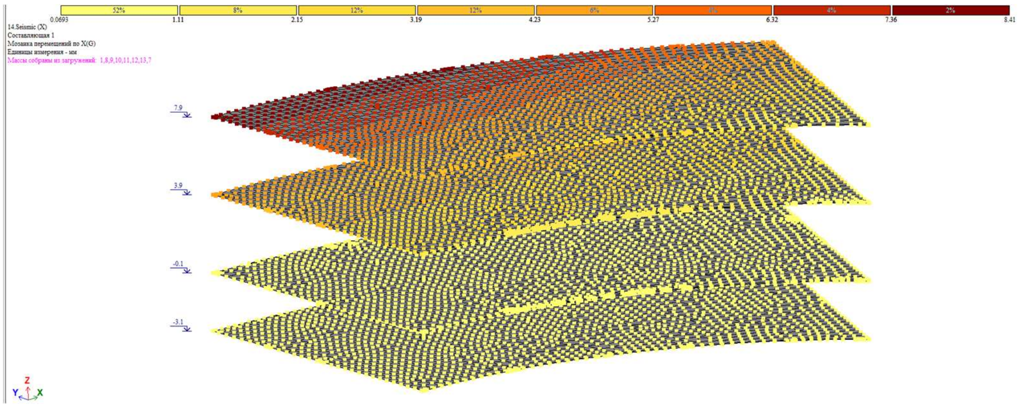


Figure D.16 - Movement of floor slabs along the X-axis from seismic impact (emergency state)

$$0.441 - 0.117 = 0.327 \leq \frac{3000 \cdot 0.02}{3.3} = 18.18,$$

$$4.61 - 0.441 = 4.169 \leq \frac{4000 \cdot 0.02}{3.3} = 24.24,$$

$$8.4 - 4.61 = 3.79 \leq \frac{4000 \cdot 0.02}{3.3} = 24.24$$

The X-axis floor skew limit condition was passed successfully.

$$1.21 - 0.303 = 0.907 \leq \frac{3000 \cdot 0.02}{3.3} = 18.18,$$

$$6.12 - 1.21 = 4.91 \leq \frac{4000 \cdot 0.02}{3.3} = 24.24,$$

$$10.3 - 6.12 = 4.18 \leq \frac{4000 \cdot 0.02}{3.3} = 24.24$$

The condition for limiting floor skew along the Y-axis was passed successfully.

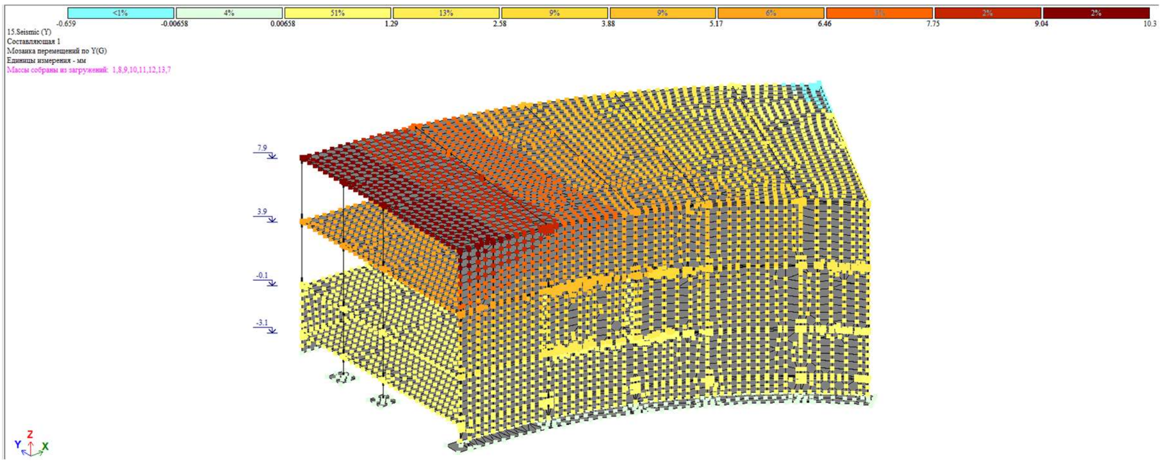


Figure D.17 – Movement along the Y-axis from seismic impact (emergency state)

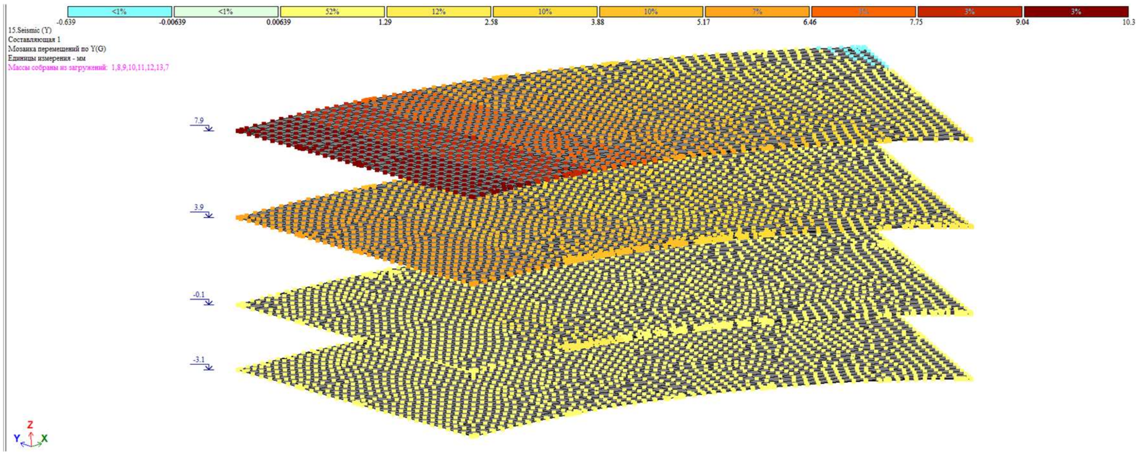


Figure D.18 – Movement of floor slabs along the Y-axis from seismic impact (emergency state)

APPENDIX E

Table E.1 – Characteristics of 118kW bulldozers

Brand		Tractor	Power, kW	Weight, t	Blade: length×width, m	Depth of the development, m	Dimensions: length×width×height, m	Capacity, m^3/h
New	Old							
DZ-27S	D-532S	T-130	118	13.4	3.2×3.3	0.5	6.5×3.9×2.8	860
DZ-28	D-533	T-130	118	14.1	3.9×1.0	0.4	6.4×3.2×3.1	860
DZ-109HL	-	T-130	118	17.5	4.1×1.1	0.5	6.4×3.2×3.1	900
DZ-110	-	T-130	118	17.7	3.2×1.3	0.5	6.6×3.9×2.8	900

Table E.2 – Characteristics of ramming machines

Machine brand	Characteristics	Weight, t	Tractor brand	Thickness of the compacted layer, m	Width of the compacted strip, m	Smallest length of the compacted strip, m
DU-126	Ramming	1.3	T-100MZ	1.2	2.5	50
DU-128	Ramming	1.3	T-130	1.2	2.5	50

Table E.3 – Characteristics of excavators

Name of the machine		Bucket volume, m3	Inventory and estimated cost of the machine, conventional units	Average cost of a machine shift, conventional units
Old	New			
E-1003	E-10011E	1	21.96	35.9
E-1004	E-10011AS	1	25.14	36.39
E-1251B	EO-5112A	1	25.04	33.4

CONTINUATION OF APPENDIX E

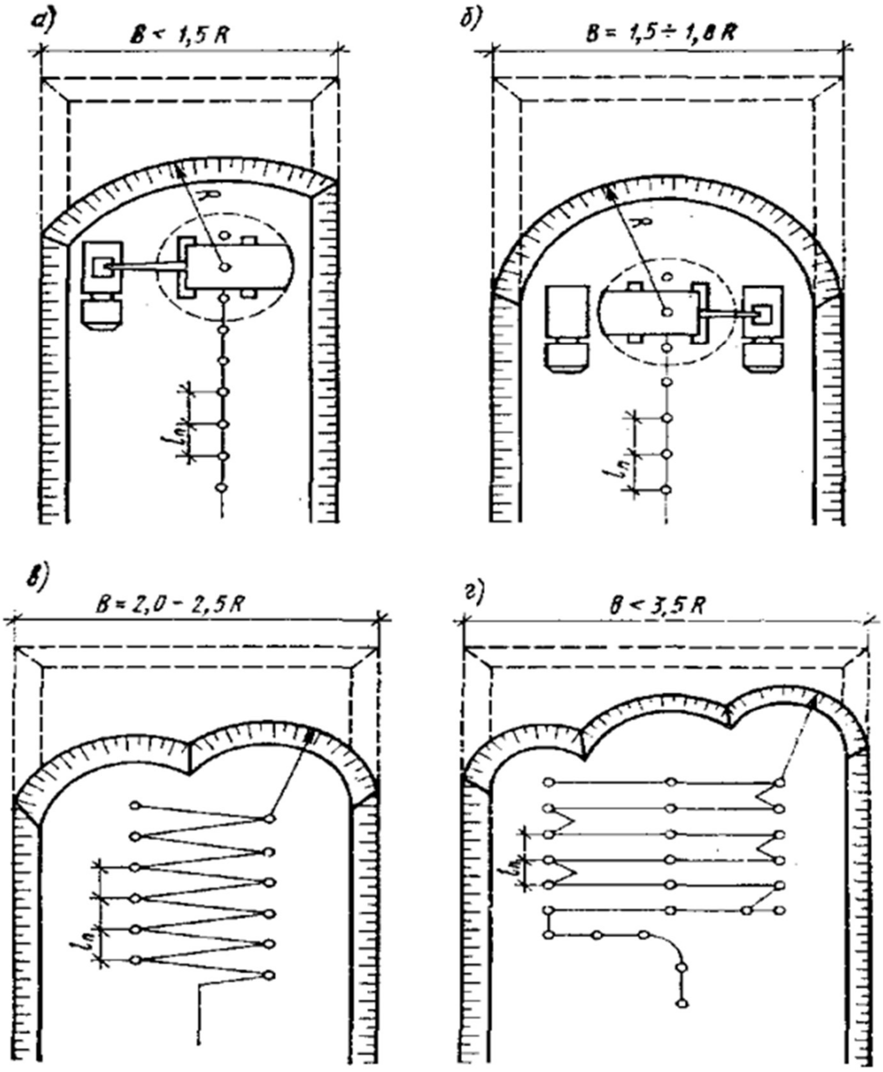


Figure E.1 – Excavation with a straight shovel: a – frontal sinking with one-way loading of soil into dump trucks; b – the same with two-way loading; c – the same with moving the excavator in a zigzag; d – expanded sinking with moving the excavator across the pit

CONTINUATION OF APPENDIX E

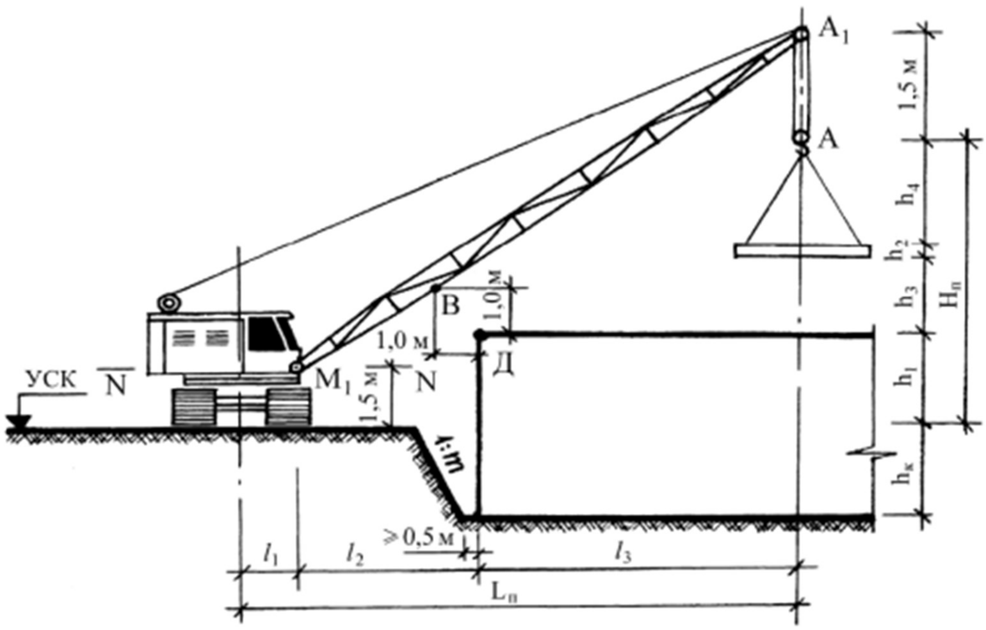


Figure E.2 – Diagram for determining the installation characteristics of a self-propelled jib crane

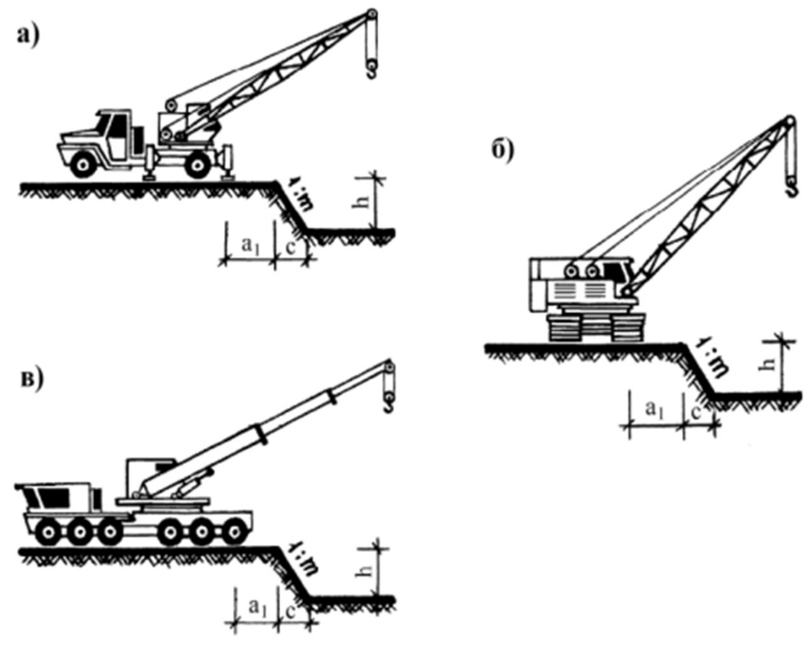


Figure E.3 – Linking jib cranes to the dimensions of open pits or pits: a) cranes on a road track, b) on a crawler track; c) cranes on a special ramp

CONTINUATION OF APPENDIX E

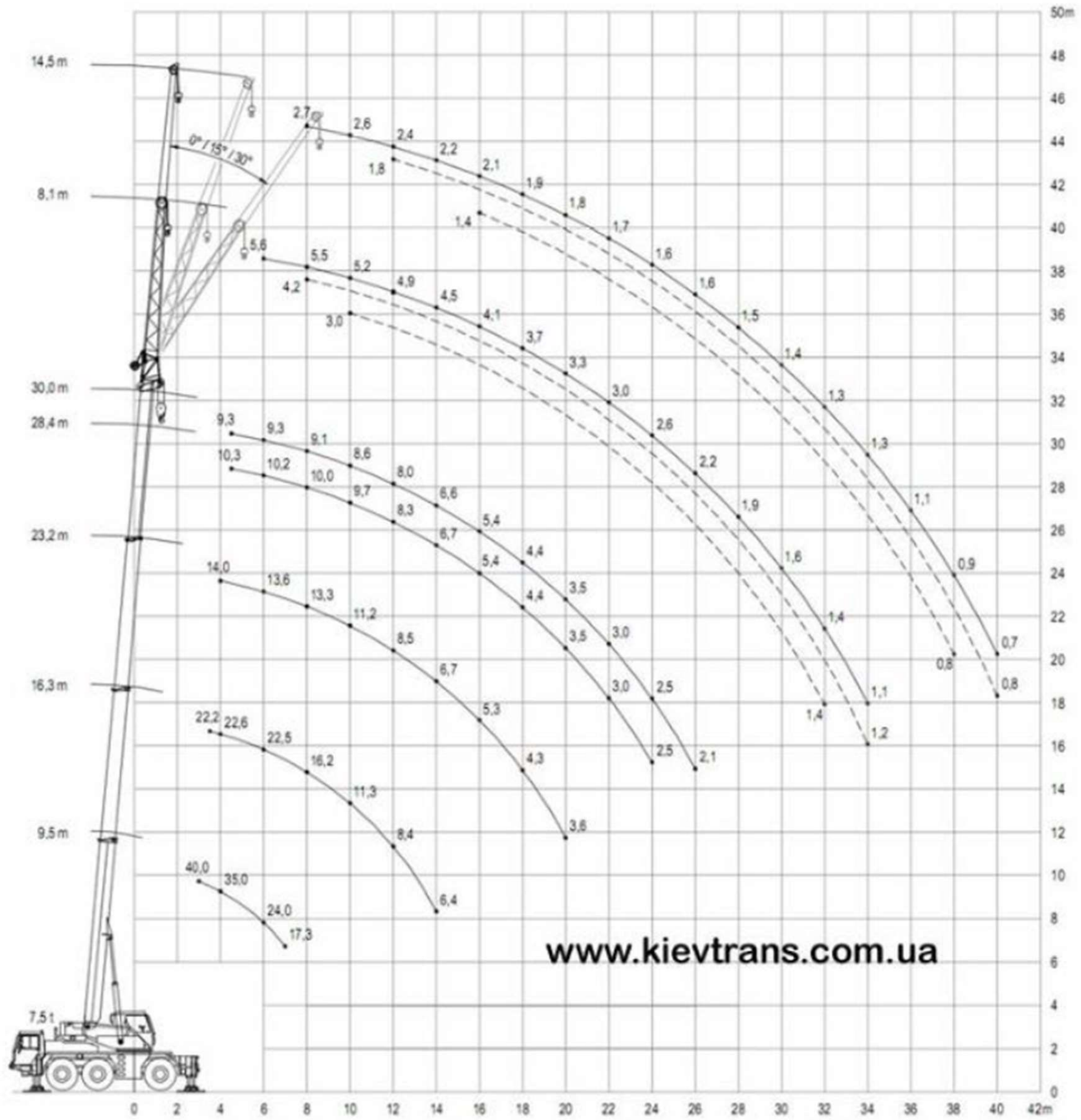


Figure E.4 – Diagram of the load capacity of XCMG QY25K5 truck crane

CONTINUATION OF APPENDIX E

Table E.4 – Labor cost calculation

№	Name of the process	Norm. Doc.	Meas.	Measures	Volume of the work	Time norm		Quotation		Labor costs		Salary	
						Work human-hour	Machinist machine-shift	Workers	Machinists	Workers, human-day	Machinists, machine-shift	Workers	Machinists
1	2	3	4		5	6	7	8	9	10	11	12	13
1	The construction of temporary fencing	E-22	m	10	369,20	1,20	-	1,30	-	5,40	-	48,00	-
2	Removal of top soil	E-2	m^2	1 000	9 973,74		0,56	-	0,60	-	5,59	-	5,98
3	Soil excavation in the pit	E-2	m^3	100	8 377,38	2,80	3,56	1,48	1,70	28,61	298,23	123,99	142,42
4	Excavation of soil underrun	E-2	m^3	1	143,79	1,64	-	0,54	-	28,76	-	77,65	-
5	Concrete preparation for foundations	E-4	m^3	1	23,11	0,79	-	0,49	-	2,23	-	11,32	-
6	Reinforcement installation for foundation manually	E-4	t	1	14,78	22,17	-	15,00	-	39,97	-	221,77	-

CONTINUATION OF APPENDIX E

Continuation of Table E.4

№	Name of the process	Norm. Doc.	Meas.	Measures	Volume of the work	Time norm		Quotation		Labor costs		Salary	
						Work human-hour	Machinist machine-shift	Workers	Machinists	Workers, human-day	Machinists, machine-shift	Workers	Machinists
1	2	3	4		5	6	7	8	9	10	11	12	13
7	Formwork installation for foundation manually	E-4	m^2	1	783,77	0,36	0,12	0,35	0,17	34,41	94,05	274,32	133,24
8	Concreting of foundation	E-4	m^3	1	96,06	1,20	0,89	0,34	0,31	14,06	85,50	32,66	29,78
9	Formwork removal for foundation	E-4	m^2	1	783,77	0,31	-	0,08	-	29,63	-	62,70	-
10	Foundation waterproofing	E-11	m^2	100	2 021,77	10,00	-	7,15	-	24,66	-	144,56	-
11	Backfilling	E-2	m^3	1	4 020,06	-	0,39	-	1,58	-	1 567,82	-	6 351,69
12	Soil compaction	E-2	m^2	100	13 400,19	-	0,92	-	0,26	-	123,28	-	34,84
13	Final land planning	E-2	m^2	100	7 120,73	0,33	0,49	1,58	1,65	2,87	34,89	112,51	117,49
14	Removal of temporary fencing	E-22	m	10	369,20	0,90	-	1,05	-	4,05	-	38,77	-

CONTINUATION OF APPENDIX E

Continuation of Table E.4

№	Name of the process	Norm. Doc.	Meas.	Measures	Volume of the work	Time norm		Quotation		Labor costs		Salary	
						Work human-hour	Machinist machine-shift	Workers	Machinists	Workers, human-day	Machinists, machine-shift	Workers	Machinists
1	2	3	4		5	6	7	8	9	10	11	12	13
15	Installation and tying of reinforcement cages for columns on the cellar	E-4	t	1	10,72	8,70		15,80		11,37	-	169,31	-
16	Installation and tying of reinforcement cages for walls on the cellar	E-4	t	1	103,23	8,70		15,80		109,52	-	1 631,01	-
17	Installation and tying of reinforcement cages for slab on the cellar	E-4	t	1	57,10	8,70		15,80		60,58	-	902,18	-

CONTINUATION OF APPENDIX E

Continuation of Table E.4

№	Name of the process	Norm. Doc.	Meas.	Measures	Volume of the work	Time norm		Quotation		Labor costs		Salary	
						Work human-hour	Machinist machine-shift	Workers	Machinists	Workers, human-day	Machinists, machine-shift	Workers	Machinists
1	2	3	4		5	6	7	8	9	10	11	12	13
18	Installation and tying of reinforcement cages for beams on the cellar	E-4	t	1	16,65	8,70		15,80		17,66	-	262,99	-
19	Installation of formwork for columns on the cellar	E-4	m^2	1	964,44	0,40		10,70		47,05	-	10 319,51	-
20	Installation of formwork for walls on the cellar	E-4	m^2	1	1 412,80	0,40		10,70		68,92	-	15 116,93	-
21	Installation of formwork for slab on the cellar	E-4	m^2	1	138,25	0,40		10,70		6,74	-	1 479,28	-

CONTINUATION OF APPENDIX E

Continuation of Table E.4

№	Name of the process	Norm. Doc.	Meas.	Measures	Volume of the work	Time norm		Quotation		Labor costs		Salary	
						Work human-hour	Machinist machine-shift	Workers	Machinists	Workers, human-day	Machinists, machine-shift	Workers	Machinists
1	2	3	4		5	6	7	8	9	10	11	12	13
22	Installation of formwork for beams on the cellar	E-4	m^2	1	1 040,00	0,40		10,70		50,73	-	11 128,00	-
23	Concreting of columns on the cellar	E-4	m^3	1	107,16	1,50		6,10		19,60	-	653,68	-
24	Concreting of walls on the cellar	E-4	m^3	1	1 032,28	1,50		6,10		188,83	-	6 296,93	-
25	Concreting of slab on the cellar	E-4	m^3	1	571,00	1,50		6,10		104,45	-	3 483,10	-
26	Concreting of beams on the cellar	E-4	m^3	1	166,45	1,50		6,10		30,45	-	1 015,35	-
27	Dismantling of formwork for columns on the cellar	E-4	m^2	1	964,44	0,15		10,70		17,64	-	10 319,51	-

CONTINUATION OF APPENDIX E

Continuation of Table E.4

№	Name of the process	Norm. Doc.	Meas.	Measures	Volume of the work	Time norm		Quotation		Labor costs		Salary	
						Work human-hour	Machinist machine-shift	Workers	Machinists	Workers, human-day	Machinists, machine-shift	Workers	Machinists
1	2	3	4		5	6	7	8	9	10	11	12	13
28	Dismantling of formwork for walls on the cellar	E-4	m^2	1	1 412,80	0,15		10,70		25,84	-	15 116,93	-
29	Dismantling of formwork for slab on the cellar	E-4	m^2	1	138,25	0,15		10,70		2,53	-	1 479,28	-
30	Dismantling of formwork for beams on the cellar	E-4	m^2	1	1 040,00	0,15		10,70		19,02	-	11 128,00	-
31	Installation and tying of reinforcement cages for columns on the 1-st floor	E-4	t	1	16,30	8,70		15,80		17,30	-	257,57	-

Continuation of Table E.4

№	Name of the process	Norm. Doc.	Meas.	Measures	Volume of the work	Time norm		Quotation		Labor costs		Salary	
						Work human-hour	Machinist machine-shift	Workers	Machinists	Workers, human-day	Machinists, machine-shift	Workers	Machinists
1	2	3	4		5	6	7	8	9	10	11	12	13
32	Installation and tying of reinforcement cages for walls on the 1-st floor	E-4	t	1	10,40	8,70		15,80		11,03	-	164,32	-
33	Installation and tying of reinforcement cages for slab on the 1-st floor	E-4	t	1	55,31	8,70		15,80		58,68	-	873,82	-
34	Installation and tying of reinforcement cages for beam on the 1-st floor	E-4	t	1	16,60	8,70		15,80		17,61	-	262,28	-

CONTINUATION OF APPENDIX E

Continuation of Table E.4

№	Name of the process	Norm. Doc.	Meas.	Measures	Volume of the work	Time norm		Quotation		Labor costs		Salary	
						Work human-hour	Machinist machine-shift	Workers	Machinists	Workers, human-day	Machinists, machine-shift	Workers	Machinists
1	2	3	4		5	6	7	8	9	10	11	12	13
35	Installation of formwork for columns on the 1-st floor	E-4	m^2	1	1 504,80	0,40		10,70		73,40	-	16 101,36	-
36	Installation of formwork for walls on the 1-st floor	E-4	m^2	1	727,00	0,40		10,70		35,46	-	7 778,90	-
37	Installation of formwork for slab on the 1-st floor	E-4	m^2	1	153,81	0,40		10,70		7,50	-	1 645,76	-
38	Installation of formwork for beams on the 1-st floor	E-4	m^2	1	1 650,00	0,40		10,70		80,49	-	17 655,00	-
39	Concreting of columns on the 1-st floor	E-4	m^3	1	163,02	1,50		6,10		29,82	-	994,42	-

CONTINUATION OF APPENDIX E

Continuation of Table E.4

№	Name of the process	Norm. Doc.	Meas.	Measures	Volume of the work	Time norm		Quotation		Labor costs		Salary	
						Work human-hour	Machinist machine-shift	Workers	Machinists	Workers, human-day	Machinists, machine-shift	Workers	Machinists
1	2	3	4		5	6	7	8	9	10	11	12	13
40	Concreting of walls on the 1-st floor	E-4	m^3	1	104,00	1,50		6,10		19,02	-	634,40	-
41	Concreting of slab on the 1-st floor	E-4	m^3	1	553,05	1,50		6,10		101,17	-	3 373,61	-
42	Concreting of beams on the 1-st floor	E-4	m^3	1	166,00	1,50		6,10		30,37	-	1 012,60	-
43	Dismantling of formwork for columns on the 1-st floor	E-4	m^2	1	1 504,80	0,15		10,70		27,53	-	16 101,36	-
44	Dismantling of formwork for walls on the 1-st floor	E-4	m^2	1	727,00	0,15		10,70		13,30	-	7 778,90	-

CONTINUATION OF APPENDIX E

Continuation of Table E.4

№	Name of the process	Norm. Doc.	Meas.	Measures	Volume of the work	Time norm		Quotation		Labor costs		Salary	
						Work human-hour	Machinist machine-shift	Workers	Machinists	Workers, human-day	Machinists, machine-shift	Workers	Machinists
1	2	3	4		5	6	7	8	9	10	11	12	13
45	Dismantling of formwork for slab on the 1-st floor	E-4	m^2	1	153,81	0,15		10,70		2,81	-	1 645,76	-
46	Dismantling of formwork for beams on the 1-st floor	E-4	m^2	1	1 650,00	0,15		10,70		30,18	-	17 655,00	-
47	Installation and tying of reinforcement cages for columns on the 2-nd floor	E-4	t	1	15,96	8,70		15,80		16,93	-	252,17	-
48	Installation and tying of reinforcement cages for walls on the 2-nd floor	E-4	t	1	11,80	8,70		15,80		12,52	-	186,44	-

CONTINUATION OF APPENDIX E

Continuation of Table E.4

№	Name of the process	Norm. Doc.	Meas.	Measures	Volume of the work	Time norm		Quotation		Labor costs		Salary	
						Work human-hour	Machinist machine-shift	Workers	Machinists	Workers, human-day	Machinists, machine-shift	Workers	Machinists
1	2	3	4		5	6	7	8	9	10	11	12	13
49	Installation and tying of reinforcement cages for slab on the 2-nd floor	E-4	t	1	55,20	8,70		15,80		58,57	-	872,16	-
50	Installation and tying of reinforcement cages for beams on the 2-nd floor	E-4	t	1	19,20	8,70		15,80		20,37	-	303,36	-
51	Installation of formwork for columns on the 2-nd floor	E-4	m^2	1	1 512,00	0,40		10,70		73,76	-	16 178,40	-
52	Installation of formwork for walls on the 2-nd floor	E-4	m^2	1	860,00	0,40		10,70		41,95	-	9 202,00	-

Continuation of Table E.4

№	Name of the process	Norm. Doc.	Meas.	Measures	Volume of the work	Time norm		Quotation		Labor costs		Salary	
						Work human-hour	Machinist machine-shift	Workers	Machinists	Workers, human-day	Machinists, machine-shift	Workers	Machinists
1	2	3	4		5	6	7	8	9	10	11	12	13
53	Installation of formwork for slab on the 2-nd floor	E-4	m^2	1	154,20	0,40		10,70		7,52	-	1 649,94	-
54	Installation of formwork for beams on the 2-nd floor	E-4	m^2	1	1 650,00	0,40		10,70		80,49	-	17 655,00	-
55	Concreting of columns on the 2-nd floor	E-4	m^3	1	159,60	1,50		6,10		29,20	-	973,56	-
56	Concreting of walls on the 2-nd floor	E-4	m^3	1	118,00	1,50		6,10		21,59	-	719,80	-
57	Concreting of slab on the 2-nd floor	E-4	m^3	1	552,00	1,50		6,10		100,98	-	3 367,20	-
58	Concreting of beams on the 2-nd floor	E-4	m^3	1	192,00	1,50		6,10		35,12	-	1 171,20	-

CONTINUATION OF APPENDIX E

Continuation of Table E.4

№	Name of the process	Norm. Doc.	Meas.	Measures	Volume of the work	Time norm		Quotation		Labor costs		Salary	
						Work human-hour	Machinist machine-shift	Workers	Machinists	Workers, human-day	Machinists, machine-shift	Workers	Machinists
1	2	3	4		5	6	7	8	9	10	11	12	13
59	Dismantling of formwork for columns on the 2-nd floor	E-4	m^2	1	1 512,00	0,15		10,70		27,66	-	16 178,40	-
60	Dismantling of formwork for columns on the 2-nd floor	E-4	m^2	1	860,00	0,15		10,70		15,73	-	9 202,00	-
61	Dismantling of formwork for columns on the 2-nd floor	E-4	m^2	1	154,20	0,15		10,70		2,82	-	1 649,94	-
62	Dismantling of formwork for columns on the 2-nd floor	E-4	m^2	1	1 650,00	0,15		10,70		30,18	-	17 655,00	-

Continuation of Table E.4

№	Name of the process	Norm. Doc.	Meas.	Measures	Volume of the work	Time norm		Quotation		Labor costs		Salary	
						Work human-hour	Machinist machine-shift	Workers	Machinists	Workers, human-day	Machinists, machine-shift	Workers	Machinists
1	2	3	4		5	6	7	8	9	10	11	12	13
63	Installation and tying of reinforcement cages for slab on the roof	E-4	t	1	57,10	8,70		15,80		60,58	-	902,18	-
64	Installation and tying of reinforcement cages for beams on the roof	E-4	t	1	19,10	8,70		15,80		20,26	-	301,78	-
65	Installation of formwork for slab on the roof	E-4	m^2	1	138,22	0,40		10,70		6,74	-	1 478,95	-
66	Installation of formwork for beams on the roof	E-4	m^2	1	1 648,00	0,40		10,70		80,39	-	17 633,60	-

CONTINUATION OF APPENDIX E

Continuation of Table E.4

№	Name of the process	Norm. Doc.	Meas.	Measures	Volume of the work	Time norm		Quotation		Labor costs		Salary	
						Work human-hour	Machinist machine-shift	Workers	Machinists	Workers, human-day	Machinists, machine-shift	Workers	Machinists
1	2	3	4		5	6	7	8	9	10	11	12	13
67	Concreting of slab on the roof	E-4	m^3	1	571,00	1,50		6,10		104,45	-	3 483,10	-
68	Concreting of beams on the roof	E-4	m^3	1	191,00	1,50		6,10		34,94	-	1 165,10	-
69	Dismantling of formwork for slab on the roof	E-4	m^2	1	138,22	0,15		10,70		2,53	-	1 478,95	-
70	Dismantling of formwork for beams on the roof	E-4	m^2	1	1 648,00	0,15		10,70		30,15	-	17 633,60	-
71	Installation of partitions with a single metal frame (height less than 5 m)	E-3	m^2	1	666,32	0,59		10,00		47,94	-	6 663,20	-
72	Laying brick walls	E-3	m^3	1	836,60	3,20		35,00		326,48	-	29 281,00	-

CONTINUATION OF APPENDIX E

Continuation of Table E.4

№	Name of the process	Norm. Doc.	Meas.	Measures	Volume of the work	Time norm		Quotation		Labor costs		Salary	
						Work human-hour	Machinist machine-shift	Workers	Machinists	Workers, human-day	Machinists, machine-shift	Workers	Machinists
1	2	3	4		5	6	7	8	9	10	11	12	13
73	Doors installation	E-6	m^2	100	1 858,37	13,40	12,00	24,00		30,37	223,00	446,01	-
74	Installation of metal frames	E-5	t	1	17,20	2,90	1,50	35,00		6,08	25,80	601,96	-
75	Installation of stained glass windows	E-6	m^2	100	13 581,00	15,10	13,70			250,09	1 860,60	-	-

CONTINUATION OF APPENDIX E

Table E.5 – Work schedule

Name of the process	Volume of work according to course work	Volume of work		Labor cost, hum-day	The required machines		Duration, day	Number of shifts	Number of workers per shift	Structure of crew
		Measurement	Number		Name	Number of machine-shift				
The construction of temporary fencing	369,20	m	36,92	5,40	Bulldozer DZ-190XL	-	1,35	1	4	1 machinist, 3 workers
Removal of top soil	9 973,74	m^2	9,97	5,59	Excavator E-1251B, truck GAZ-53A	5,59	0,80	1	7	7 machinists
Soil excavation in the pit	8 377,38	m^3	83,77	326,84	Excavator E-1251B, truck GAZ-53A	298,23	14,91	1	20	20 machinists
Excavation of soil underrun	143,79	m^3	143,79	28,76		-	1,44	1	20	20 earthworkers
Concrete preparation for foundations	23,11	m^3	23,11	2,23	KamAZ 65201	-	0,56	1	4	1 machinist, 3 workers
Reinforcement installation	14,78	t	14,78	39,97	Crane XCMG QY25K5	-	2,66	1	15	12 fitters, 3 welder

Continuation of Table E.5

Name of the process	Volume of work according to course work	Volume of work		Labor cost, hum-day	The required machines		Duration, day	Number of shifts	Number of workers per shift	Structure of crew
		Measurement	Number		Name	Number of machine-shift				
Formwork installation	783,77	m^2	783,77	128,46	Crane XCMG QY25K5	94,05	7,84	1	12	9 carpenters, 3 crane operator
Concreting of foundations	96,06	m^3	96,06	99,56	Concrete pump	85,50	8,55	1	4	1 machinist, 3 workers
Formwork removal	783,77	m^2	783,77	29,63	Crane XCMG QY25K5	-	2,47	1	12	9 carpenters, 3 crane operator
Foundation waterproofing	2 021,77	m^2	20,22	24,66		-	12,33	1	2	2 workers
Backfilling	4 020,06	m^3	4 020,06	1 567,82	Bulldozer DZ-190XL	1 567,82	39,20	2	20	20 machinist
Soil compaction	13 400,19	m^2	134,00	123,28	DU-126	123,28	13,40	1	10	10 machinist
Final land planning	7 120,73	m^2	71,21	37,76	Excavator E-1251B, truck GAZ-53A	34,89	1,74	1	10	4 machinists, 6 workers

CONTINUATION OF APPENDIX E

Continuation of Table E.5

Name of the process	Volume of work according to course work	Volume of work		Labor cost, hum-day	The required machines		Duration, day	Number of shifts	Number of workers per shift	Structure of crew
		Measurement	Number		Name	Number of machine-shift				
Removal of temporary fencing	369,20	m	36,92	4,05		-	1,35	1	3	3 workers
Installation and tying of reinforcement cages for columns on the cellar	10,72	t	10,72	11,37		-	0,57	1	20	2 fitters
Installation and tying of reinforcement cages for walls on the cellar	103,23	t	103,23	109,52		-	5,48	1	20	2 fitters
Installation and tying of reinforcement cages for slab on the cellar	57,10	t	57,10	60,58		-	3,03	1	20	2 fitters

CONTINUATION OF APPENDIX E

Continuation of Table E.5

Name of the process	Volume of work according to course work	Volume of work		Labor cost, hum-day	The required machines		Duration, day	Number of shifts	Number of workers per shift	Structure of crew
		Measurement	Number		Name	Number of machine-shift				
Installation and tying of reinforcement cages for beams on the cellar	16,65	t	16,65	17,66		-	0,88	1	20	2 fitters
Installation of formwork for columns on the cellar	964,44	m^2	964,44	47,05		-	2,35	1	20	2 carpenters
Installation of formwork for walls on the cellar	1 412,80	m^2	1 412,80	68,92		-	3,45	1	20	2 carpenters
Installation of formwork for slab on the cellar	138,25	m^2	138,25	6,74		-	0,34	1	20	2 carpenters

CONTINUATION OF APPENDIX E

Continuation of Table E.5

Name of the process	Volume of work according to course work	Volume of work		Labor cost, hum-day	The required machines		Duration, day	Number of shifts	Number of workers per shift	Structure of crew
		Measurement	Number		Name	Number of machine-shift				
Installation of formwork for beams on the cellar	1 040,00	m^2	1 040,00	50,73		-	2,54	1	20	2 carpenters
Concreting of columns on the cellar	107,16	m^3	107,16	19,60	KamAZ 65201	-	0,98	1	20	1 machinist, 3 workers
Concreting of walls on the cellar	1 032,28	m^3	1 032,28	188,83	KamAZ 65202	-	9,44	1	20	1 machinist, 3 workers
Concreting of slab on the cellar	571,00	m^3	571,00	104,45	KamAZ 65203	-	5,22	1	20	1 machinist, 3 workers
Concreting of beams on the cellar	166,45	m^3	166,45	30,45	KamAZ 65204	-	1,52	1	20	1 machinist, 3 workers

CONTINUATION OF APPENDIX E

Continuation of Table E.5

Name of the process	Volume of work according to course work	Volume of work		Labor cost, hum-day	The required machines		Duration, day	Number of shifts	Number of workers per shift	Structure of crew
		Measurement	Number		Name	Number of machine-shift				
Dismantling of formwork for columns on the cellar	964,44	m^2	964,44	17,64		-	0,88	1	20	2 carpenters
Dismantling of formwork for walls on the cellar	1 412,80	m^2	1 412,80	25,84		-	1,29	1	20	2 carpenters
Dismantling of formwork for slab on the cellar	138,25	m^2	138,25	2,53		-	0,13	1	20	2 carpenters
Dismantling of formwork for beams on the cellar	1 040,00	m^2	1 040,00	19,02		-	0,95	1	20	2 carpenters

CONTINUATION OF APPENDIX E

Continuation of Table E.5

Name of the process	Volume of work according to course work	Volume of work		Labor cost, hum-day	The required machines		Duration, day	Number of shifts	Number of workers per shift	Structure of crew
		Measurement	Number		Name	Number of machine-shift				
Installation and tying of reinforcement cages for columns on the 1-st floor	16,30	t	16,30	17,30		-	0,86	1	20	2 fitters
Installation and tying of reinforcement cages for walls on the 1-st floor	10,40	t	10,40	11,03		-	0,55	1	20	2 fitters
Installation and tying of reinforcement cages for slab on the 1-st floor	55,31	t	55,31	58,68		-	2,93	1	20	2 fitters

Continuation of Table E.5

Name of the process	Volume of work according to course work	Volume of work		Labor cost, hum-day	The required machines		Duration, day	Number of shifts	Number of workers per shift	Structure of crew
		Measurement	Number		Name	Number of machine-shift				
Installation and tying of reinforcement cages for beam on the 1-st floor	16,60	t	16,60	17,61		-	0,88	1	20	2 fitters
Installation of formwork for columns on the 1-st floor	1 504,80	m^2	1 504,80	73,40		-	3,67	1	20	2 carpenters
Installation of formwork for walls on the 1-st floor	727,00	m^2	727,00	35,46		-	1,77	1	20	2 carpenters
Installation of formwork for slab on the 1-st floor	153,81	m^2	153,81	7,50		-	0,38	1	20	2 carpenters

CONTINUATION OF APPENDIX E

Continuation of Table E.5

Name of the process	Volume of work according to course work	Volume of work		Labor cost, hum-day	The required machines		Duration, day	Number of shifts	Number of workers per shift	Structure of crew
		Measurement	Number		Name	Number of machine-shift				
Installation of formwork for beams on the 1-st floor	1 650,00	m^2	1 650,00	80,49		-	4,02	1	20	2 carpenters
Concreting of columns on the 1-st floor	163,02	m^3	163,02	29,82	KamAZ 65201	-	1,49	1	20	1 machinist, 3 workers
Concreting of walls on the 1-st floor	104,00	m^3	104,00	19,02	KamAZ 65202	-	0,95	1	20	1 machinist, 3 workers
Concreting of slab on the 1-st floor	553,05	m^3	553,05	101,17	KamAZ 65203	-	5,06	1	20	1 machinist, 3 workers
Concreting of beams on the 1-st floor	166,00	m^3	166,00	30,37	KamAZ 65204	-	1,52	1	20	1 machinist, 3 workers

CONTINUATION OF APPENDIX E

Continuation of Table E.5

Name of the process	Volume of work according to course work	Volume of work		Labor cost, hum-day	The required machines		Duration, day	Number of shifts	Number of workers per shift	Structure of crew
		Measurement	Number		Name	Number of machine-shift				
Dismantling of formwork for columns on the 1-st floor	1 504,80	m^2	1 504,80	27,53		-	1,38	1	20	2 carpenters
Dismantling of formwork for walls on the 1-st floor	727,00	m^2	727,00	13,30		-	0,66	1	20	2 carpenters
Dismantling of formwork for slab on the 1-st floor	153,81	m^2	153,81	2,81		-	0,14	1	20	2 carpenters
Dismantling of formwork for beams on the 1-st floor	1 650,00	m^2	1 650,00	30,18		-	1,51	1	20	2 carpenters

CONTINUATION OF APPENDIX E

Continuation of Table E.5

Name of the process	Volume of work according to course work	Volume of work		Labor cost, hum-day	The required machines		Duration, day	Number of shifts	Number of workers per shift	Structure of crew
		Measurement	Number		Name	Number of machine-shift				
Installation and tying of reinforcement cages for columns on the 2-nd floor	15,96	t	15,96	16,93		-	0,85	1	20	2 fitters
Installation and tying of reinforcement cages for walls on the 2-nd floor	11,80	t	11,80	12,52		-	0,63	1	20	2 fitters
Installation and tying of reinforcement cages for slab on the 2-nd floor	55,20	t	55,20	58,57		-	2,93	1	20	2 fitters

CONTINUATION OF APPENDIX E

Continuation of Table E.5

Name of the process	Volume of work according to course work	Volume of work		Labor cost, hum-day	The required machines		Duration, day	Number of shifts	Number of workers per shift	Structure of crew
		Measurement	Number		Name	Number of machine-shift				
Installation and tying of reinforcement cages for beams on the 2-nd floor	19,20	t	19,20	20,37		-	1,02	1	20	2 fitters
Installation of formwork for columns on the 2-nd floor	1 512,00	m^2	1 512,00	73,76		-	3,69	1	20	2 carpenters
Installation of formwork for walls on the 2-nd floor	860,00	m^2	860,00	41,95		-	2,10	1	20	2 carpenters
Installation of formwork for slab on the 2-nd floor	154,20	m^2	154,20	7,52		-	0,38	1	20	2 carpenters

CONTINUATION OF APPENDIX E

Continuation of Table E.5

Name of the process	Volume of work according to course work	Volume of work		Labor cost, hum-day	The required machines		Duration, day	Number of shifts	Number of workers per shift	Structure of crew
		Measurement	Number		Name	Number of machine-shift				
Installation of formwork for beams on the 2-nd floor	1 650,00	m^2	1 650,00	80,49		-	4,02	1	20	2 carpenters
Concreting of columns on the 2-nd floor	159,60	m^3	159,60	29,20	KamAZ 65201	-	1,46	1	20	1 machinist, 3 workers
Concreting of walls on the 2-nd floor	118,00	m^3	118,00	21,59	KamAZ 65202	-	1,08	1	20	1 machinist, 3 workers
Concreting of slab on the 2-nd floor	552,00	m^3	552,00	100,98	KamAZ 65203	-	5,05	1	20	1 machinist, 3 workers
Concreting of beams on the 2-nd floor	192,00	m^3	192,00	35,12	KamAZ 65204	-	1,76	1	20	1 machinist, 3 workers

CONTINUATION OF APPENDIX E

Continuation of Table E.5

Name of the process	Volume of work according to course work	Volume of work		Labor cost, hum-day	The required machines		Duration, day	Number of shifts	Number of workers per shift	Structure of crew
		Measurement	Number		Name	Number of machine-shift				
Dismantling of formwork for columns on the 2-nd floor	1 512,00	m^2	1 512,00	27,66		-	1,38	1	20	2 carpenters
Dismantling of formwork for columns on the 2-nd floor	860,00	m^2	860,00	15,73		-	0,79	1	20	2 carpenters
Dismantling of formwork for columns on the 2-nd floor	154,20	m^2	154,20	2,82		-	0,14	1	20	2 carpenters
Dismantling of formwork for columns on the 2-nd floor	1 650,00	m^2	1 650,00	30,18		-	1,51	1	20	2 carpenters

CONTINUATION OF APPENDIX E

Continuation of Table E.5

Name of the process	Volume of work according to course work	Volume of work		Labor cost, hum-day	The required machines		Duration, day	Number of shifts	Number of workers per shift	Structure of crew
		Measurement	Number		Name	Number of machine-shift				
Installation and tying of reinforcement cages for slab on the roof	57,10	t	57,10	60,58		-	3,03	1	20	2 fitters
Installation and tying of reinforcement cages for beams on the roof	19,10	t	19,10	20,26		-	1,01	1	20	2 fitters
Installation of formwork for slab on the roof	138,22	m^2	138,22	6,74		-	0,34	1	20	2 carpenters
Installation of formwork for beams on the roof	1 648,00	m^2	1 648,00	80,39		-	4,02	1	20	2 carpenters
Concreting of slab on the roof	571,00	m^3	571,00	104,45	KamAZ 65201	-	5,22	1	20	1 machinist, 3 workers

CONTINUATION OF APPENDIX E

Continuation of Table E.5

Name of the process	Volume of work according to course work	Volume of work		Labor cost, hum-day	The required machines		Duration, day	Number of shifts	Number of workers per shift	Structure of crew
		Measurement	Number		Name	Number of machine-shift				
Concreting of beams on the roof	191,00	m^3	191,00	34,94	KamAZ 65202	-	1,75	1	20	1 machinist, 3 workers
Dismantling of formwork for slab on the roof	138,22	m^2	138,22	2,53		-	0,13	1	20	2 carpenters
Dismantling of formwork for beams on the roof	1 648,00	m^2	1 648,00	30,15		-	1,51	1	20	2 carpenters
Installation of partitions with a single metal frame (height less than 5 m)	666,32	m^2	666,32	47,94		-	3,20	1	15	3 installer of structures
Laying brick walls	836,60	m^3	836,60	326,48		-	16,32	1	20	2 bricklayers

CONTINUATION OF APPENDIX E

Continuation of Table E.5

Name of the process	Volume of work according to course work	Volume of work		Labor cost, hum-day	The required machines		Duration, day	Number of shifts	Number of workers per shift	Structure of crew
		Measurement	Number		Name	Number of machine-shift				
Doors installation	1 858,37	m^2	18,58	30,37	Crane XCMG QY25K5	223,00	3,37	1	9	1 crane operator, 2 carpenters
Installation of metal frames	17,20	t	17,20	6,08	Crane XCMG QY25K5	25,80	2,03	1	3	1 crane operator, 2 installers
Installation of stained glass windows	13 581,00	m^2	135,81	250,09	Crane XCMG QY25K5	1 860,60	20,84	1	12	1 crane operator, 3 carpenters

APPENDIX F

As a result of the work in the budget program of the Republic of Kazakhstan, 4 types of estimates were created: consolidated budget calculation, resource estimate, local estimate and object estimate. For a more plausible calculation, various overhead costs have also been added, which can be studied in detail in the estimate tables.

According to the received calculation, the cost of construction of the hospital, excluding finishing, amounted to 1609380.171 thousand tenge. Thus, the cost of one square meter of the hospital will be:

$$\frac{1609380171}{3000.4 + 2903.3 + 2840.7} = 184047\ tenge \qquad (F.1)$$

ЕСЦ РК 2025 пр. 48-нк, г. Алматы введен с 01.04.2025
ЭСН РК 2025 И43 введен с 01.04.2025
ССЦ 2025 пр. 48-нк, г. Алматы введен с 01.04.2025
ССЦ Февраль 2025, г. Алматы введен с 01.02.2025

Приложение Г
НДЦС РК 8.01-08-2022
Форма 4

Наименование стройки Oncological hospital with high-tech departments in Almaty

Наименование объекта Oncological hospital (object estimate)

Локальная смета № 2-2
(Локальный сметный расчет)

на Oncological hospital (local estimate)

(наименование работ и затрат)

Основание: Diploma project, technological map, labor costs, calendar plan

Сметная стоимость 743 939,680 тыс. тенге
Средства на оплату труда 580 435,464 тыс. тенге
Нормативная трудоемкость 116,72916 тыс. чел.-ч

Составлен(а) в текущих ценах по состоянию на 2025г.

Номер по порядку	Шифр позиции норматива, код ресурса	Наименование работ и затрат	Единица измерения	Количество	Стоимость единицы измерения, тенге	Общая стоимость, тенге
1	2	3	4	5	6	7
		ВСЕГО ПО СМЕТЕ				**743 939 680**
		из них				
		затраты на труд рабочих	тенге			542 852 339
		в том числе оплата труда рабочих	*тенге*			*269 675 276*
		машины и механизмы	тенге			140 311 975
		в том числе оплата труда машинистов	*тенге*			*37 583 125*
		материалы, изделия и конструкции	тенге			60 775 366
		оборудование	тенге			-
		перевозки	тенге			-
		Нормативная трудоемкость	чел.-ч.	116 729,16		
	Раздел № 1	**Земляные работы**				**95 143 679**
		из них				
		затраты на труд рабочих	тенге			64 884 912

1	2	3	4	5	6	7
		в том числе оплата труда рабочих	*тенге*			*31 400 242*
		машины и механизмы	тенге			21 884 448
		в том числе оплата труда машинистов	*тенге*			*6 713 158*
		материалы, изделия и конструкции	тенге			8 374 319
		оборудование	тенге			-
		перевозки	тенге			-
		Нормативная трудоемкость	чел.-ч.	17 561,31		
1	1114-0301-0101 Ккл=1,08	Устройство забора глухого с установкой столбов Объём = 369,2 * 3,0 из них:	м2 забора	1 107,6	17 973	19 906 895
		затраты на труд рабочих	тенге		9 622	10 657 327
		в том числе оплата труда рабочих	*тенге*		*4 790*	*5 305 404*
		машины и механизмы	тенге		791	876 112
		в том числе оплата труда машинистов	*тенге*		*243*	*269 147*
		материалы, изделия и конструкции	тенге		7 560	8 373 456
		Нормативная трудоемкость	чел.-ч.	2 104		
2	1101-0203-0401 Ккл=1,08	Планировка площади бульдозером, мощность до 132 кВт (до 180 л с) из них:	м2 спланированной поверхности за проход бульдозера	9 973,74	4	39 895
		затраты на труд рабочих	тенге		-	-
		в том числе оплата труда рабочих	*тенге*		-	-
		машины и механизмы	тенге		4	39 895
		в том числе оплата труда машинистов	*тенге*		*1*	*9 974*
		материалы, изделия и конструкции	тенге		-	-
		Нормативная трудоемкость	чел.-ч.	-		
3	1101-0201-0309 Ккл=1,08	Разработка грунта в котловане в отвал экскаватором "Обратная лопата", вместимость ковша 1,25 м3, группа грунта 3 из них:	м3 грунта	8 377,38	382	3 200 159

1	2	3	4	5	6	7
		затраты на труд рабочих	тенге		-	-
		в том числе оплата труда рабочих	*тенге*		-	-
		машины и механизмы	тенге		382	3 200 159
		в том числе оплата труда машинистов	*тенге*		*73*	*611 549*
		материалы, изделия и конструкции	тенге		-	-
		Нормативная трудоемкость	чел.-ч.	168		
4	1101-0301-0803 Ккл=1,08	Срезка выемки недобора грунта, группа грунта 3	м3 грунта недобора	143,79	4 733	680 558
		из них:				
		затраты на труд рабочих	тенге		3 376	485 435
		в том числе оплата труда рабочих	*тенге*		*1 626*	*233 803*
		машины и механизмы	тенге		1 351	194 260
		в том числе оплата труда машинистов	*тенге*		*310*	*44 575*
		материалы, изделия и конструкции	тенге		6	863
		Нормативная трудоемкость	чел.-ч.	114		
5	1101-0102-0903 Ккл=1,08	Засыпка траншей, пазух, котлованов и ям, группа грунта 3	м3 грунта	4 020,06	6 133	24 655 028
		из них:				
		затраты на труд рабочих	тенге		6 133	24 655 028
		в том числе оплата труда рабочих	*тенге*		*2 953*	*11 871 237*
		машины и механизмы	тенге		-	-
		в том числе оплата труда машинистов	*тенге*		-	-
		материалы, изделия и конструкции	тенге		-	-
		Нормативная трудоемкость	чел.-ч.	5 266		
6	1101-0701-0602 Ккл=1,08	Уплотнение грунта пневматической трамбовкой, группа грунта 3-4 Объём = 13 400,19 * 0,3 * (4,35 / 0,3)	м3 уплотненного грунта	58 290,8265	800	46 632 661
		из них:				
		затраты на труд рабочих	тенге		499	29 087 122
		в том числе оплата труда рабочих	*тенге*		*240*	*13 989 798*
		машины и механизмы	тенге		301	17 545 539

1	2	3	4	5	6	7
		в том числе оплата труда машинистов	*тенге*		*99*	*5 770 792*
		материалы, изделия и конструкции	тенге		-	-
		Нормативная трудоемкость	чел.-ч.	9 909		
7	1101-0203-0401 Ккл=1,08	Планировка площади бульдозером, мощность до 132 кВт (до 180 л с)	м2 спланированной поверхности за проход бульдозера	7 120,73	4	28 483
		из них:				
		затраты на труд рабочих	тенге		-	-
		в том числе оплата труда рабочих	*тенге*		-	-
		машины и механизмы	тенге		4	28 483
		в том числе оплата труда машинистов	*тенге*		*1*	*7 121*
		материалы, изделия и конструкции	тенге		-	-
		Нормативная трудоемкость	чел.-ч.	-		
	Раздел № 2	**Фундаменты**				**22 272 718**
		из них				
		затраты на труд рабочих	тенге			7 673 981
		в том числе оплата труда рабочих	*тенге*			*3 819 172*
		машины и механизмы	тенге			2 921 796
		в том числе оплата труда машинистов	*тенге*			*733 861*
		материалы, изделия и конструкции	тенге			11 676 941
		оборудование	тенге			-
		перевозки	тенге			-
		Нормативная трудоемкость	чел.-ч.	1 684,21		
8	6103-0701-0101	Устройство бетонной подготовки	м3	23,11	10 567	244 203
		из них:				
		затраты на труд рабочих	тенге		6 040	139 584
		в том числе оплата труда рабочих	*тенге*		*3 006*	*69 469*
		машины и механизмы	тенге		2 775	64 130

1	2	3	4	5	6	7
		в том числе оплата труда машинистов	*тенге*		*576*	*13 311*
		материалы, изделия и конструкции	тенге		1 752	40 489
		Нормативная трудоемкость	чел.-ч.	38		
9	212-101-0101	Бетон тяжелый класса В3,5 ГОСТ 7473-2010 без добавок Объём = 23,11 * 1,02	м3	23,5722	19 589	461 756
10	1106-0101-0206 Ккл=1,08	Монтаж опалубки фундамента железобетонного стаканного типа под колонны производственных зданий, объем более 40 м3	м2	783,77	6 423	5 034 155
		из них:				
		затраты на труд рабочих	тенге		3 056	2 395 201
		в том числе оплата труда рабочих	*тенге*		*1 521*	*1 192 114*
		машины и механизмы	тенге		2 453	1 922 588
		в том числе оплата труда машинистов	*тенге*		*632*	*495 343*
		материалы, изделия и конструкции	тенге		914	716 366
		Нормативная трудоемкость	чел.-ч.	596		
11	1106-0101-0101 Ккл=1,08	Устройство фундаментов бетонных под колонны, объем до 3 м3	м3	96,06	53 501	5 139 306
		из них:				
		затраты на труд рабочих	тенге		23 576	2 264 711
		в том числе оплата труда рабочих	*тенге*		*11 736*	*1 127 360*
		машины и механизмы	тенге		4 411	423 721
		в том числе оплата труда машинистов	*тенге*		*929*	*89 240*
		материалы, изделия и конструкции	тенге		25 514	2 450 874
		Нормативная трудоемкость	чел.-ч.	487		
12	212-101-0601	Бетон тяжелый класса В15 ГОСТ 7473-2010 без добавок Объём = 96,06 * 1,015	м3	97,5009	22 138	2 158 475
13	261-1020122 К173=0,963	Арматура ГОСТ 10922-2012 Объём = 96,06 * 0,1	т	9,606	-	-
14	1106-0101-0209 Ккл=1,08	Демонтаж опалубки фундамента железобетонного стаканного типа под колонны производственных зданий, объем более 40 м3	м2	783,77	1 841	1 442 921
		из них:				
		затраты на труд рабочих	тенге		1 235	967 956
		в том числе оплата труда рабочих	*тенге*		*615*	*482 019*

1	2	3	4	5	6	7
		машины и механизмы	тенге		606	474 965
		в том числе оплата труда машинистов	*тенге*		*158*	*123 836*
		материалы, изделия и конструкции	тенге		-	-
		Нормативная трудоемкость	чел.-ч.	219		
15	1113-0101-0208 Ккл=1,04	Устройство гидроизоляции битумной поверхности вертикальной в 2 слоя по выровненной поверхности бутовой кладки, кирпичу, бетону	м2 поверхности	2 021,77	3 854	7 791 902
		из них:				
		затраты на труд рабочих	тенге		943	1 906 529
		в том числе оплата труда рабочих	*тенге*		*469*	*948 210*
		машины и механизмы	тенге		18	36 392
		в том числе оплата труда машинистов	*тенге*		*6*	*12 131*
		материалы, изделия и конструкции	тенге		2 893	5 848 981
		Нормативная трудоемкость	чел.-ч.	344		
	Раздел № 3	**Бетонные и железобетонные конструкции**				**481 412 253**
		из них				
		затраты на труд рабочих	тенге			350 975 347
		в том числе оплата труда рабочих	*тенге*			*174 705 277*
		машины и механизмы	тенге			104 271 654
		в том числе оплата труда машинистов	*тенге*			*26 773 200*
		материалы, изделия и конструкции	тенге			26 165 252
		оборудование	тенге			-
		перевозки	тенге			-
		Нормативная трудоемкость	чел.-ч.	75 329,85		
16	6103-0201-0110	Армирование колонны железобетонной квадратного или прямоугольного сечения с установкой и вязкой арматуры отдельными стержнями, периметр до 2 м Объём = 10,72 + 16,3 + 15,96	т	42,98	89 249	3 835 922
		из них:				
		затраты на труд рабочих	тенге		76 117	3 271 509
		в том числе оплата труда рабочих	*тенге*		*37 891*	*1 628 555*
		машины и механизмы	тенге		4 992	214 556
		в том числе оплата труда машинистов	*тенге*		*992*	*42 636*

1	2	3	4	5	6	7
		материалы, изделия и конструкции	тенге		8 140	349 857
		Нормативная трудоемкость	чел.-ч.	616		
17	261-1020122 К173=0,963	Арматура ГОСТ 10922-2012 Объём = 42,98 * 1,1	т	47,278	-	-
18	6103-0301-0202	Армирование стены железобетонной с установкой и вязкой арматуры отдельными стержнями Объём = 103,23 + 10,4 + 11,8 из них:	т	125,43	139 896	17 547 155
		затраты на труд рабочих	тенге		131 301	16 469 084
		в том числе оплата труда рабочих	*тенге*		*65 364*	*8 198 607*
		машины и механизмы	тенге		3 062	384 067
		в том числе оплата труда машинистов	*тенге*		*621*	*77 892*
		материалы, изделия и конструкции	тенге		5 533	694 004
		Нормативная трудоемкость	чел.-ч.	3 286		
19	261-1020122 К173=0,963	Арматура ГОСТ 10922-2012 Объём = 125,43 * 1,1	т	137,973	-	-
20	6103-0501-0112	Армирование перекрытия железобетонного ребристого на высоте от опорной поверхности до 6 м Объём = 57,1 + 16,65 + 55,31 + 16,6 + 55,2 + 19,2 + 57,1 + 19,1 из них:	т	296,26	122 946	36 423 982
		затраты на труд рабочих	тенге		104 319	30 905 547
		в том числе оплата труда рабочих	*тенге*		*51 931*	*15 385 078*
		машины и механизмы	тенге		9 388	2 781 289
		в том числе оплата труда машинистов	*тенге*		*1 939*	*574 448*
		материалы, изделия и конструкции	тенге		9 239	2 737 146
		Нормативная трудоемкость	чел.-ч.	6 091		
21	261-1020122 К173=0,963	Арматура ГОСТ 10922-2012 Объём = 296,26 * 1,1	т	325,886	-	-
22	261-1020123 К173=0,963	Каркасы арматурные ГОСТ 10922-2012 Объём = 296,26 * 1,1	т	325,886	-	-
23	1106-0103-0103 Ккл=1,08	Монтаж опалубки колонн железобетонных квадратного или прямоугольного сечения, периметр до 3 м Объём = 964,44 + 1 504,8 + 1 512,0 из них:	м2	3 981,24	3 822	15 216 299
		затраты на труд рабочих	тенге		1 075	4 279 833

1	2	3	4	5	6	7
		в том числе оплата труда рабочих	*тенге*		*535*	*2 129 963*
		машины и механизмы	тенге		1 909	7 600 187
		в том числе оплата труда машинистов	*тенге*		*395*	*1 572 590*
		материалы, изделия и конструкции	тенге		838	3 336 279
		Нормативная трудоемкость	чел.-ч.	1 354		
24	1106-0104-0201 Ккл=1,08	Монтаж опалубки стен и перегородок железобетонных Объём = 1 412,8 + 727,0 + 860,0 из них:	м2	2 999,8	4 377	13 130 125
		затраты на труд рабочих	тенге		1 776	5 327 645
		в том числе оплата труда рабочих	*тенге*		*884*	*2 651 823*
		машины и механизмы	тенге		1 500	4 499 700
		в том числе оплата труда машинистов	*тенге*		*310*	*929 938*
		материалы, изделия и конструкции	тенге		1 101	3 302 780
		Нормативная трудоемкость	чел.-ч.	1 410		
25	1106-0106-0107 Ккл=1,08	Монтаж опалубки перекрытий железобетонных ребристых на высоте от опорной поверхности до 6 м на основе телескопических стоек Объём = 138,25 + 1 040,0 + 153,81 + 1 650,0 + 154,2 + 1 650,0 + 138,22 + 1 648,0 из них:	м2 перекрытия	6 572,48	21 894	143 897 877
		затраты на труд рабочих	тенге		18 969	124 673 373
		в том числе оплата труда рабочих	*тенге*		*9 442*	*62 057 356*
		машины и механизмы	тенге		577	3 792 321
		в том числе оплата труда машинистов	*тенге*		*117*	*768 980*
		материалы, изделия и конструкции	тенге		2 348	15 432 183
		Нормативная трудоемкость	чел.-ч.	23 595		
26	6103-0201-0114	Бетонирование колонны железобетонной по схеме «Кран-бадья» квадратного или прямоугольного сечения, периметр до 3 м Объём = 107,16 + 163,02 + 159,6 из них:	м3	429,78	18 801	8 080 294
		затраты на труд рабочих	тенге		9 160	3 936 785
		в том числе оплата труда рабочих	*тенге*		*4 560*	*1 959 797*
		машины и механизмы	тенге		9 449	4 060 991

1	2	3	4	5	6	7
		в том числе оплата труда машинистов	*тенге*		*1 946*	*836 352*
		материалы, изделия и конструкции	тенге		192	82 518
		Нормативная трудоемкость	чел.-ч.	1 010		
27	261-1010210 K173=0,963	Бетон Объём = 429,78 * 1,015	м3	436,2267	-	-
28	6103-0301-0204	Бетонирование стены железобетонной бетононасосом Объём = 1 032,28 + 104,0 + 118,0 из них:	м3	1 254,28	22 866	28 680 366
		затраты на труд рабочих	тенге		11 686	14 657 516
		в том числе оплата труда рабочих	*тенге*		*5 817*	*7 296 147*
		машины и механизмы	тенге		11 171	14 011 562
		в том числе оплата труда машинистов	*тенге*		*3 120*	*3 913 354*
		материалы, изделия и конструкции	тенге		9	11 288
		Нормативная трудоемкость	чел.-ч.	4 076		
29	261-1010210 K173=0,963	Бетон Объём = 1 254,28 * 1,015	м3	1 273,0942	-	-
30	6103-0501-0120	Бетонирование перекрытия железобетонного ребристого на высоте от опорной поверхности до 6 м бетононасосом Объём = 571,0 + 166,45 + 166,0 + 1 504,8 + 552,0 + 192,0 + 571,0 + 191,0 из них:	м3	3 914,25	33 029	129 283 763
		затраты на труд рабочих	тенге		18 142	71 012 324
		в том числе оплата труда рабочих	*тенге*		*9 031*	*35 349 592*
		машины и механизмы	тенге		14 831	58 052 242
		в том числе оплата труда машинистов	*тенге*		*4 145*	*16 224 566*
		материалы, изделия и конструкции	тенге		56	219 197
		Нормативная трудоемкость	чел.-ч.	18 593		
31	261-1010210 K173=0,963	Бетон Объём = 3 914,25 * 1,015	м3	3 972,96375	-	-
32	1106-0103-0121 Kкл=1,08	Демонтаж опалубки колонн железобетонных квадратного или прямоугольного сечения, периметр до 3 м Объём = 964,44 + 1 504,8 + 1 512,0 из них:	м2	3 981,24	1 780	7 086 607
		затраты на труд рабочих	тенге		458	1 823 408

1	2	3	4	5	6	7
		в том числе оплата труда рабочих	*тенге*		*228*	*907 723*
		машины и механизмы	тенге		1 322	5 263 199
		в том числе оплата труда машинистов	*тенге*		*273*	*1 086 879*
		материалы, изделия и конструкции	тенге		-	-
		Нормативная трудоемкость	чел.-ч.	717		
33	1106-0104-0205 Ккл=1,08	Демонтаж опалубки стен и перегородок железобетонных Объём = 1 412,8 + 727,0 + 860,0 из них:	м2	2 999,8	1 798	5 393 640
		затраты на труд рабочих	тенге		903	2 708 819
		в том числе оплата труда рабочих	*тенге*		*449*	*1 346 910*
		машины и механизмы	тенге		895	2 684 821
		в том числе оплата труда машинистов	*тенге*		*185*	*554 963*
		материалы, изделия и конструкции	тенге		-	-
		Нормативная трудоемкость	чел.-ч.	780		
34	1106-0106-0126 Ккл=1,08	Демонтаж опалубки перекрытий железобетонных балочных с капителями на высоте от опорной поверхности до 6 м на основе телескопических стоек Объём = 138,25 + 1 040,0 + 153,81 + 1 650,0 + 154,2 + 1 650,0 + 138,22 + 1 648,0 из них:	м2 перекрытия	6 572,48	11 082	72 836 223
		затраты на труд рабочих	тенге		10 941	71 909 504
		в том числе оплата труда рабочих	*тенге*		*5 446*	*35 793 726*
		машины и механизмы	тенге		141	926 719
		в том числе оплата труда машинистов	*тенге*		*29*	*190 602*
		материалы, изделия и конструкции	тенге		-	-
		Нормативная трудоемкость	чел.-ч.	13 802		
	Раздел № 4	**Перегородки**				**130 931 996**
		из них				
		затраты на труд рабочих	тенге			107 991 775
		в том числе оплата труда рабочих	*тенге*			*54 113 137*
		машины и механизмы	тенге			9 676 005
		в том числе оплата труда машинистов	*тенге*			*2 936 585*
		материалы, изделия и конструкции	тенге			13 264 216

1	2	3	4	5	6	7
		оборудование	тенге			-
		перевозки	тенге			-
		Нормативная трудоемкость	чел.-ч.	19 714,26		
35	6107-0201-0404	Устройство гипсокартонной перегородки на одинарном каркасе из оцинкованных профилей с обшивкой гипсокартонными листами в 2 слоя с двух сторон толщина 100-150 мм, глухой	м2	666,32	12 377	8 247 043
		из них:				
		затраты на труд рабочих	тенге		8 185	5 453 829
		в том числе оплата труда рабочих	*тенге*		*4 074*	*2 714 588*
		машины и механизмы	тенге		157	104 612
		в том числе оплата труда машинистов	*тенге*		*51*	*33 982*
		материалы, изделия и конструкции	тенге		4 035	2 688 602
		Нормативная трудоемкость	чел.-ч.	1 013		
36	222-529-0103	Профиль направляющий ПН для гипсокартона, оцинкованный СТ РК 2621-2015 размерами 75 мм x 40 мм, толщиной стали от 0,4 до 0,45 мм Объём = 666,32 * 0,6929	м	461,693128	252	116 347
37	222-529-0302	Профиль стоечный ПС для гипсокартона, оцинкованный СТ РК 2621-2015 размерами 75 мм x 50 мм, толщиной стали от 0,4 до 0,45 мм Объём = 666,32 * 2,0504	м	1 366,222528	297	405 768
38	261-1050132 K173=0,963	Плиты теплоизоляционные ГОСТ 16381-77 Объём = 666,32 * 1,03	м2	686,3096	-	-
39	6112-0202-0105	Штукатурка поверхности внутри зданий цементными растворами по камню и бетону высококачественная, стена Объём = 666,32 / 0,09	м2	7 403,55555555 6	7 744	57 333 134
		из них:				
		затраты на труд рабочих	тенге		7 403	54 808 522
		в том числе оплата труда рабочих	*тенге*		*3 720*	*27 541 227*
		машины и механизмы	тенге		338	2 502 402
		в том числе оплата труда машинистов	*тенге*		*145*	*1 073 516*
		материалы, изделия и конструкции	тенге		3	22 210
		Нормативная трудоемкость	чел.-ч.	9 477		
40	212-402-0107	Раствор отделочный ГОСТ 28013-98 тяжелый цементно-известковый 1:1:6 Объём = 7 403,5555556 * 0,025	м3	185,088888889	21 134	3 911 669

1	2	3	4	5	6	7
41	214-402-0103	Сетка проволочная тканая с квадратными ячейками, без покрытия ГОСТ 3826-82 размерами 5 мм х 5 мм х 1,6 мм Объём = 7 403,5555556 * 0,0554	м2	410,156977778	1 073	440 098
42	6105-0201-0102	Кладка стены наружной однослойной из кирпича, средней сложности	м3	836,6	39 700	33 213 020
		из них:				
		затраты на труд рабочих	тенге		32 375	27 084 925
		в том числе оплата труда рабочих	*тенге*		*16 117*	*13 483 482*
		машины и механизмы	тенге		7 323	6 126 422
		в том числе оплата труда машинистов	*тенге*		*1 703*	*1 424 730*
		материалы, изделия и конструкции	тенге		2	1 673
		Нормативная трудоемкость	чел.-ч.	5 655		
43	212-401-0102	Раствор кладочный цементный ГОСТ 28013-98 марки М50 Объём = 836,6 * 0,25	м3	209,15	19 270	4 030 320
44	261-1010304 К173=0,963	Кирпич керамический или силикатный рядовой Объём = 836,6 * 0,384	1000 шт.	321,2544	-	-
45	6112-0202-0105	Штукатурка поверхности внутри зданий цементными растворами по камню и бетону высококачественная, стена Объём = 836,6 / 0,3	м2	2 788,66666666 7	7 744	21 595 435
		из них:				
		затраты на труд рабочих	тенге		7 403	20 644 499
		в том числе оплата труда рабочих	*тенге*		*3 720*	*10 373 840*
		машины и механизмы	тенге		338	942 569
		в том числе оплата труда машинистов	*тенге*		*145*	*404 357*
		материалы, изделия и конструкции	тенге		3	8 367
		Нормативная трудоемкость	чел.-ч.	3 569		
46	212-402-0107	Раствор отделочный ГОСТ 28013-98 тяжелый цементно-известковый 1:1:6 Объём = 2 788,6666667 * 0,025	м3	69,716666667	21 134	1 473 392
47	214-402-0103	Сетка проволочная тканая с квадратными ячейками, без покрытия ГОСТ 3826-82 размерами 5 мм х 5 мм х 1,6 мм Объём = 2 788,6666667 * 0,0554	м2	154,492133333	1 073	165 770
	Раздел № 5	**Двери**				**6 699 424**
		из них				

1	2	3	4	5	6	7
		затраты на труд рабочих	тенге			6 537 746
		в том числе оплата труда рабочих	*тенге*			*3 254 006*
		машины и механизмы	тенге			161 678
		в том числе оплата труда машинистов	*тенге*			*44 601*
		материалы, изделия и конструкции	тенге			-
		оборудование	тенге			-
		перевозки	тенге			-
		Нормативная трудоемкость	чел.-ч.	1 393,77		
48	6107-0302-0103	Устройство дверных блоков внутренних однопольных из алюминиевых профилей в перегородки, площадь более 2 м2	м2	1 858,37	3 605	6 699 424
		из них:				
		затраты на труд рабочих	тенге		3 518	6 537 746
		в том числе оплата труда рабочих	*тенге*		*1 751*	*3 254 006*
		машины и механизмы	тенге		87	161 678
		в том числе оплата труда машинистов	*тенге*		*24*	*44 601*
		материалы, изделия и конструкции	тенге		-	-
		Нормативная трудоемкость	чел.-ч.	1 394		
49	223-3010200 К173=0,963	Дверь из алюминиевых профилей для конструкций витражей Объём = 1 858,37 * 1,0	м2	1 858,37	-	-
	Раздел № 6	**Металлоконструкции**				**3 602 506**
		из них				
		затраты на труд рабочих	тенге			1 427 892
		в том числе оплата труда рабочих	*тенге*			*710 738*
		машины и механизмы	тенге			1 393 338
		в том числе оплата труда машинистов	*тенге*			*381 720*
		материалы, изделия и конструкции	тенге			781 276
		оборудование	тенге			-
		перевозки	тенге			-
		Нормативная трудоемкость	чел.-ч.	367,39		
50	6106-0302-0108	Монтаж стропильной фермы, подстропильной фермы: пролет до 48 м, масса до 8 т, высота до 25 м	т	17,2	209 448	3 602 506
		из них:				

1	2	3	4	5	6	7
		затраты на труд рабочих	тенге		83 017	1 427 892
		в том числе оплата труда рабочих	*тенге*		*41 322*	*710 738*
		машины и механизмы	тенге		81 008	1 393 338
		в том числе оплата труда машинистов	*тенге*		*22 193*	*381 720*
		материалы, изделия и конструкции	тенге		45 423	781 276
		Нормативная трудоемкость	чел.-ч.	367		
51	261-1020322 K173=0,963	Конструкции стальные Объём = 17,2 * 1,2	т	20,64	-	-
	Раздел № 7	**Витражи**				**3 877 104**
		из них				
		затраты на труд рабочих	тенге			3 360 686
		в том числе оплата труда рабочих	*тенге*			*1 672 704*
		машины и механизмы	тенге			3 056
		в том числе оплата труда машинистов	*тенге*			-
		материалы, изделия и конструкции	тенге			513 362
		оборудование	тенге			-
		перевозки	тенге			-
		Нормативная трудоемкость	чел.-ч.	678,37		
52	6108-0301-0101	Установка блока витражного из ПВХ Объём = 13 581,0 * 45,0 / 1 000,0 из них:	м2	611,145	6 344	3 877 104
		затраты на труд рабочих	тенге		5 499	3 360 686
		в том числе оплата труда рабочих	*тенге*		*2 737*	*1 672 704*
		машины и механизмы	тенге		5	3 056
		в том числе оплата труда машинистов	*тенге*		-	-
		материалы, изделия и конструкции	тенге		840	513 362
		Нормативная трудоемкость	чел.-ч.	678		

1	2	3	4	5	6	7
53	261-1040109 К173=0,963	Витражи из ПВХ Объём = 611,145 * 1,0	м2	611,145	-	-

Составил student Yessengeldinova A.K.

должность, подпись (инициалы, фамилия)

Проверил Senior Lecturer Niyetbay S.Y.

должность, подпись (инициалы, фамилия)

ССЦ 2025 пр. 48-нк, г. Алматы введен с 01.04.2025

ССЦ Февраль 2025, г. Алматы введен с 01.02.2025

Форма 4рс

Наименование стройки Oncological hospital with high-tech departments in Almaty. Bauyrzhan Momyshuly Street, close to Almaty Arena

Наименование объекта Oncological hospital (object estimate)

Объект номер - 1

РЕСУРСНАЯ СМЕТА

Приложение к локальной смете № 2-2. Oncological hospital (local estimate)

на Oncological hospital (local estimate)

Основание: Diploma project, technological map, labor costs, calendar plan

Составлен в текущих ценах по состоянию на 2025г.

тыс. тенге

Номер п/п	Шифр ресурса	Наименование ресурсов, оборудования, конструкций, изделий и деталей	Единица измерения	Количество единиц	Сметная цена на единицу / обоснование	Отпускная цена на единицу / обоснование	Транспортные расходы на единицу / всего	Стоимость (Всего)
1	2	3	4	5	6	7	8	9
Затраты труда по специальностям								
1	001-0110	Затраты труда рабочих (средний разряд работы 1)	чел.-ч	8 121,0779	3,581	-	-	29 081,580
					-	-	-	
2	002-0120	Затраты труда рабочих (средний разряд работы 2)	чел.-ч	33,6944	4,143	-	-	139,596
					-	-	-	
3	001-0125	Затраты труда рабочих (средний разряд работы 2,5)	чел.-ч	5 356,8397	4,693	-	-	25 139,649
					-	-	-	
4	002-0126	Затраты труда рабочих (средний разряд работы 2,6)	чел.-ч	586,0769	4,620	-	-	2 707,675
					-	-	-	
5	002-0128	Затраты труда рабочих (средний разряд работы 2,8)	чел.-ч	1 367,3961	4,781	-	-	6 537,521
					-	-	-	
6	002-0130	Затраты труда рабочих (средний разряд работы 3)	чел.-ч	2 213,0084	4,950	-	-	10 954,392
					-	-	-	
7	002-0131	Затраты труда рабочих (средний разряд работы 3,1)	чел.-ч	3 624,9761	5,046	-	-	18 291,629
					-	-	-	

1	2	3	4	5	6	7	8	9
8	002-0133	Затраты труда рабочих (средний разряд работы 3,3)	чел.-ч	28 277,1785	5,241	-	-	148 200,692
					-	-	-	
9	002-0134	Затраты труда рабочих (средний разряд работы 3,4)	чел.-ч	26 369,6247	5,338	-	-	140 761,057
					-	-	-	
10	002-0135	Затраты труда рабочих (средний разряд работы 3,5)	чел.-ч	15 398,3039	5,434	-	-	83 674,383
					-	-	-	
11	002-0137	Затраты труда рабочих (средний разряд работы 3,7)	чел.-ч	338,5252	5,629	-	-	1 905,558
					-	-	-	
12	003-0142	Затраты труда рабочих (средний разряд работы 4,2)	чел.-ч	12 401,896	6,084	-	-	75 453,135
					-	-	-	
		Итого по специальностям:	тенге	104 088,5977				542 846,867
Трудовые ресурсы								
1	099-0100	Затраты труда машинистов	чел.-ч	4 139,4259	9,085	-	-	(37 606,550)
					-	-	-	
		Всего трудовые ресурсы:	тенге					542 846,867
Строительные машины и механизмы подрядчика								
					Эксплуатация машин		**Зарплата машинистов**	
1	331-101-0101	Автомобили бортовые грузоподъёмностью до 5 т	маш.-ч	154,012428	8,732	-	2,943	1 344,837
					-	-	453,259	
2	331-101-0101	Автомобили бортовые грузоподъёмностью до 5 т	маш.-ч	16,509091	8,732	-	2,943	144,157
					-	-	48,586	
3	314-503-0601	Автопогрузчики, грузоподъёмность 5 т	маш.-ч	0,280111	11,999	-	2,943	3,361
					-	-	0,824	
4	315-202-0501	Аппарат для газовой сварки и резки	маш.-ч	27,12096	0,096	-	-	2,604
					-	-	-	
5	313-202-0101	Бадьи 2 м3	маш.-ч	175,963966	0,038	-	-	6,687
					-	-	-	
6	313-201-0501	Бетононасосы стационарные производительностью 20 м3/ч	маш.-ч	6 842,636647	10,496	-	2,943	71 820,314
					-	-	20 137,880	

1	2	3	4	5	6	7	8	9
7	311-101-0102	Бульдозеры-рыхлители на гусеничном ходу, легкого класса мощностью свыше 66 до 96 кВт, массой свыше 8,5 до 14 т	маш.-ч	1,956694	16,304	-	4,205	31,902
					-	-	8,228	
8	311-101-0201	Бульдозеры-рыхлители на гусеничном ходу, среднего класса мощностью свыше 96 до 140 кВт, массой свыше 14,0 до 18,5 т	маш.-ч	3,138545	21,323	-	4,205	66,923
					-	-	13,198	
9	313-302-0201	Вибратор глубинный	маш.-ч	4 271,668575	0,059	-	-	252,028
					-	-	-	
10	313-302-0201	Вибратор глубинный	маш.-ч	27,284882	0,059	-	-	1,610
					-	-	-	
11	313-302-0202	Вибратор поверхностный	маш.-ч	11,980224	0,028	-	-	0,335
					-	-	-	
12	315-103-0101	Выпрямители сварочные однопостовые с номинальным сварочным током 315-500 А	маш.-ч	67,43088	0,490	-	-	33,041
					-	-	-	
13	343-302-0201	Дрели электрические	маш.-ч	100,720714	0,018	-	-	1,813
					-	-	-	
14	343-302-0201	Дрели электрические	маш.-ч	78,475248	0,018	-	-	1,413
					-	-	-	
15	315-102-0102	Компрессоры передвижные с двигателем внутреннего сгорания давлением до 686 кПа (7 атм), производительность 5 м3/мин	маш.-ч	1 967,315394	8,848	-	2,943	17 406,807
					-	-	5 789,809	
16	321-201-0101	Котлы битумные передвижные, 400 л	маш.-ч	11,722838	1,096	-	-	12,848
					-	-	-	
17	314-101-0104	Краны башенные максимальной грузоподъёмностью 10 т, высота подъема до 75 м, максимальный вылет стрелы до 65 м	маш.-ч	1 735,794161	14,230	-	2,943	24 700,351
					-	-	5 108,442	
18	314-101-0104	Краны башенные максимальной грузоподъёмностью 10 т, высота подъема до 75 м, максимальный вылет стрелы до 65 м	маш.-ч	850,918837	14,230	-	2,943	12 108,575
					-	-	2 504,254	
19	314-101-0103	Краны башенные максимальной грузоподъёмностью 8 т, высота подъема до 41,5 м, максимальный вылет стрелы до 55 м	маш.-ч	28,892927	14,136	-	2,943	408,430
					-	-	85,032	
20	314-101-0103	Краны башенные максимальной грузоподъёмностью 8 т, высота подъема до 41,5 м, максимальный вылет стрелы до 55 м	маш.-ч	4,492584	14,136	-	2,943	63,507
					-	-	13,222	
21	314-301-0303	Краны козловые при работе на монтаже технологического оборудования грузоподъёмностью 32 т	маш.-ч	0,37152	13,397	-	3,518	4,977
					-	-	1,307	
22	314-102-0101	Краны на автомобильном ходу максимальной грузоподъёмностью 10 т	маш.-ч	56,246769	13,507	-	4,205	759,725
					-	-	236,518	

1	2	3	4	5	6	7	8	9
23	314-102-0101	Краны на автомобильном ходу максимальной грузоподъёмностью 10 т	маш.-ч	20,1928	13,507	-	4,205	272,744
					-	-	84,911	
24	314-104-0102	Краны на гусеничном ходу максимальной грузоподъёмностью 25 т	маш.-ч	175,896798	13,513	-	3,518	2 376,893
					-	-	618,805	
25	314-104-0104	Краны на гусеничном ходу максимальной грузоподъёмностью 50-63 т	маш.-ч	44,76816	27,821	-	7,723	1 245,495
					-	-	345,744	
26	314-502-0301	Лебедки электрические тяговым усилием до 5,79 кН (0,59 т)	маш.-ч	37,424075	0,037	-	-	1,385
					-	-	-	
27	343-202-0201	Машины шлифовальные угловые	маш.-ч	106,536988	0,038	-	-	4,048
					-	-	-	
28	343-202-0201	Машины шлифовальные угловые	маш.-ч	85,7723	0,038	-	-	3,259
					-	-	-	
29	343-202-0101	Машины шлифовальные электрические	маш.-ч	2,60064	0,053	-	-	0,138
					-	-	-	
30	343-101-0101	Ножницы электрические	маш.-ч	0,791588	0,095	-	-	0,075
					-	-	-	
31	343-302-0101	Перфоратор электрический	маш.-ч	134,470053	0,022	-	-	2,958
					-	-	-	
32	343-302-0101	Перфоратор электрический	маш.-ч	48,384363	0,022	-	-	1,064
					-	-	-	
33	343-102-0101	Пила дисковая электрическая	маш.-ч	578,50969	0,114	-	-	65,950
					-	-	-	
34	343-102-0201	Пилы электрические цепные	маш.-ч	10,167768	0,105	-	-	1,068
					-	-	-	
35	314-504-0501	Подъемники мачтовые высотой подъема 50 м	маш.-ч	104,93912	6,533	-	2,464	685,567
					-	-	258,570	
36	333-201-0101	Полуприцепы общего назначения грузоподъёмностью 12 т	маш.-ч	1,253297	0,965	-	-	1,209
					-	-	-	
37	333-201-0103	Полуприцепы общего назначения грузоподъёмностью 20 т	маш.-ч	5,960434	0,899	-	-	5,358
					-	-	-	
38	313-201-0801	Растворонасосы производительностью 1 м3/ч	маш.-ч	498,195822	5,544	-	2,464	2 761,998
					-	-	1 227,555	

1	2	3	4	5	6	7	8	9
39	343-201-0101	Рубанки электрические	маш.-ч	19,139328	0,177	-	-	3,388
					-	-	-	
40	341-204-0101	Станки для гибки арматуры	маш.-ч	41,262456	0,341	-	-	14,070
					-	-	-	
41	341-204-0201	Станки для гнутья ручные	маш.-ч	56,036292	0,107	-	-	5,996
					-	-	-	
42	341-105-0101	Станки для резки арматуры	маш.-ч	230,75323	0,268	-	-	61,842
					-	-	-	
43	341-105-0101	Станки для резки арматуры	маш.-ч	1,831883	0,268	-	-	0,491
					-	-	-	
44	343-402-0101	Трамбовки пневматические при работе от компрессора	маш.-ч	7 869,261577	0,018	-	-	141,647
					-	-	-	
45	333-101-0101	Тягачи седельные грузоподъёмностью 12 т	маш.-ч	1,253297	11,510	-	3,518	14,425
					-	-	4,409	
46	333-101-0103	Тягачи седельные грузоподъёмностью 22 т	маш.-ч	5,960434	14,202	-	3,518	84,650
					-	-	20,969	
47	315-103-0501	Установки постоянного тока для ручной дуговой сварки	маш.-ч	70,172496	0,284	-	-	19,929
					-	-	-	
48	343-302-0301	Шуруповерты строительно-монтажные	маш.-ч	188,112113	0,023	-	-	4,327
					-	-	-	
49	311-401-0105	Экскаваторы одноковшовые дизельные на гусеничном ходу ковш свыше 0,5 до 0,65 м3, масса свыше 10 до 13 т	маш.-ч	8,634302	18,798	-	4,205	162,308
					-	-	36,307	
50	311-401-0107	Экскаваторы одноковшовые дизельные на гусеничном ходу ковш свыше 1 до 1,25 м3, масса свыше 20 до 23 т	маш.-ч	144,761126	22,095	-	4,205	3 198,497
					-	-	608,721	
		Всего строительные машины и механизмы подрядчика:	тенге				37 606 550,0	140 317,024
		Материалы поставки подрядчика						
1	261-1020122	Арматура ГОСТ 10922-2012	т	520,743	-	-	-	-
					-	-	-	
2	218-101-0201	Балки опалубки двутавровые клееные фанерно-деревянные окрашенные	м	999,01696	3,717	3,661	-	3 713,346
					-	-	-	

1	2	3	4	5	6	7	8	9
3	212-101-0601	Бетон тяжелый класса B15 ГОСТ 7473-2010 без добавок	м3	97,5009	22,138	16,845	-	2 158,475
					-	-	-	
4	212-101-0101	Бетон тяжелый класса B3,5 ГОСТ 7473-2010 без добавок	м3	23,5722	19,589	14,337	-	461,756
					-	-	-	
5	212-101-0301	Бетон тяжелый класса B7,5 ГОСТ 7473-2010 без добавок	м3	97,9812	20,354	15,089	-	1 994,309
					-	-	-	
6	261-1010210	Бетон	м3	5 682,28465	-	-	-	-
					-	-	-	
7	217-101-0107	Болт с гайкой и шайбой ГОСТ ISO 8992-2015 строительный	т	0,080855	954,056	940,554	-	77,140
					-	-	-	
8	217-101-0107	Болт с гайкой и шайбой ГОСТ ISO 8992-2015 строительный	т	0,0172	954,056	-	-	16,410
					-	-	-	
9	215-202-0602	Брусок обрезной хвойных пород длиной от 2 м до 3,75 м, шириной от 75 мм до 150 мм, толщиной от 40 мм до 75 мм ГОСТ 8486-86 сорт 2	м3	0,525798	114,170	111,607	-	60,030
					-	-	-	
10	215-202-0702	Брусок обрезной хвойных пород длиной от 4 м до 6,5 м, шириной от 25 мм до 50 мм, толщиной от 16 мм до 50 мм ГОСТ 8486-86 сорт 2	м3	0,024446	114,170	-	-	2,791
					-	-	-	
11	215-202-0501	Брусок обрезной хвойных пород длиной от 4 м до 6,5 м, шириной от 75 мм до 150 мм, толщиной от 40 мм до 75 мм ГОСТ 8486-86 сорт 1	м3	0,017716	114,170	-	-	2,023
					-	-	-	
12	215-202-0502	Брусок обрезной хвойных пород длиной от 4 м до 6,5 м, шириной от 75 мм до 150 мм, толщиной от 40 мм до 75 мм ГОСТ 8486-86 сорт 2	м3	11,18676	114,170	111,607	-	1 277,192
					-	-	-	
13	215-202-0502	Брусок обрезной хвойных пород длиной от 4 м до 6,5 м, шириной от 75 мм до 150 мм, толщиной от 40 мм до 75 мм ГОСТ 8486-86 сорт 2	м3	0,024446	114,170	-	-	2,791
					-	-	-	
14	218-103-0203	Бумага шлифовальная двухслойная с зернистостью 40/25 ГОСТ 13344-79	м2	3,3316	4,057	-	-	13,516
					-	-	-	
15	261-1040109	Витражи из ПВХ	м2	611,145	-	-	-	-
					-	-	-	
16	217-603-0103	Вода питьевая ГОСТ 2874-82	м3	0,399792	0,339	-	-	0,136
					-	-	-	

1	2	3	4	5	6	7	8	9
17	217-603-0104	Вода техническая	м3	52,268866	0,036	-	-	1,882
					-	-	-	
18	217-603-0104	Вода техническая	м3	0,423625	0,036	0,036	-	0,015
					-	-	-	
19	217-108-0101	Гвоздь ГОСТ 283-75 строительный	кг	402,558856	0,861	0,849	-	346,603
					-	-	-	
20	217-108-0101	Гвоздь ГОСТ 283-75 строительный	кг	12,402667	0,861	-	-	10,679
					-	-	-	
21	235-202-0118	Герметик ГОСТ 25621-83 полиуретановый однокомпонентный 750 мл(монтажная пена)	шт.	114,076326	2,307	-	-	263,174
					-	-	-	
22	216-103-0101	Гипсовое вяжущее ГОСТ 125-2018 марки Г-3	т	0,611533	37,327	-	-	22,827
					-	-	-	
23	236-101-0116	Грунтовка водно-дисперсионная акриловая глубокого проникновения для внутренних и наружных работ СТ РК ГОСТ Р 52020-2007	кг	15,99168	0,219	-	-	3,502
					-	-	-	
24	236-101-0107	Грунтовка глифталевая ГФ-021 СТ РК ГОСТ Р 51693-2003	т	0,005332	736,075	-	-	3,925
					-	-	-	
25	223-3010200	Дверь из алюминиевых профилей для конструкций витражей	м2	1 858,37	-	-	-	-
					-	-	-	
26	215-204-0503	Доска обрезная хвойных пород длиной до 6,5 м, шириной от 75 мм до 150 мм, толщиной 44 мм и более ГОСТ 8486-86 сорт 3	м3	0,653208	114,170	111,607	-	74,577
					-	-	-	
27	215-204-0203	Доска обрезная хвойных пород длиной до 6,5 м, шириной от 75 мм до 150 мм, толщиной от 19 мм до 22 мм ГОСТ 8486-86 сорт 3	м3	28,68684	114,170	111,607	-	3 275,177
					-	-	-	
28	215-204-0403	Доска обрезная хвойных пород длиной до 6,5 м, шириной от 75 мм до 150 мм, толщиной от 32 мм до 40 мм ГОСТ 8486-86 сорт 3	м3	8,8608	114,170	111,607	-	1 011,638
					-	-	-	
29	215-204-0404	Доска обрезная хвойных пород длиной до 6,5 м, шириной от 75 мм до 150 мм, толщиной от 32 мм до 40 мм ГОСТ 8486-86 сорт 4	м3	0,007189	114,170	111,607	-	0,821
					-	-	-	
30	215-204-0702	Доска обрезная хвойных пород длиной от 2 м до 3,75 м, шириной от 75 мм до 150 мм, толщиной от 19 мм до 22 мм ГОСТ 8486-86 сорт 2	м3	0,474016	113,984	-	-	54,030
					-	-	-	
31	217-105-0102	Дюбель полипропиленовый универсальный с шурупами	кг	4,66424	1,186	-	-	5,532
					-	-	-	

1	2	3	4	5	6	7	8	9
32	216-102-0301	Известь строительная негашеная комовая ГОСТ 9179-2018 сорт 1	т	0,025936	65,286	62,500	-	1,693
					-	-	-	
33	214-214-0108	Канат стальной двойной свивки типа ТК конструкции 6х37(1+6+12+18)+1 о.с., оцинкованный, из проволоки марки В, маркировочная группа 1770 Н/мм2, диаметром 5 мм	10 м	0,32164	10,602	-	-	3,410
					-	-	-	
34	218-103-0207	Канаты пеньковые пропитанные ГОСТ 30055-93	т	0,00172	1 352,536	-	-	2,326
					-	-	-	
35	261-1020123	Каркасы арматурные ГОСТ 10922-2012	т	325,886	-	-	-	-
					-	-	-	
36	261-1010304	Кирпич керамический или силикатный рядовой	1000 шт.	321,2544	-	-	-	-
					-	-	-	
37	213-101-0101	Кирпич керамический рядовой полнотелый ГОСТ 530-2012 марки М100	1000 усл. шт.	0,5538	39,546	33,929	-	21,901
					-	-	-	
38	217-605-0101	Кислород технический газообразный ГОСТ 5583-78	м3	20,64	0,456	-	-	9,412
					-	-	-	
39	261-1020322	Конструкции стальные	т	20,64	-	-	-	-
					-	-	-	
40	232-101-0603	Лента армирующая бумажная	м	1 339,769624	0,017	-	-	22,776
					-	-	-	
41	223-503-0502	Лента бутиловая диффузионная	м	641,70225	0,121	-	-	77,646
					-	-	-	
42	223-503-0503	Лента ПСУЛ	м	641,70225	0,259	-	-	166,201
					-	-	-	
43	232-101-0601	Лента разделительная для сопряжения потолка и стен	м	935,84644	0,067	-	-	62,702
					-	-	-	
44	232-101-0602	Лента уплотнительная самоклеящаяся	м	755,873408	0,063	-	-	47,620
					-	-	-	
45	215-101-0102	Лесоматериал круглый хвойных пород для строительства ГОСТ 9463-2016 толщиной от 140 мм до 240 мм, длиной от 3 м до 6,5 м, сорт 2	м3	19,60452	123,390	120,536	-	2 419,002
					-	-	-	
46	232-101-0102	Лист гипсокартонный обычный ГКЛ СТ РК EN 520-2012 толщиной 12,5 мм	м2	2 805,2072	0,830	-	-	2 328,322
					-	-	-	

1	2	3	4	5	6	7	8	9
47	235-201-0204	Мастика битумно-гидроизоляционная холодного применения для фундамента ГОСТ 30693-2000	кг	4 852,248	1,090	1,051	-	5 288,950
					-	-	-	
48	218-101-0301	Металлические поддерживающие и несущие элементы крупнощитовой опалубки колонн	комплект/м2 опалубки	15,92496	90,382	89,286	-	1 439,330
					-	-	-	
49	218-101-0303	Металлические поддерживающие и несущие элементы крупнощитовой опалубки перекрытий на телескопических стойках	комплект/м2 опалубки	46,00736	45,210	44,643	-	2 079,993
					-	-	-	
50	218-101-0306	Металлические поддерживающие и несущие элементы крупнощитовой опалубки стен	комплект/м2 опалубки	23,9984	76,829	75,893	-	1 843,773
					-	-	-	
51	218-101-0302	Металлические поддерживающие и несущие элементы мелкощитовой опалубки	комплект/м2 опалубки	5,48639	54,239	53,571	-	297,576
					-	-	-	
52	222-525-0102	Отдельные конструктивные элементы зданий и сооружений с преобладанием горячекатаных профилей средняя масса сборочной единицы от 0,1 до 0,5 т	т	0,0688	1 122,070	-	-	77,198
					-	-	-	
53	235-104-0301	Пленка полиэтиленовая ГОСТ 10354-82 толщина 0,15 мм	1000 м2	3,281602	95,688	-	-	314,010
					-	-	-	
54	261-1050132	Плиты теплоизоляционные ГОСТ 16381-77	м2	686,3096	-	-	-	-
					-	-	-	
55	235-201-0101	Праймер битумный ГОСТ 30693-2000 эмульсионный	кг	1 010,885	0,554	0,533	-	560,030
					-	-	-	
56	214-209-0802	Проволока сварочная легированная марки СВ-10НМА с неомедненной поверхностью ГОСТ 2246-70 диаметром 4 мм	кг	36,0225	2,146	2,135	-	77,304
					-	-	-	
57	214-209-0802	Проволока сварочная легированная марки СВ-10НМА с неомедненной поверхностью ГОСТ 2246-70 диаметром 4 мм	кг	0,516	2,146	-	-	1,107
					-	-	-	
58	214-209-0106	Проволока стальная термически обработанная, без покрытия ГОСТ 3282-74 диаметром 1,6 мм	кг	3 235,208	0,476	-	-	1 539,959
					-	-	-	
59	217-605-0104	Пропан-бутан, смесь техническая ГОСТ Р 52087-2018	кг	6,192	0,252	-	-	1,560
					-	-	-	
60	222-529-0103	Профиль направляющий ПН для гипсокартона, оцинкованный СТ РК 2621-2015 размерами 75 мм х 40 мм, толщиной стали от 0,4 до 0,45 мм	м	461,693128	0,252	0,251	-	116,347
					-	-	-	
61	222-529-0302	Профиль стоечный ПС для гипсокартона, оцинкованный СТ РК 2621-2015 размерами 75 мм х 50 мм, толщиной стали от 0,4 до 0,45 мм	м	1 366,222528	0,297	0,295	-	405,768
					-	-	-	

1	2	3	4	5	6	7	8	9
62	212-401-0102	Раствор кладочный цементный ГОСТ 28013-98 марки М50	м3	209,15	19,270	14,435	-	4 030,321
					-	-	-	
63	212-402-0107	Раствор отделочный ГОСТ 28013-98 тяжелый цементно-известковый 1:1:6	м3	254,805556	21,134	16,961	-	5 385,061
					-	-	-	
64	236-104-0103	Растворитель Р-4 ГОСТ 7827-74	т	0,01032	963,660	-	-	9,945
					-	-	-	
65	214-402-0301	Сетка проволочная тканая с квадратными ячейками из нержавеющей стали ГОСТ 3826-82 диаметром 0,3 мм	м2	94,8032	8,508	-	-	806,586
					-	-	-	
66	214-402-0103	Сетка проволочная тканая с квадратными ячейками, без покрытия ГОСТ 3826-82 размерами 5 мм х 5 мм х 1,6 мм	м2	564,649111	1,073	1,058	-	605,868
					-	-	-	
67	218-103-0202	Скотч прозрачный клейкий 230 м	рулон	223,46432	1,085	1,071	-	242,459
					-	-	-	
68	217-605-0304	Смазка для опалубки	кг	3 860,60415	0,973	0,960	-	3 756,368
					-	-	-	
69	232-504-0201	Смесь сухая для затирки швов гипсокартонных листов СТ РК 1168-2006	кг	1 068,044328	0,109	-	-	116,417
					-	-	-	
70	261-107-0765	Смола каменноугольная	т	0,294622	106,532	102,213	-	31,387
					-	-	-	
71	236-106-0404	Состав антисептический на органическом растворителе для защиты древесины паста ПАФ ЛСТ	т	0,117959	1 174,643	1 160,714	-	138,560
					-	-	-	
72	214-210-0101	Сталь арматурная гладкого профиля класса А-I (А240) СТ РК 2591-2014 диаметром от 6 до 12 мм	т	0,156754	307,414	304,357	-	48,188
					-	-	-	
73	214-210-0201	Сталь арматурная периодического профиля класса А-III (А400) СТ РК 2591-2014 диаметром от 6 до 12 мм	т	1,322988	296,799	293,789	-	392,661
					-	-	-	
74	218-103-0206	Ткань мешочная ГОСТ 30090-93	10 м2	14,69718	7,006	6,920	-	102,968
					-	-	-	
75	218-103-0206	Ткань мешочная ГОСТ 30090-93	10 м2	5,7775	7,006	-	-	40,477
					-	-	-	
76	218-101-0501	Трубка защитная ПВХ для опалубки	м	368,9754	0,092	0,090	-	33,946
					-	-	-	
77	215-301-0902	Фанера ламинированная толщиной 21 мм	м2	781,399383	11,100	10,798	-	8 673,533
					-	-	-	

1	2	3	4	5	6	7	8	9
78	218-101-0403	Фиксатор арматуры для защитного слоя бетона вертикальных поверхностей	шт.	17 057,69	0,023	-	-	392,327
					-	-	-	
79	218-101-0404	Фиксатор арматуры для защитного слоя бетона горизонтальных поверхностей	шт.	42 957,7	0,023	-	-	988,027
					-	-	-	
80	214-203-0103	Швеллер горячекатаный с внутренним уклоном граней полок из углеродистой стали ГОСТ 8240-97 № 22У-40У	т	0,033368	555,144	-	-	18,524
					-	-	-	
81	217-106-0103	Шуруп ГОСТ 1147-80 для крепления гипсокартона и деревянных изделий	кг	48,274884	1,855	-	-	89,550
					-	-	-	
82	218-101-0101	Щиты из досок, толщина 25 мм	м2	61,57446	2,928	2,846	-	180,290
					-	-	-	
83	217-301-0105	Электрод типа Э38, Э42, Э46, Э50 ГОСТ 9467-75, марки АНО-4 диаметром 4 мм	кг	278,64	2,280	-	-	635,299
					-	-	-	
84	261-107-0576	Электроды, d=4 мм, Э46 ГОСТ 9466-75	т	0,001724	289,955	282,039	-	0,500
					-	-	-	
		Всего по материалам поставки подрядчика:	тенге					60 779,474
		Всего по ведомости:	тенге					884 260,389

Составил student Yessengeldinova A.K.

должность, подпись (инициалы, фамилия)

Проверил Senior Lecturer Niyetbay S.Y.

должность, подпись (инициалы, фамилия)

ЕСЦ РК 2025 пр. 48-нк, г. Алматы введен с 01.04.2025 Приложение Г
ЭСН РК 2025 И43 введен с 01.04.2025 НДЦС РК 8.01-08-2022
ССЦ 2025 пр. 48-нк, г. Алматы введен с 01.04.2025 Форма 3
ССЦ Февраль 2025, г. Алматы введен с 01.02.2025

Объектная смета № 1
(Объектный сметный расчет)

на строительство Oncological hospital (object estimate)
(наименование объекта)

Сметная стоимость работ и затрат 743 939,680 тыс. тенге
Нормативная трудоемкость 116,72916 тыс. чел.-ч
Средства на оплату труда 580 435,464 тыс. тенге
Расчётный измеритель единичной стоимости
Показатель единичной стоимости - тыс. тенге / расчетный измеритель

Составлен(а) в текущих ценах по состоянию на 2025г.

Номер по порядку	Номера смет и расчетов	Наименование работ и затрат	Сметная стоимость, тыс. тенге				Норматив-ная трудо-емкость, тыс. чел.-ч	Средства на оплату труда, тыс. тенге	Показатель единичной стоимости
			строительно-монтажных работ	оборудования, мебели, инвентаря	прочих затрат	всего			
1	2	3	4	5	6	7	8	9	10
1	2-2	Oncological hospital (local estimate)	743 939,680			743 939,680	116,72916	580 435,464	
		Итого по смете	743 939,680			743 939,680	116,72916	580 435,464	

Составил student Yessengeldinova A.K.
должность, подпись (инициалы, фамилия)

Проверил Senior Lecturer Niyetbay S.Y.
должность, подпись (инициалы, фамилия)

ЕСЦ РК 2025 пр. 48-нк, г. Алматы введен с 01.04.2025 Приложение Г
ЭСН РК 2025 И43 введен с 01.04.2025 НДЦС РК 8.01-08-2022
ССЦ 2025 пр. 48-нк, г. Алматы введен с 01.04.2025 Форма 1
ССЦ Февраль 2025, г. Алматы введен с 01.02.2025

Наименование инвестиционного проекта Oncological hospital

Заказчик Satbayev University
(наименование организации)

Утверждена

общая сметная стоимость по Сводному сметному расчету
в сумме 1 609 380,171 тыс. тенге
в том числе:
возвратных сумм - тыс. тенге
налог на добавленную стоимость 172 433,590 тыс. тенге

(ссылка на документ об утверждении)

"____"____________________20____ год.

Сводный сметный расчет стоимости строительства

Oncological hospital
(наименование стройки)

Составлен в текущих ценах по состоянию на 2025г.

Номер по порядку	Номера смет и расчетов, иные документы	Наименование частей, глав, объектов, работ и затрат	Сметная стоимость, тыс. тенге			Общая сметная стоимость, тыс. тенге
			строительно-монтажных работ	оборудования, мебели и инвентаря	прочих затрат	
1	2	3	4	5	6	7
		Часть I. Проектирование				
		Итого по части I				
1		**Часть II. Строительство**				
		Глава 3. Объекты подсобного и обслуживающего назначения				
2	1	Oncological hospital (object estimate)	743 939,680			743 939,680

1	2	3	4	5	6	7
		Итого по главе № 3	743 939,680			743 939,680
		Итого по главам № 1 - 7	743 939,680			743 939,680
		Глава 8. Затраты на организацию и управление строительством				
3	НДЦС РК 8.04-09-2022 п.4	Затраты связанные с организацией и управлением строительно-монтажными работами на строительной площадке по стройке в целом (общеплощадочные затраты) - 6,6%	49 100,019			49 100,019
4	НДЦС РК 8.04-09-2022 п.5.9	Затраты по перевозке автомобильным транспортом работников строительных и монтажных организаций			15 222,942	15 222,942
5	НДЦС РК 8.04-09-2022 п.5.11	Затраты, связанные с командированием работников для выполнения строительных, монтажных и специальных строительных работ			499 835,840	499 835,840
		Итого по главе № 8	49 100,019		515 058,782	564 158,801
		Итого по главам № 1 - 8	793 039,699		515 058,782	1 308 098,481
6	НДЦС РК 8.01-08-2022 п.8.2.65	Сметная прибыль - 8 %	63 443,176			63 443,176
7		Возврат стоимости эксплуатации машин поставки заказчика				
		Итого со сметной прибылью	856 482,875		515 058,782	1 371 541,657
8	НДЦС РК 8.01-08-2022 п.8.2.66.3.а).2	Непредвиденные работы и затраты На предпроектной стадии (в составе технико-экономического обоснования на строительство, в расчете стоимости строительства по объектам, не требующим разработки технико-экономического обоснования), на стадии «Проект» при двухстадийном проектировании непредвиденные работы и затраты учитываются в следующих размерах (в процентах от стоимости строительства, средства показываются по графам 4-7 сводного сметного расчета стоимости строительства) на строительство, осуществляемое по индивидуальным проектам: остальные предприятия и сооружения промышленности, сельского хозяйства, транспорта, связи, общественные здания и сооружения (кроме жилых домов); - 5%	39 651,985		25 752,939	65 404,924
		Итого по части II	896 134,860		540 811,721	1 436 946,581
		Часть III. Инжиниринговые услуги				
		Итого по части III				
		Итого по частям I-III	896 134,860		540 811,721	1 436 946,581
	Налоговый Кодекс РК от 25.12.2017 № 120-VI, ст.422	**Налог на добавленную стоимость (НДС) - 12 %**			172 433,590	172 433,590

1	2	3	4	5	6	7
		Всего по сводному сметному расчету	896 134,860		713 245,311	1 609 380,171

Составил student Yessengeldinova A.K.

должность, подпись (инициалы, фамилия)

Проверил Senior Lecturer Niyetbay S.Y.

должность, подпись (инициалы, фамилия)

НЕКОММЕРЧЕСКОЕ АКЦИОНЕРНОЕ ОБЩЕСТВО «КАЗАХСКИЙ НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ ТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ имени К.И.САТПАЕВА»

ОТЗЫВ

НАУЧНОГО РУКОВОДИТЕЛЯ

на дипломный проект
(наименование вида работы)

Есенгельдиновой Адель Кайратовны
(Ф.И.О. обучающегося)

6В07302 – Строительная инженерия
(шифр и наименование ОП)

Тема:
Онкологический госпиталь с высокотехнологичными отделениями в городе Алматы

Дипломный проект выполнен в соответствии с требованиями, предъявляемыми к выпускным квалификационным работам по направлению «Строительная инженерия». Тема проекта является актуальной, отражает современные потребности в сфере здравоохранения и ориентирована на повышение доступности и качества медицинской помощи в условиях мегаполиса.

Проект включает графическую часть на 11 листах и пояснительную записку объемом 172 страницы. В работе рассмотрены архитектурно-планировочные и конструктивные решения, предложены современные инженерные системы и применены расчёты с учетом действующих нормативных документов. Особое внимание уделено функциональному зонированию, обеспечению энергоэффективности и санитарно-гигиеническим требованиям к медицинским учреждениям.

Студентка продемонстрировала высокий уровень подготовки, самостоятельность в принятии проектных решений, умение работать с нормативно-технической документацией и программными средствами расчёта. Оформление проекта соответствует установленным стандартам.

Выпускная квалификационная работа рекомендуется к защите, а Есенгельдинова Адель Кайратовна заслуживает присвоения академической степени бакалавра техники и технологии по образовательной программе 6В07302 – Строительная инженерия.

Научный руководитель
Ст. преподаватель, PhD
(должность, уч. степень, звание)
Ниетбай С.Е.
(подпись)
« 02 » 06 2025 г.

НЕКОММЕРЧЕСКОЕ АКЦИОНЕРНОЕ ОБЩЕСТВО «КАЗАХСКИЙ НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ ТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ имени К.И.САТПАЕВА»

REVIEW

OF THE SCIENTIFIC SUPERVISOR

на thesis project
(наименование вида работы)
Adel Kairatovna Yessengeldinova
(Ф.И.О. обучающегося)
6B07302 – Civil Engineering
(шифр и наименование ОП)

Тема:
Oncology Hospital with High-Tech Departments in the City of Almaty

The diploma project has been completed in accordance with the requirements for final qualification works in the field of Civil Engineering. The project topic is highly relevant, reflecting current needs in the healthcare sector and aiming to improve the accessibility and quality of medical services in an urban environment.
The project includes a graphic part on 11 sheets and an explanatory note consisting of 172 pages. It addresses architectural planning and structural solutions, proposes modern engineering systems, and applies calculations in compliance with current building codes and standards. Particular attention is paid to functional zoning, energy efficiency, and sanitary and hygiene requirements for medical facilities.
The student has demonstrated a high level of preparation, independence in decision-making, the ability to work with regulatory and technical documentation, and proficiency in engineering software. The design documentation is properly formatted and meets all required standards.
The final qualification project is recommended for defense, and Adel Kairatovna Esengeldinova is worthy of being awarded the Bachelor of Engineering and Technology degree in the educational program 6B07302 – Civil Engineering.

Scientific Supervisor
Senior Lecturer, PhD
(position, academic degree)
_______ S.E. Niyetbay
(signature)
«_0_» 06 2025 г.

НЕКОММЕРЧЕСКОЕ АКЦИОНЕРНОЕ ОБЩЕСТВО «КАЗАХСКИЙ НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ ТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ имени К.И.САТПАЕВА»

РЕЦЕНЗИЯ

на Дипломный Проект

Есенгельдиновой Адель Кайратовны

6B07302 – Строительная инженерия

На тему: Онкологический госпиталь с высокотехнологичными отделениями в городе Алматы

Выполнено:

а) графическая часть на 11 листах

б) пояснительная записка на 172 страницах

ЗАМЕЧАНИЯ К РАБОТЕ

- Не заполнены все штампы на графической части дипломного проекта

Оценка работы

Дипломный проект включает 172 листа расчетно-пояснительной записки и 11 листов графического материала.

В архитектурно-строительном разделе представлены современные архитектурно-планировочные решения, направленные на обеспечение комфортных условий пребывания пользователей больницы. Проект демонстрирует понимание принципов функционального зонирования и рационального использования внутренних пространств.

Расчетно-конструктивная часть выполнена с использованием актуального программного обеспечения ЛИРА-САПР 2022. Расчеты соответствуют требованиям действующих строительных норм и правил Республики Казахстан. Следует отметить, что автор проекта также владеет ручными методами расчета, что подтверждается самостоятельным выполнением расчета монолитной балки и колонны прямоугольного сечения.

Раздел, посвящённый технологии строительного производства, характеризуется применением современных строительных технологий и логичной организацией производственных процессов. Отмечена последовательная увязка технологических операций, а также рассмотрены аспекты совместимости различных видов работ. Проектирование объектного стройгенплана выполнено в соответствии с нормативными документами и объемами работ, что свидетельствует о комплексном подходе. Подробно разработана технологическая карта — на выполнение земляных работ. Для выполнения подземных работ обоснован выбор основных строительных машин и механизмов. Составлен календарный план и произведены расчёты трудозатрат.

Экономический раздел проекта содержит обоснованный расчет себестоимости строительных работ с применением нормативных документов и программного обеспечения СМЕТА РК, что обеспечивает достоверность и актуальность полученных данных.

Работа соответствует требованиям предъявляемым к дипломным проектам, заслуживает оценки «отлично», а его автор Есенгельдинова Адель Кайратовна — присвоения академической степени «бакалавра техники и технологий» по Образовательной программе 6B07302 — «Строительная инженерия».

Рецензент

м.т.н., главный инженер архитектурно-строительной части

АО «Mega Center Management»

__________ Рудняев Р.Г.

«04» 06 __________ 2025 г.

Ф КазНИТУ 706-17. Рецензия

Mega Center Management (Мега Центр Менеджмент)

NON-PROFIT JOINT STOCK COMPANY «KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY NAMED AFTER K. I. SATPAEV»

REVIEW

for a Graduation Project of

Yessengeldinova Adel Kairatovna

6B07302 - Civil Engineering

On the topic: Oncological hospital with high-tech departments in Almaty

Completed:

a) graphic part on 11 sheets

b) explanatory note on 172 pages

COMMENTS ON THE WORK

- All stamps on the graphic part of the graduation project are not filled in

Job evaluation

The diploma project includes 172 sheets of a calculation and explanatory note and 11 sheets of graphic material.

The architectural and construction section presents modern architectural and planning solutions aimed at providing comfortable conditions for hospital users. The project demonstrates an understanding of the principles of functional zoning and rational use of internal spaces.

The calculation and construction part is performed using the latest LIRA-CAD 2022 software. Calculations comply with the requirements of the current building codes of the Republic of Kazakhstan. It should be noted that the author of the project also knows manual calculation methods, which is confirmed by the independent calculation of a monolithic beam and a rectangular column.

The section devoted to construction production technology is characterized by the use of modern construction technologies and logical organization of production processes. The consistent linking of technological operations is noted, as well as aspects of compatibility of various types of work are considered. The design of the object construction plan was carried out in accordance with regulatory documents and work volumes, which indicates an integrated approach. A detailed technological map has been developed for performing earthworks. The choice of basic construction machines and mechanisms for performing underground works is justified. A calendar plan has been drawn up and labor costs calculated.

The economic section of the project contains a reasonable calculation of the cost of construction works using regulatory documents and software ESTIMATES of the Republic of Kazakhstan, which ensures the reliability and relevance of the data obtained.

The work meets the requirements for diploma projects, deserves an "excellent" rating, and its author Yessengeldinova Adel Kairatovna is awarded the academic degree of "Bachelor of Engineering and Technology" in the Educational program 6B07302 - "Construction Engineering".

Reviewer

m.t.s., Chief Engineer of the Architectural and Construction Department of «Mega Center Management» JSC

_______________ Rudnyayev R.G.

"04" 06 2025 y.

Mega Center Management (Мега Центр Менеджмент)

Ф КазНИТУ 706-17. Рецензия

Протокол

о проверке на наличие неавторизованных заимствований (плагиата)

Автор: Есенгельдинова Адель Кайратовна

Соавтор (если имеется):

Тип работы: Дипломная работа

Название работы: Oncological hospital with high-tech departments in Almaty.

Научный руководитель: Саулет Шаяхметов

Коэффициент Подобия 1: 16.3

Коэффициент Подобия 2: 1.2

Микропробелы: 0

Знаки из здругих алфавитов: 32

Интервалы: 0

Белые Знаки: 0

После проверки Отчета Подобия было сделано следующее заключение:

☑ Заимствования, выявленные в работе, является законным и не является плагиатом. Уровень подобия не превышает допустимого предела. Таким образом работа независима и принимается.

☐ Заимствование не является плагиатом, но превышено пороговое значение уровня подобия. Таким образом работа возвращается на доработку.

☐ Выявлены заимствования и плагиат или преднамеренные текстовые искажения (манипуляции), как предполагаемые попытки укрытия плагиата, которые делают работу противоречащей требованиям приложения 5 приказа 595 МОН РК, закону об авторских и смежных правах РК, а также кодексу этики и процедурам. Таким образом работа не принимается.

☐ Обоснование:

Дата

3.06.25г

проверяющий эксперт

Протокол

о проверке на наличие неавторизованных заимствований (плагиата)

Автор: Есенгельдинова Адель Кайратовна

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Интервалы: 0

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☐ Выявлены заимствования и плагиат или преднамеренные текстовые искажения (манипуляции), как предполагаемые попытки укрытия плагиата, которые делают работу противоречащей требованиям приложения 5 приказа 595 МОН РК, закону об авторских и смежных правах РК, а также кодексу этики и процедурам. Таким образом работа не принимается.

☐ Обоснование:

Дата *Заведующий кафедрой*

Форма подтверждения руководителя о доработке графической части дипломного проекта

Студент: Есенгельдинова Адель Кайратовна
Группа: РПЗС СИ-21-4ар

Тема дипломного проекта:
«Oncological hospital with high-tech departments in Almaty»

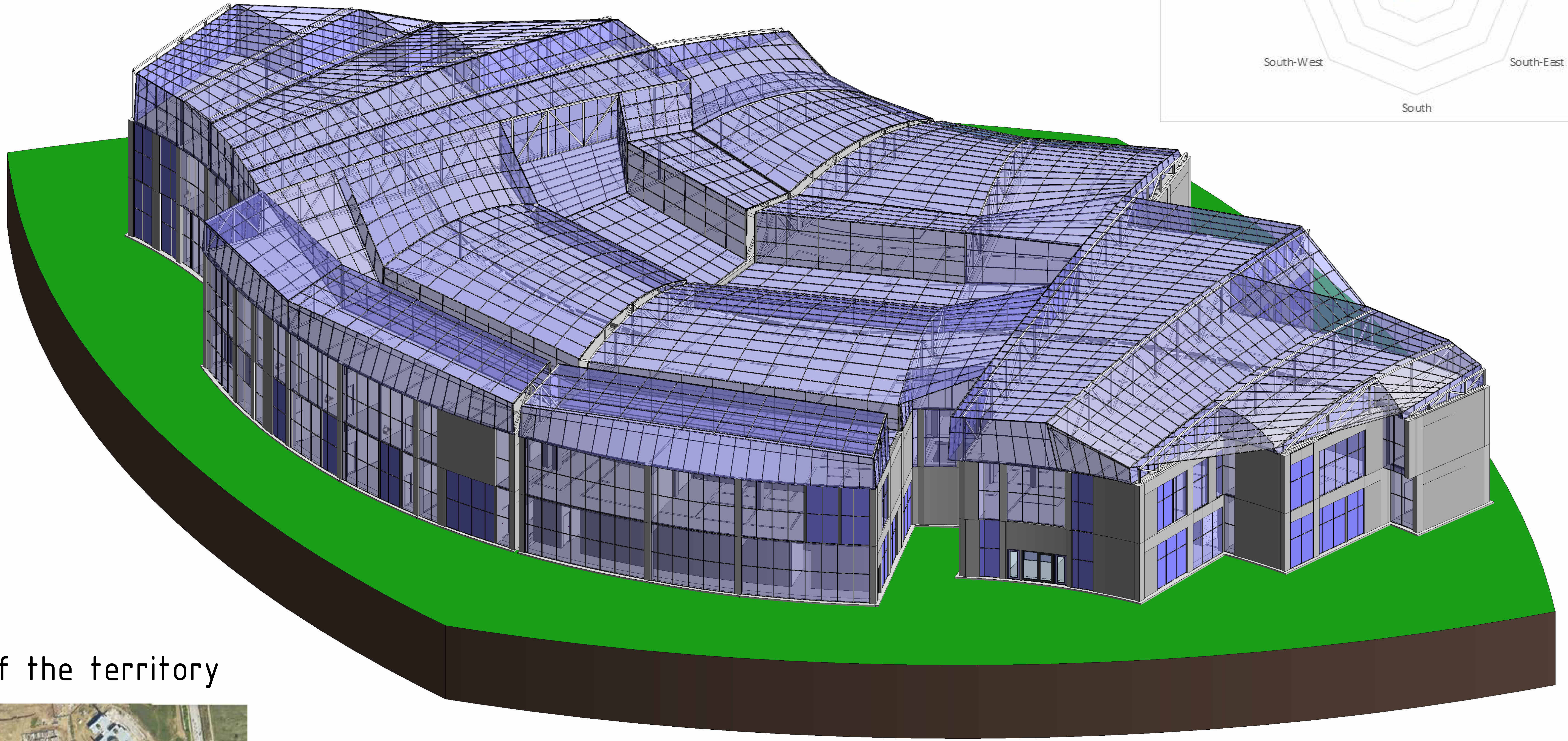
Подтверждаю, что графическая часть дипломного проекта (чертежи) студента полностью доработана в соответствии с замечаниями, выданными на предзащите.
Чертежи проверены, исправления внесены, к дальнейшему контролю допускаются.

Дата: «05» июня 2025 г.

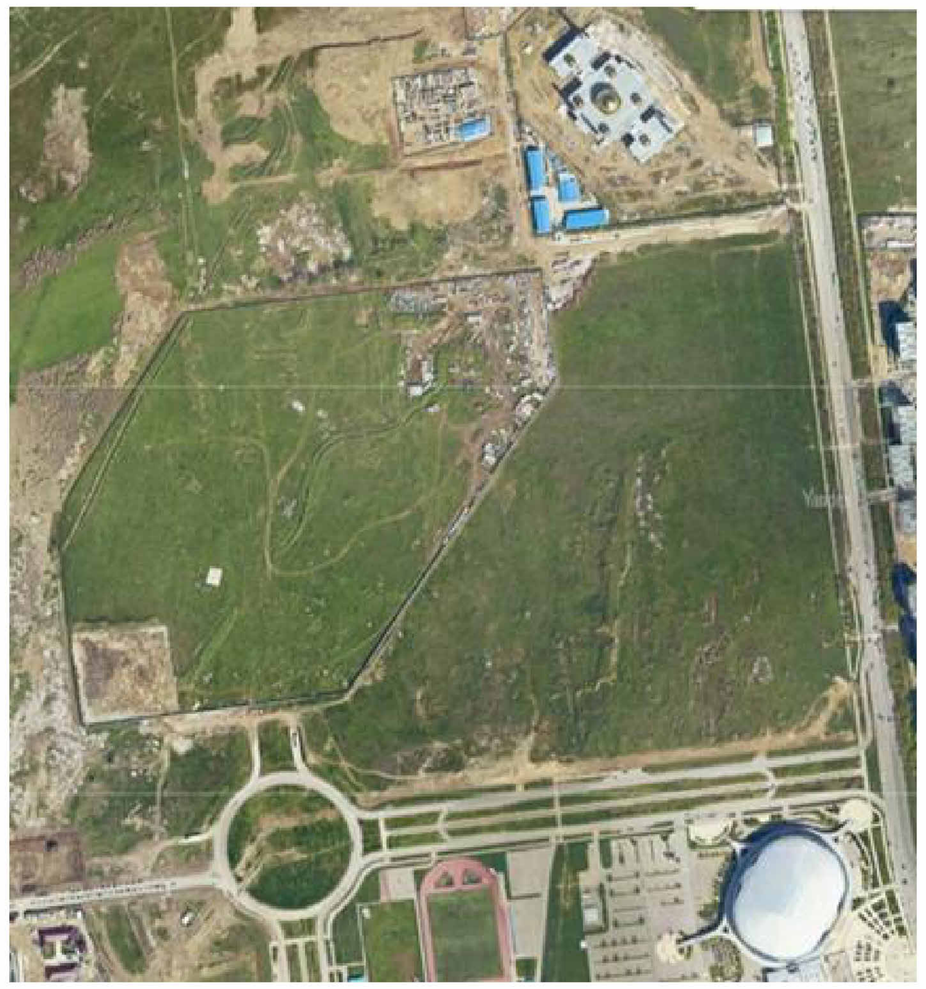
Подпись руководителя: ____________

Ф.И.О. руководителя: Ниетбай С.Е.

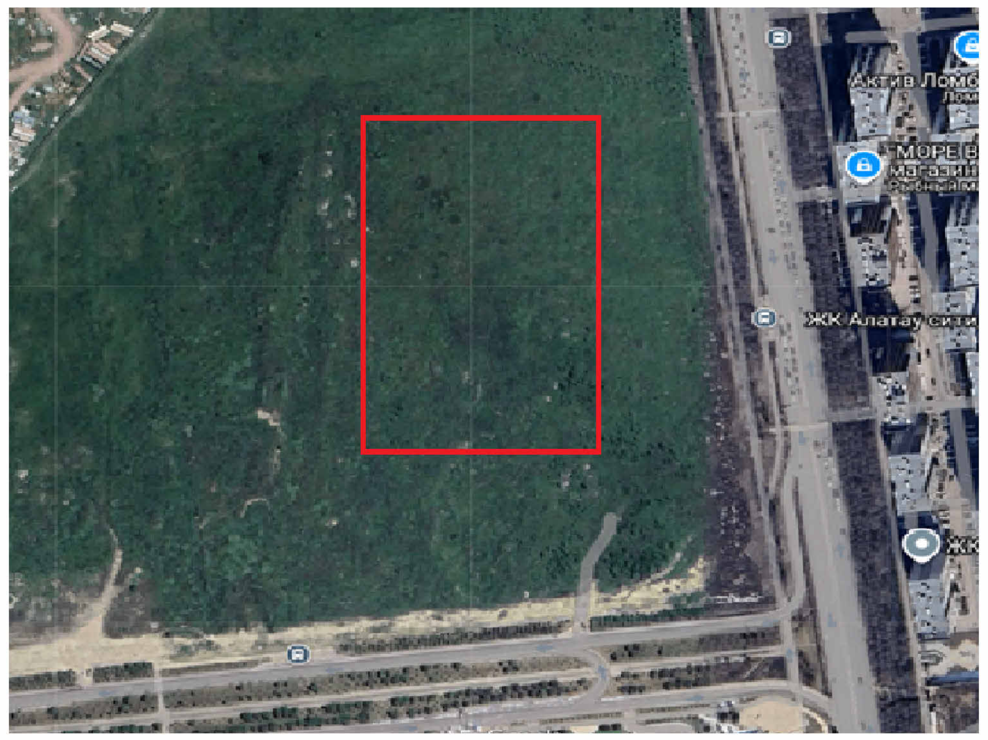
3D view (M1:200)



Plan of the territory



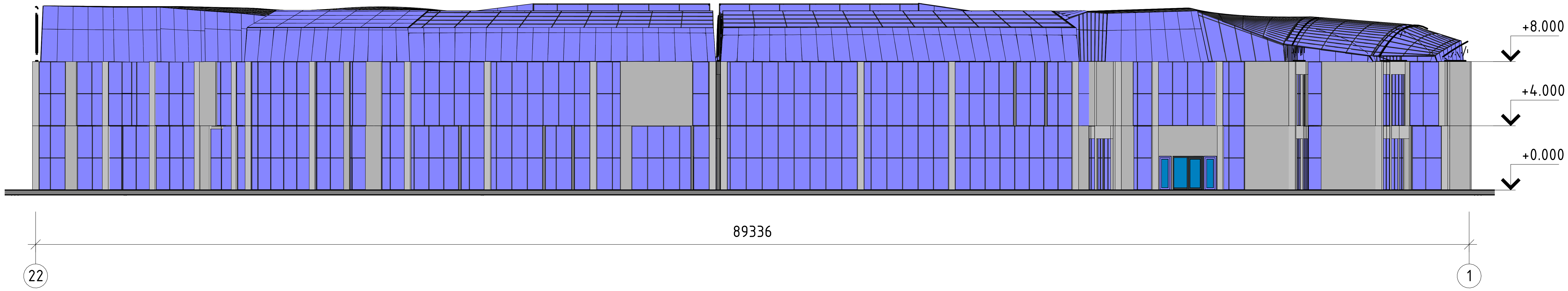
Situation plan



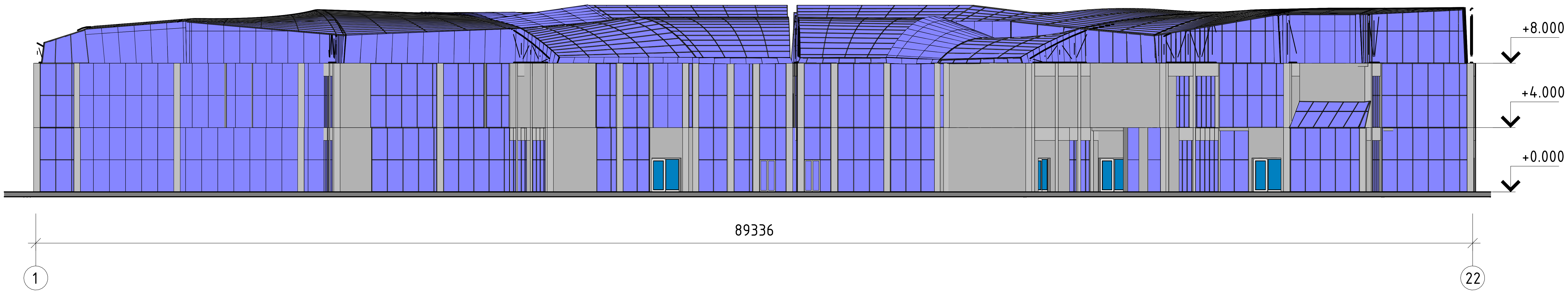
						SU - 6B07302 - Civil Engineering - 2025 - DP			
						Oncological hospital with high-tech departments in Almaty			
Meas.	N.part.	Sheet	Doc.№	Sign.	Date				
Head of Dep.		Shayakhmetov S.B.			05.06	Architectural and analytical section	Stage	Page	Sheets
Supervisor		Niyetbay S.Y.			02.06		DP	1	11
Norm Control		Yessembayeva A.A.			02.06				
Qual. Control		Kozyukova N.V.			2.06	3D view	"CEaBM" department, CaDoBaS-21-4ar group		
Completed		Yessengeldinova A.K.			02.06				

Формат A2A

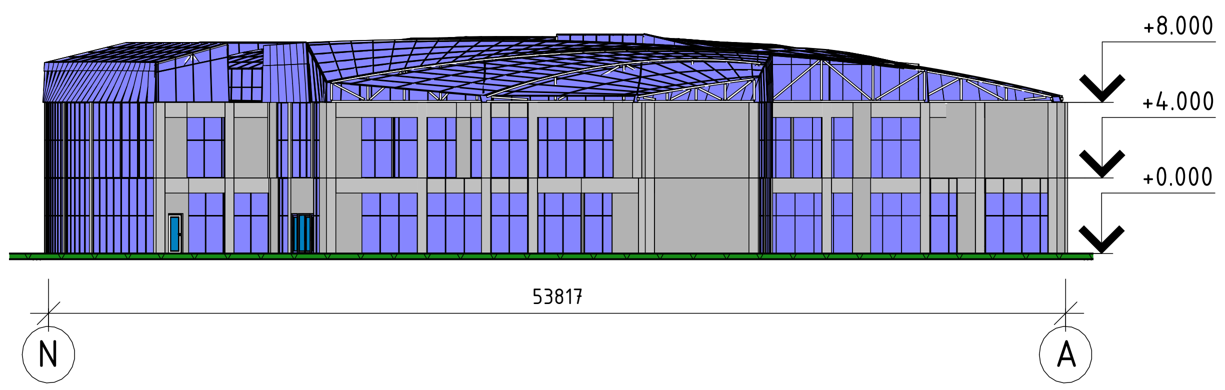
Facade 22-1 (M1:200)



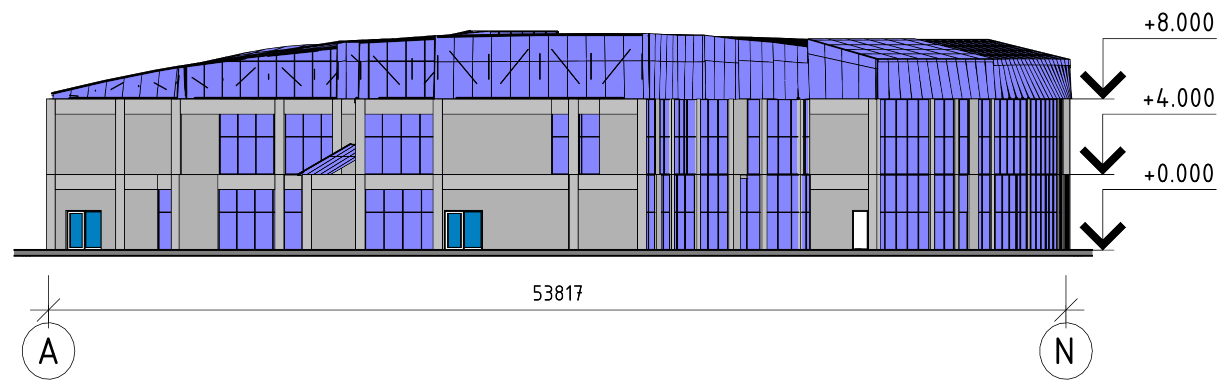
Facade 1-22 (M1:200)



Facade N-A (M1:500)



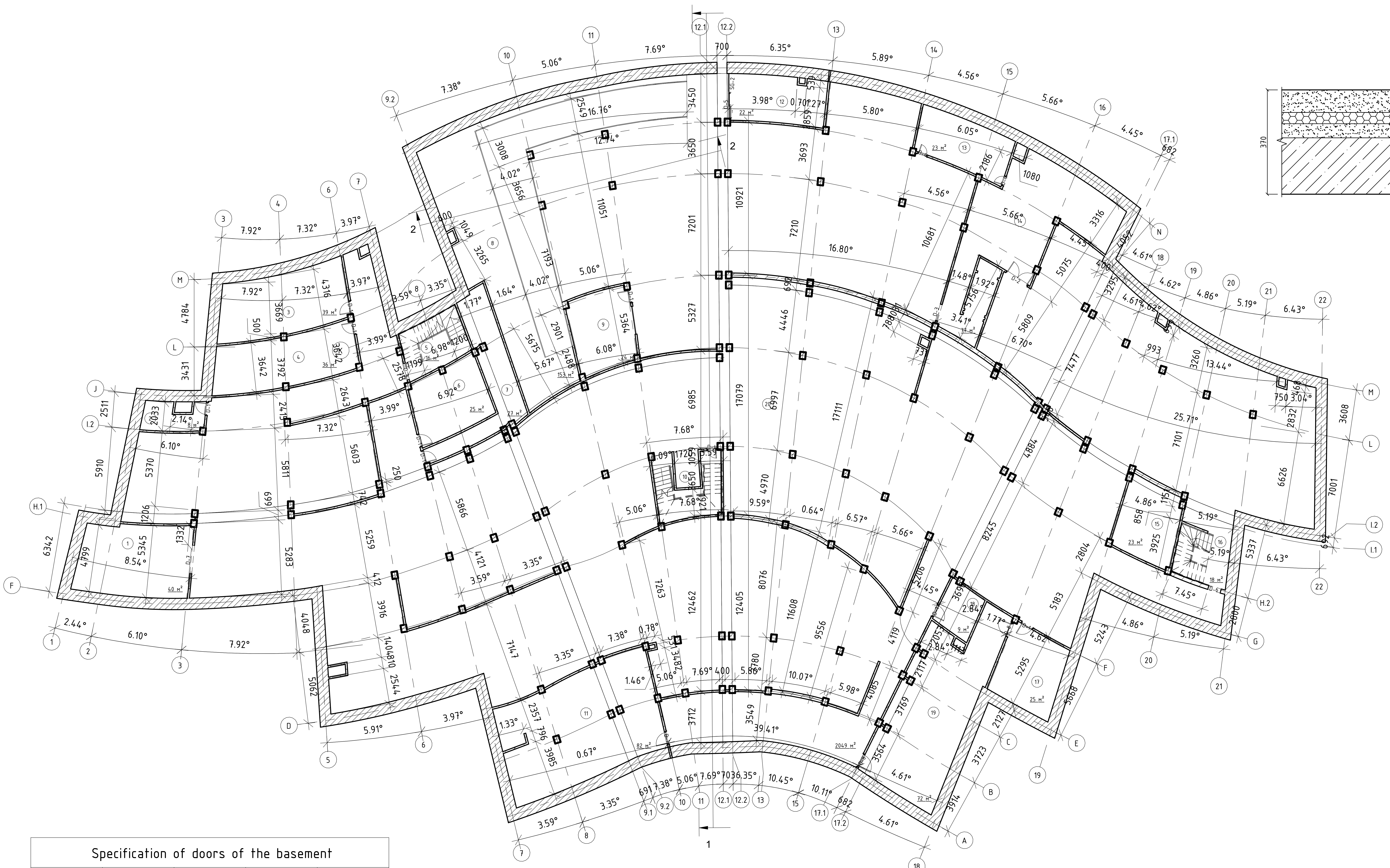
Facade A-N (M1:200)



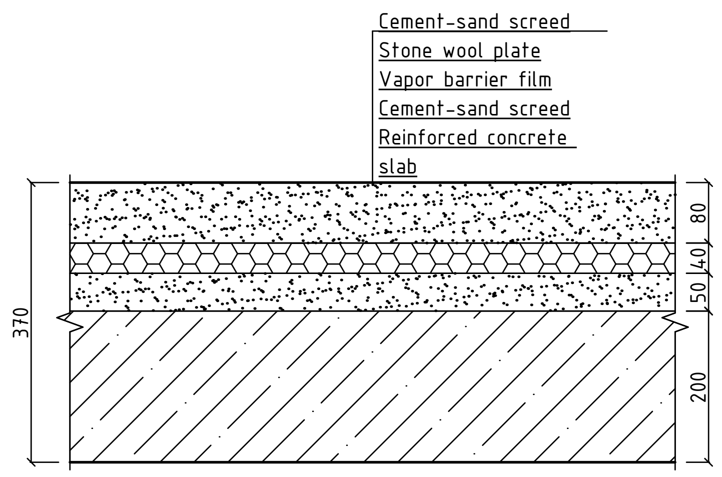
Meas.	N.part.	Sheet	Doc.№	Sign.	Date	SU - 6B07302 - Civil Engineering - 2025 - DP		
						Oncological hospital with high-tech departments in Almaty		
Head of Dep.		Shayakhmetov S.B.			05.06	Architectural and analytical section	Stage	Page	Sheets
Supervisor		Niyetbay S.Y.			02.06		DP	2	11
Norm Control		Yessembayeva A.A.			02.06				
Qual. Control		Kozyukova N.V.			2.06	Facades	"CEaBM" department, CaDoBaS-21-4ar group		
Completed		Yessengeldinova A.K.			02.06				

Формат А2А

Plan of the basement (M1:200)



Scheme of the flooring (M1:10)



Specification of doors of the basement				
Mark	Height, mm	Width, mm	Quantity, pcs	Notice
D-1	2110	910	9	
D-2	2110	1810	1	
D-3	2032	1200	2	
D-4	2110	700	3	
D-5	1955	1955	1	
D-6	2032	915	1	
D-7	2032	2000	1	
D-8	2110	1010	2	

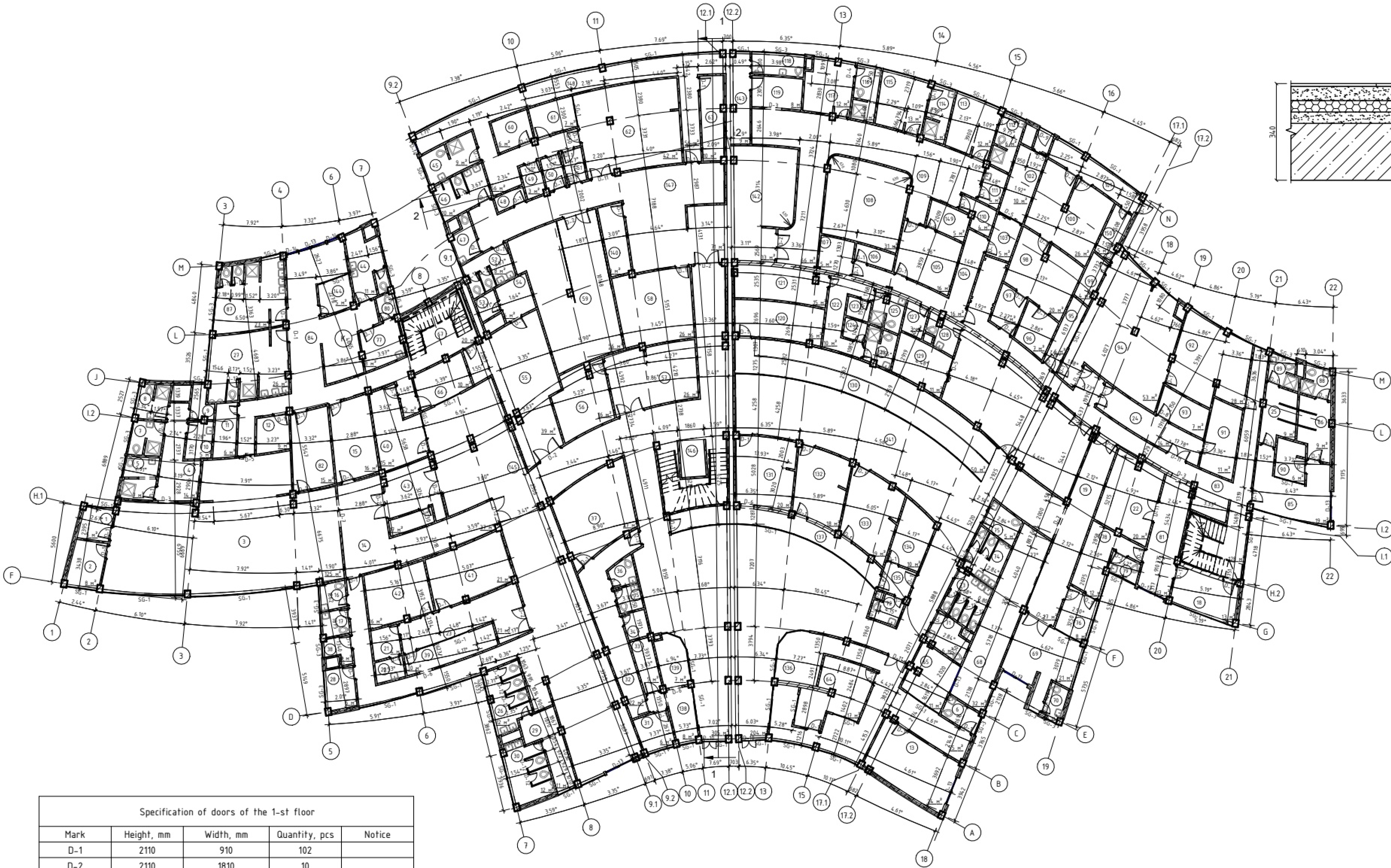
Specification of stained glass windows of the...				
Mark	Sizes of glass section, mm	Colour	Quantity, pcs	Notice
SG-1	1000x2000	nontransparent	1	
SG-2	1000x2000	transparent	1	

The explication of the premises can be found in the explanatory note, Appendix A, Table A.1.

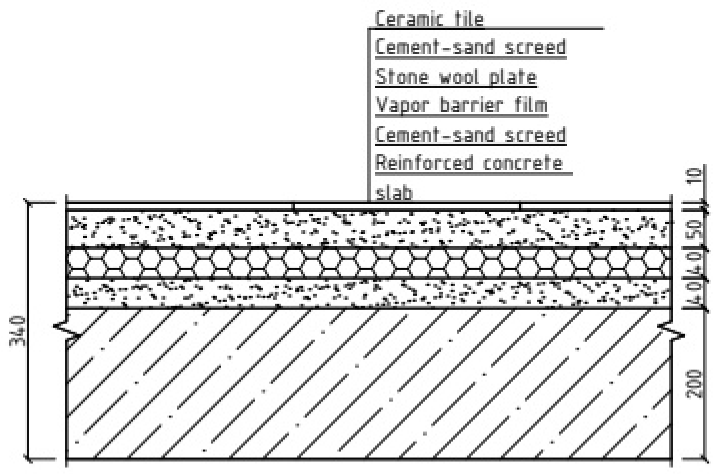
						SU - 6B07302 - Civil Engineering - 2025 - DP		
						Oncological hospital with high-tech departments in Almaty		
Meas.	N.part.	Sheet	Doc.№	Sign.	Date			
Head of Dep.		Shayakhmetov S.B.			05.06	Architectural and analytical section	Stage	Page	Sheets
Supervisor		Niyetbay S.Y.			02.0[illegible]		DP	3	11
Norm Control		Yessembayeva A.A.			02.0[illegible]				
Qual. Control		Kozyukova N.V.			2.06	Plan of the basement, Specification of doors, Specification of stained glass windows	"CEaBM" department, CaDoBaS-21-4ar group		
Completed		Yessengeldinova A.K.			02.06				

Формат А2А

Plan of the 1-st floor (M1:200)



Scheme of the flooring (M1:10)



Specification of doors of the 1-st floor

Mark	Height, mm	Width, mm	Quantity, pcs	Notice
D-1	2110	910	102	
D-2	2110	1810	10	
D-3	2032	1200	4	
D-4	2110	700	35	
D-5	1955	«варианты»	4	
D-6	2032	915	4	
D-7	2032	2000	2	
D-8	2110	1010	1	
D-9	1955	955	1	
D-10	1955	955	2	
D-11	2110	1510	8	
D-12	2110	600	17	
D-13	2110	2020	7	
D-14	2110	820	3	

Specification of stained glass windows of the 1-st floor

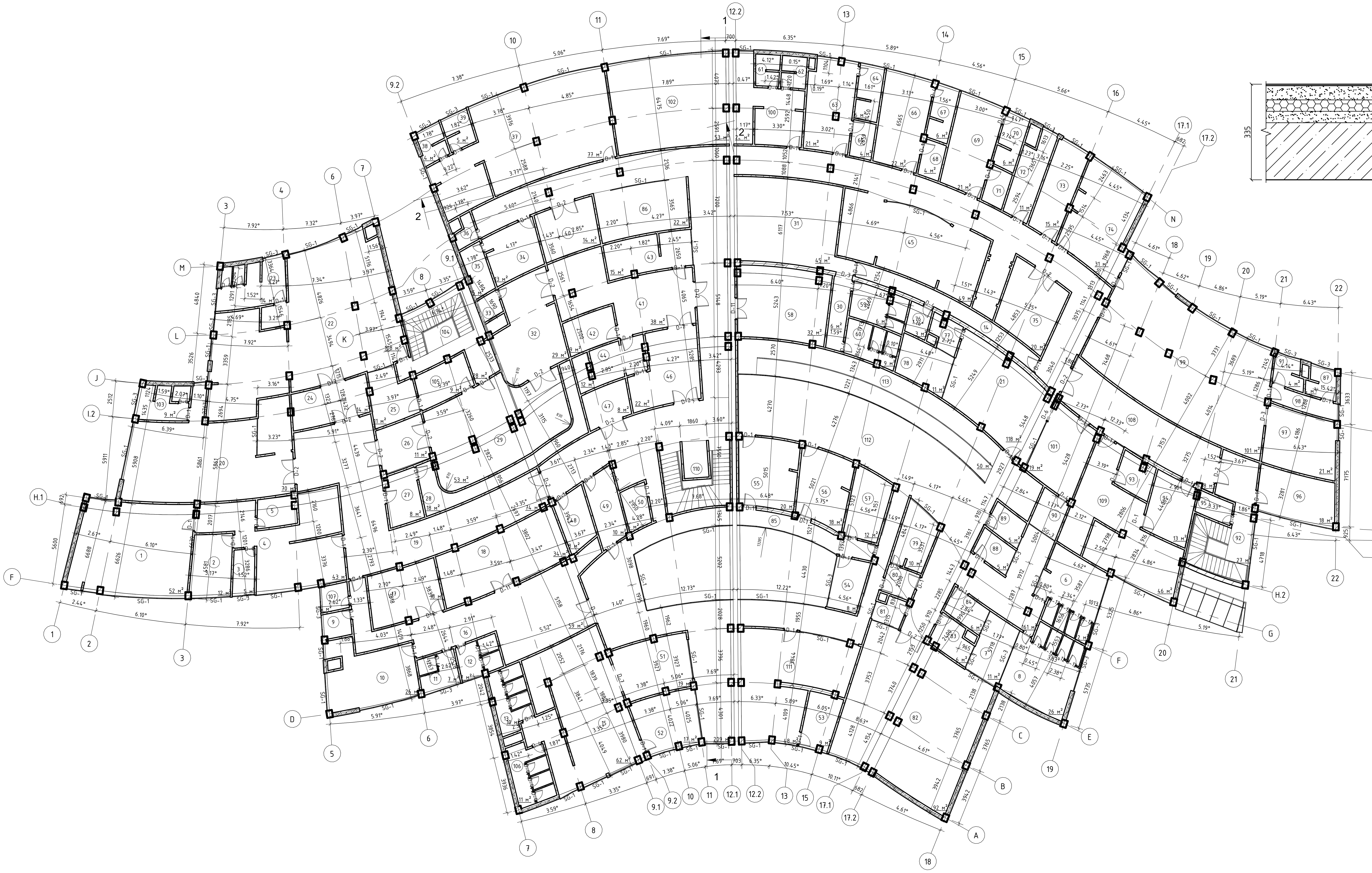
Mark	Sizes of glass section, mm	Colour	Quantity, pcs	Notice
SG-1	1000x2000	nontransparent	61	
SG-2	1000x2000	transparent	2	
SG-3	1000x2000	transparent	27	

The explication of the premises can be found in the explanatory note, Appendix A, Table A.2.

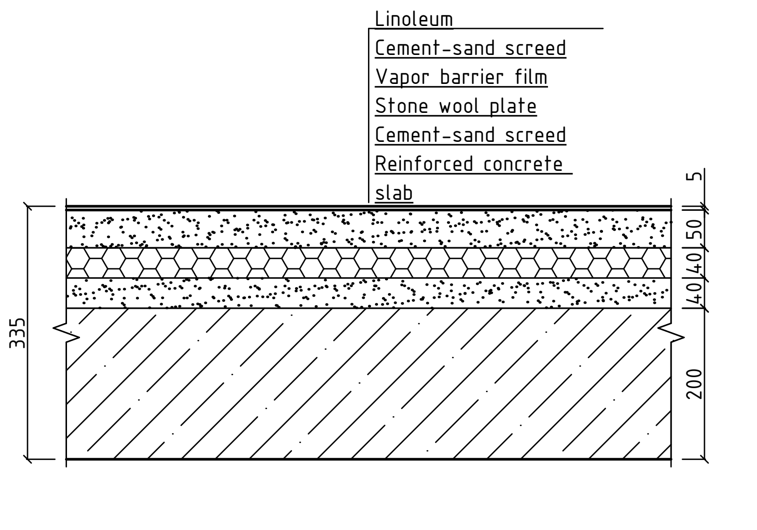
SU - 6B07302 - Civil Engineering - 2025 - DP					
Oncological hospital with high-tech departments in Almaty					
Meas. / N.part. / Sheet / Doc.№	Sign	Date			
Head of Dep.	Shayakhmetov S.B.		05.06	Architectural and analytical section	Stage: DP / Page: 4 / Sheets: 11
Supervisor	Niyetbay S.Y.		02.06		
Norm Control	Yessembayeva A.A.		02.06		
Qual. Control	Kozyukova N.V.		2.06	Plan of the 1-st floor, Specification of doors, Specification of stained glass windows	"CEaBM" department, CaDoBaS-21-4ar group
Completed	Yessengeldinova A.K.		02.06		

Формат А2А

Plan of the 2-nd floor (M1:200)



Scheme of the flooring (M1:10)



Specification of doors of the 2-nd floor

Mark	Height, mm	Width, mm	Quantity, pcs	Notice
D-1	2110	910	63	
D-2	2110	1810	19	
D-3	2032	1200	2	
D-4	2110	700	44	
D-6	2032	915	1	
D-7	2032	2000	2	
D-11	2110	1510	2	
D-12	2110	600	8	

Specification of stained glass windows of the 2-nd floor

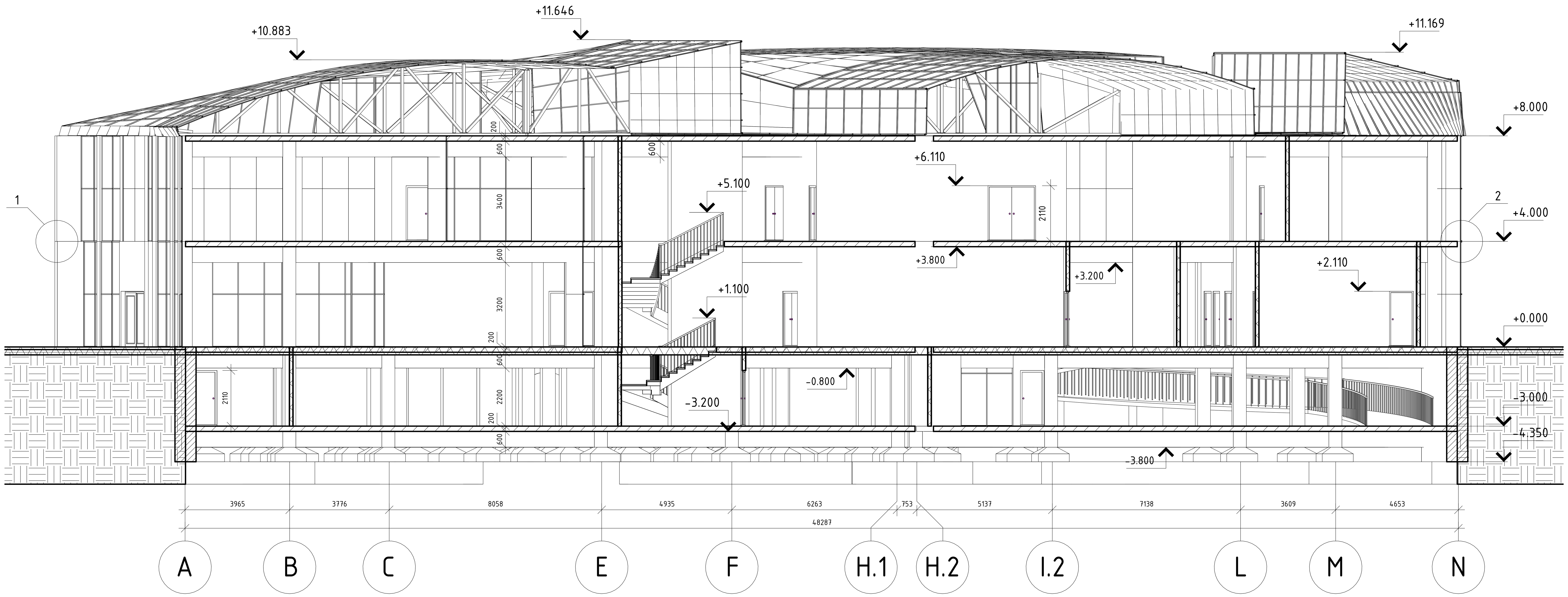
Mark	Sizes of glass section, mm	Colour	Quantity, mm	Notice
SG-1	1000x2000	nontransparent	74	
SG-3	1000x2000	transparent	23	

The explication of the premises can be found in the explanatory note, Appendix A, Table A.3.

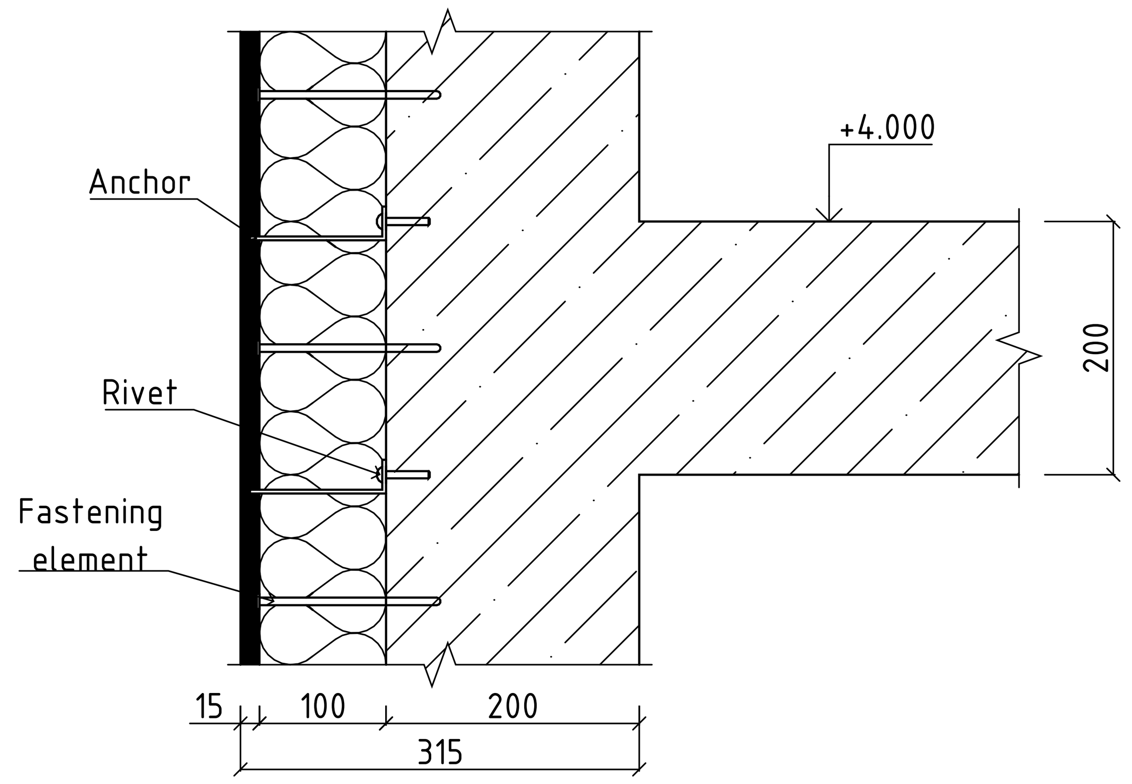
Meas.	N.part.	Sheet	Doc.№	Sign.	Date				
						SU - 6B07302 - Civil Engineering - 2025 - DP			
						Oncological hospital with high-tech departments in Almaty			
Head of Dep.		Shayakhmetov S.B.			05.06	Architectural and analytical section	Stage	Page	Sheets
Supervisor		Niyetbay S.Y.			02.0		DP	5	11
Norm Control		Yessembayeva A.A.			02.0				
Qual. Control		Kozyukova N.V.			2.06	Plan of the 2-nd floor, Specification of doors, Specification of stained glass windows	"CEaBM" department, CaDoBaS-21-4ar group		
Completed		Yessengeldinova A.K.			02.06				

Формат A2A

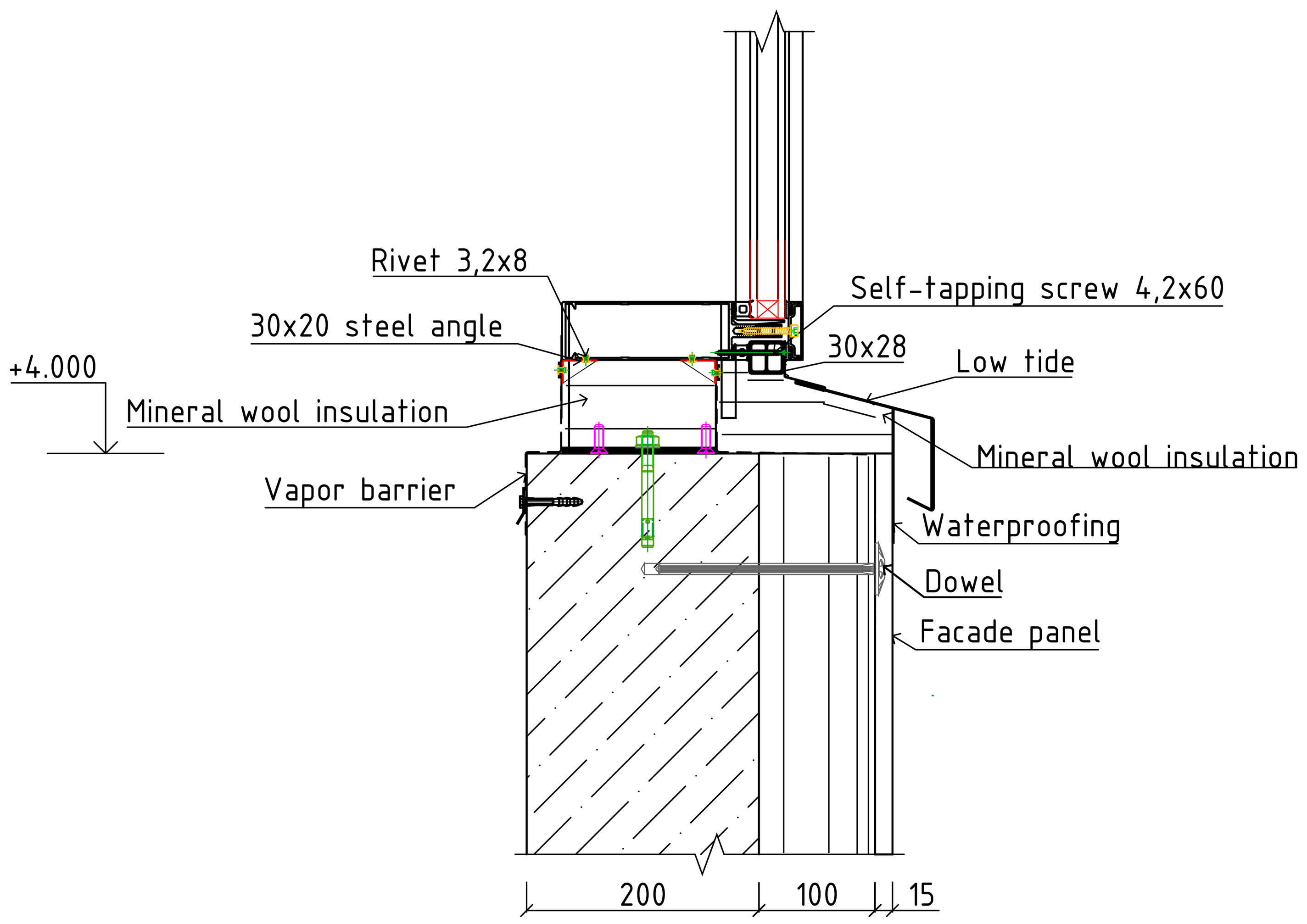
Section 1-1 (M1:100)



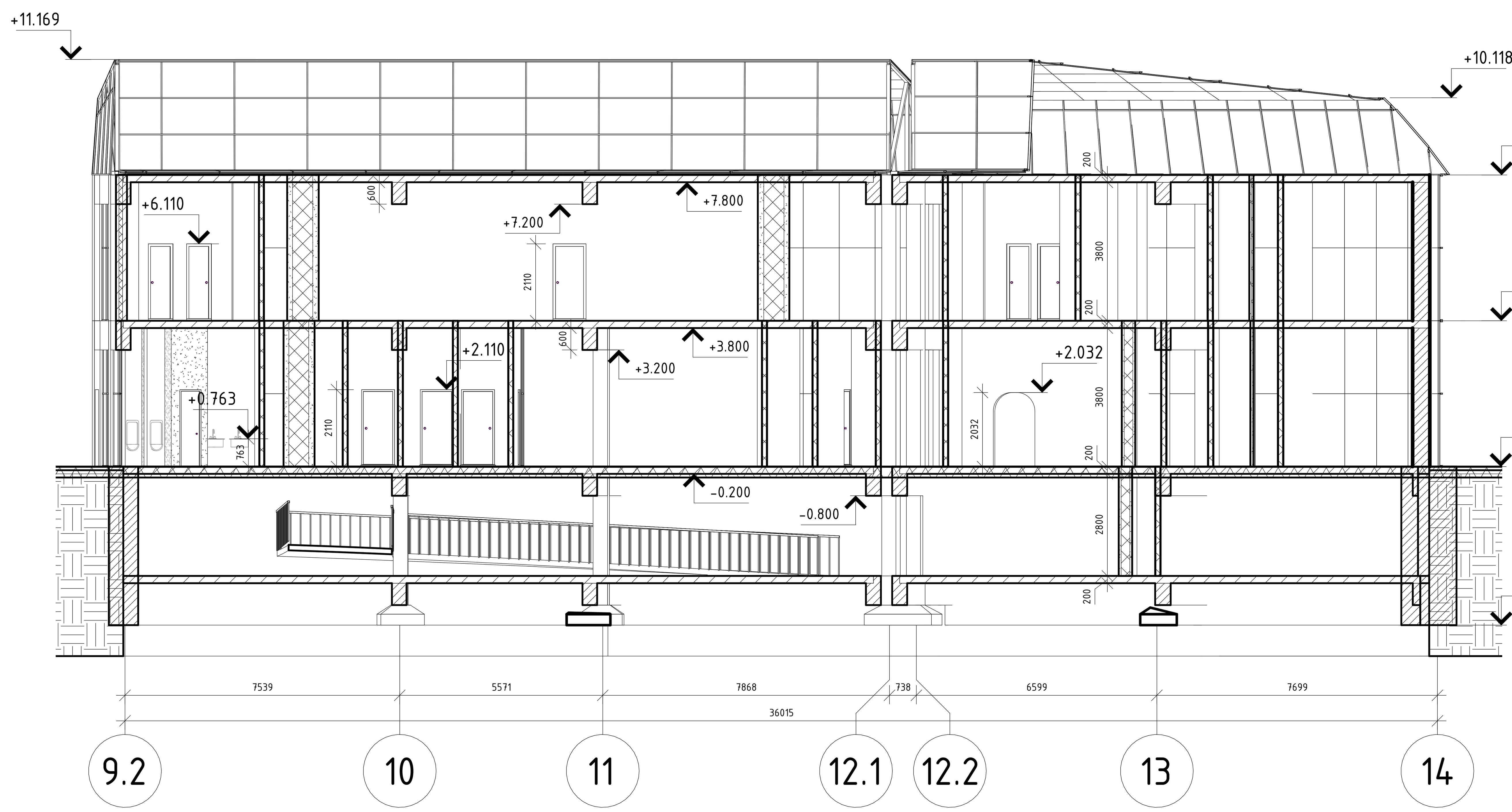
Knot 1 (M1:5)



Knot 2 (M1:5)



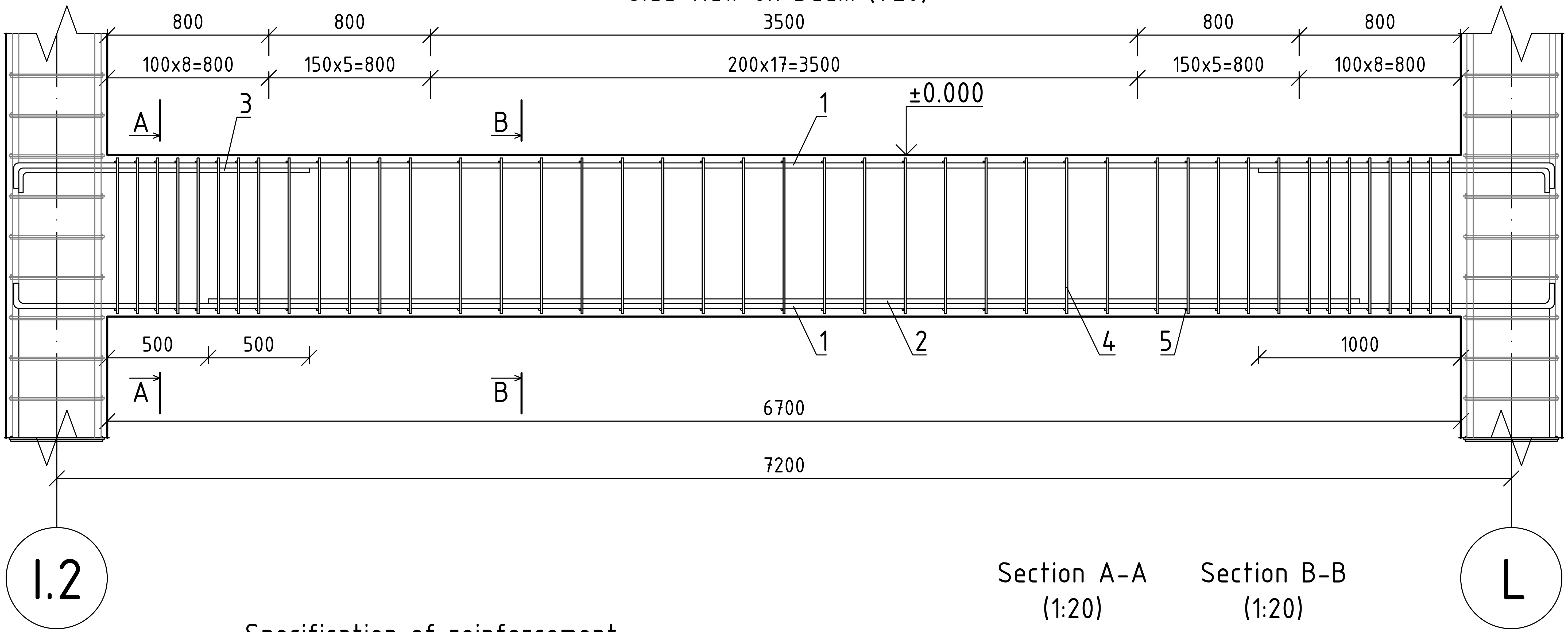
Section 2-2 (M1:100)



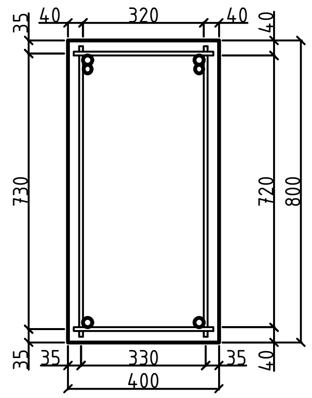
Meas.	N.part.	Sheet	Doc.№	Sign.	Date	SU - 6B07302 - Civil Engineering - 2025 - DP			
						Oncological hospital with high-tech departments in Almaty			
Head of Dep.		Shayakhmetov S.B.			05.06	Architectural and analytical section	Stage	Page	Sheets
Supervisor		Niyetbay S.Y.			02.06		DP	6	11
Norm Control		Yessembayeva A.A.			02.06				
Qual. Control		Kozyukova N.V.			2.06	Section 1-1, Section 2-2, Knot 1, Knot 2	"CEaBM" department, CaDoBaS-21-4ar group		
Completed		Yessengeldinova A.K.			02.06				

Формат А1А

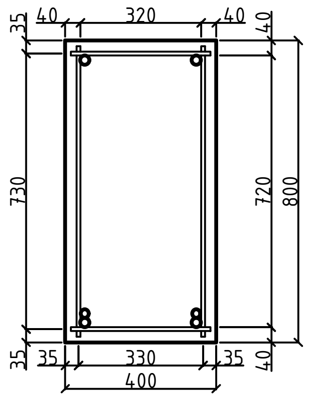
Side view on Beam (1:20)



Section A-A (1:20)



Section B-B (1:20)



Specification of reinforcement

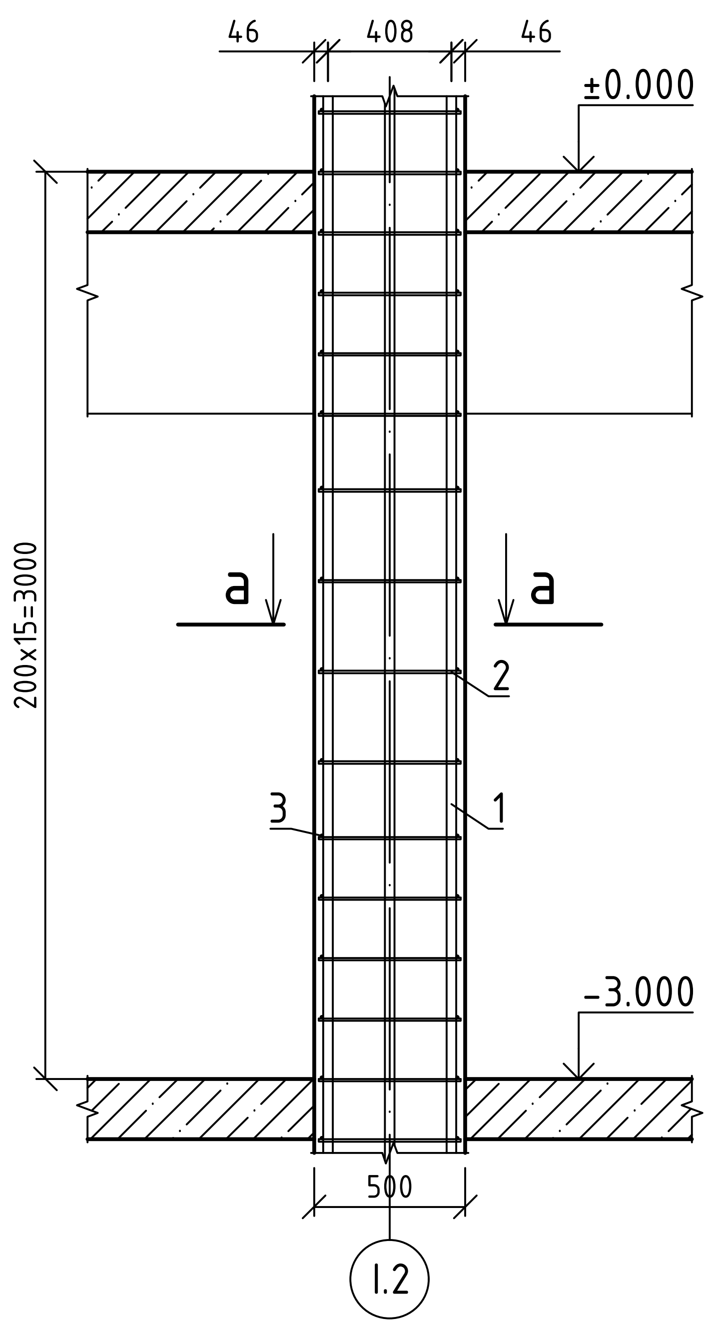
Position	Designation	Name	Quantity	Mass per unit, kg	Notice
1	ST RK EN 10080-2011	⌀25 S500 L=6700	6	25.82	154.89
2	ST RK EN 10080-2011	⌀22 S500 L=5700	3	17.01	51.03
3	ST RK EN 10080-2011	⌀22 S500 L=1000	6	2.98	17.9
4	ST RK EN 10080-2011	⌀10 S240 L=770	43	0.48	20.43
5	ST RK EN 10080-2011	⌀10 S240 L=370	43	0.23	9.82

Steel consumption statement

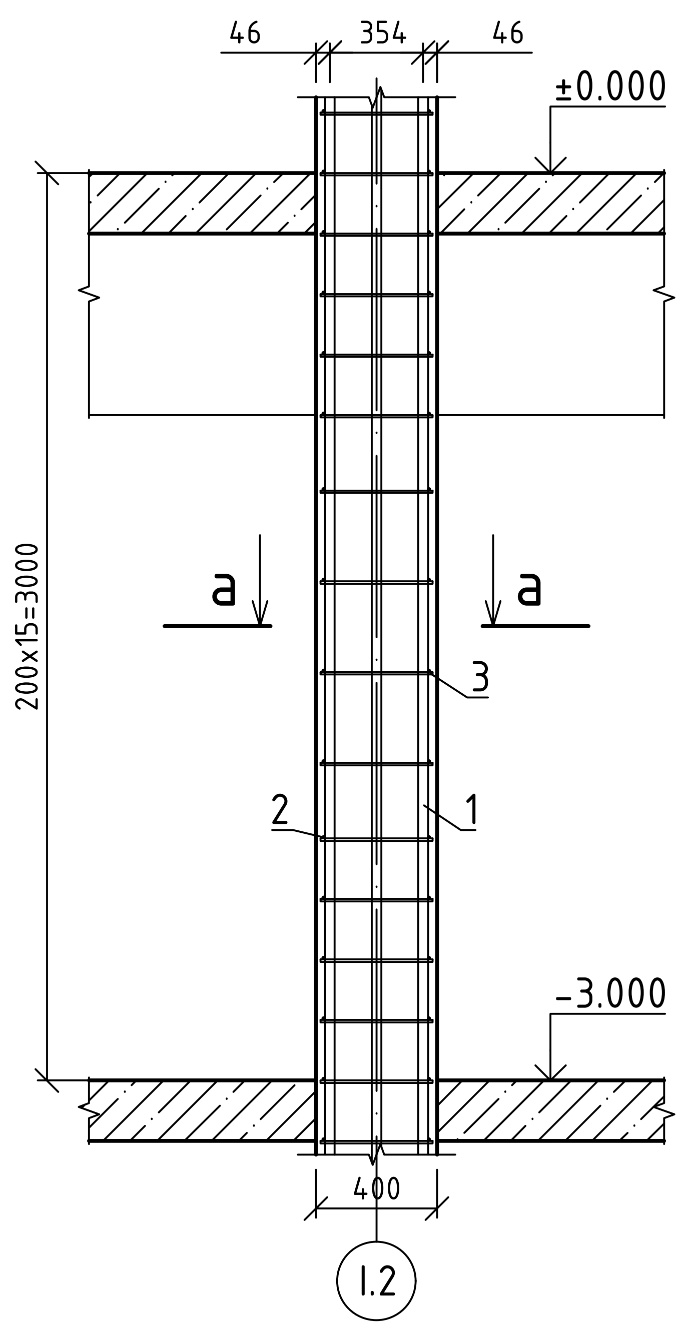
Element mark	Reinforcement details			Total
	Reinforcement class			
	S500		S240	
	ST RK EN 10080-2011			
	⌀25	⌀22	⌀10	
Beam	154.89	68.93	30.25	254.07

Meas.	N.part	Sheet	Doc.№	Sign.	Date	SU - 6B07302 - Civil Engineering - 2025 - DP		
						Oncological hospital with high-tech departments in Almaty		
Head of Dep.		Shayakhmetov S.B.			05.06	Calculation and construction section	Stage: DP	Page: 7
Supervisor		Niyetbay S.Y.			02.06			Sheets: 11
Norm Control		Yessembyeva A.A.			02.06			
Qual. Control		Kozyukova N.V.			2.06	Side view on Beam, Section A-A, Section B-B, Specification of reinforcement, Steel consumption statement	"CEaBM" department, CaDoBaS-21-4ar group	
Completed		Yessengeldinova A.K.			02.06			

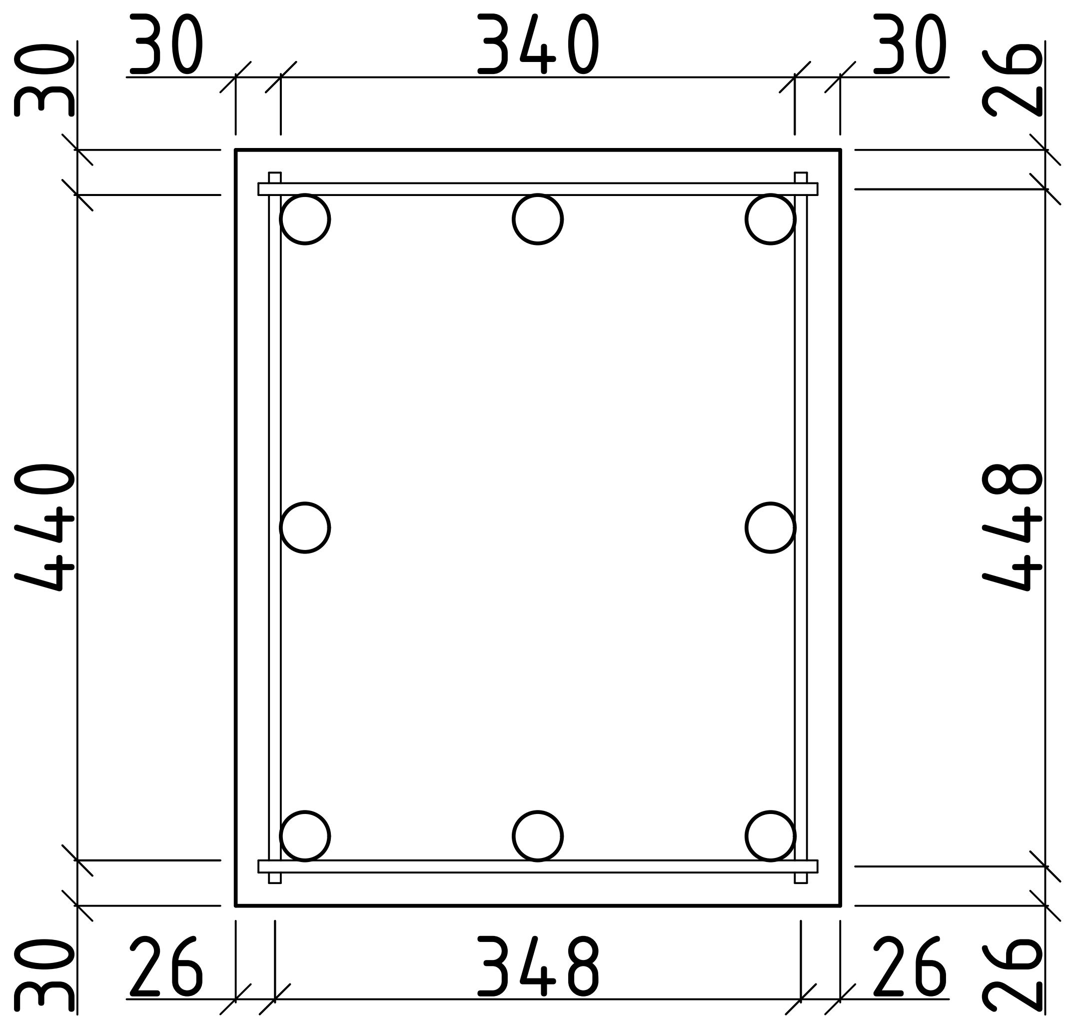
Reinforcement scheme for column by length (1:25)



Reinforcement scheme for column by width (1:25)



Section a-a (1:5)



Steel consumption statement

Element mark	Reinforcement details		
	Reinforcement class		Total
	S500	S240	
	ST RK EN 10080-2011		
	⌀32	⌀8	
Column	202.02	9.91	211.93

Specification of reinforcement

Position	Designation	Name	Quantity	Mass per unit, kg	Notice
1	ST RK EN 10080-2011	⌀32 S500 L=4000	8	25.25	202.02
2	ST RK EN 10080-2011	⌀8 S240 L=468	30	0.18	5.55
3	ST RK EN 10080-2011	⌀8 S240 L=368	30	0.15	4.36

SU - 6B07302 - Civil Engineering - 2025 - DP

Oncological hospital with high-tech departments in Almaty

Meas.	N.part	Sheet	Doc.№	Sign.	Date
Head of Dep.		Shayakhmetov S.B.			05.06
Supervisor		Niyetbay S.Y.			02.06
Norm Control		Yessembyeva A.A.			02.06
Qual. Control		Kozyukova N.V.			2.06
Completed		Yessengeldinova A.K.			02.06

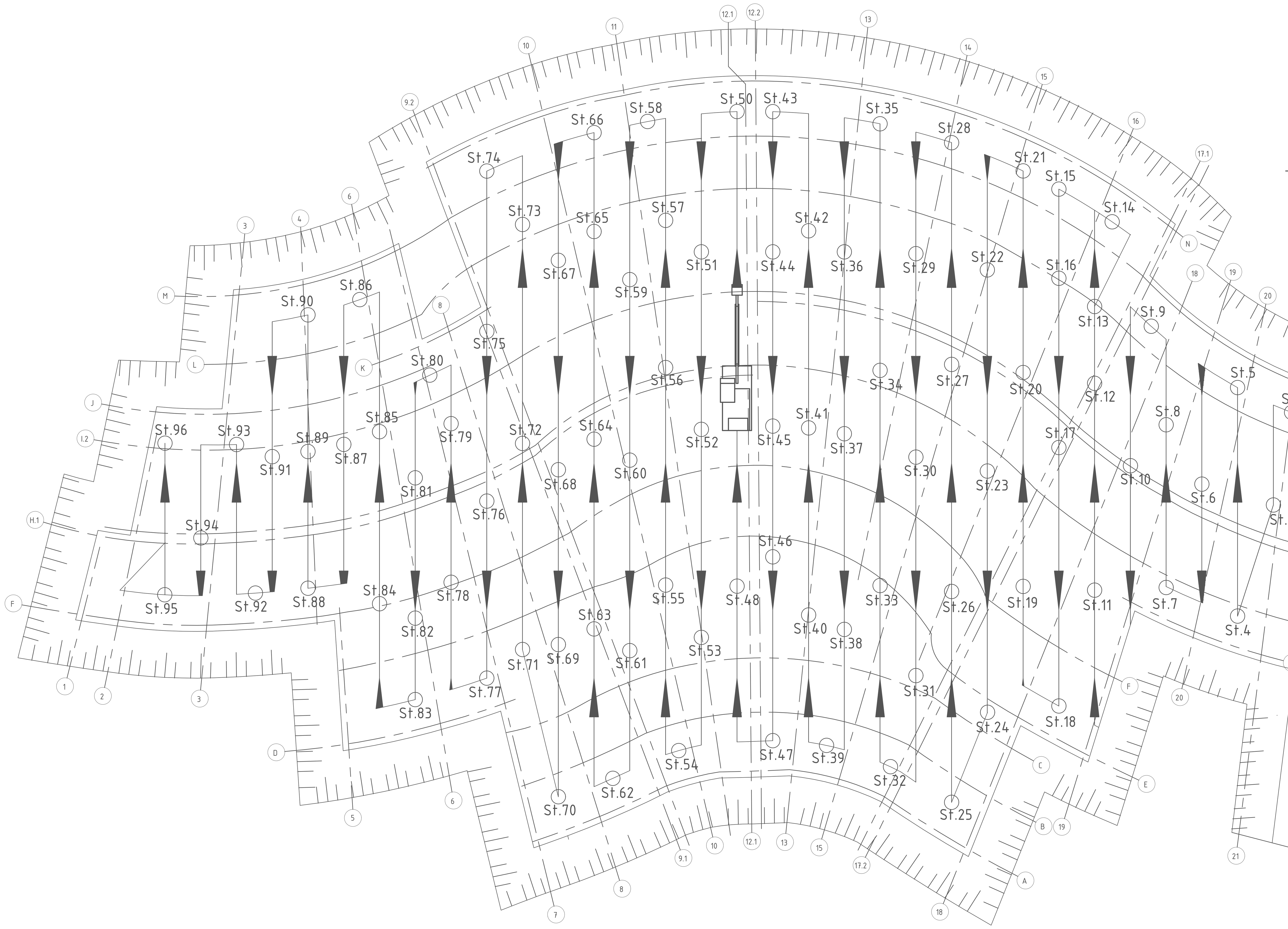
Calculation and construction section

Stage	Page	Sheets
DP	8	11

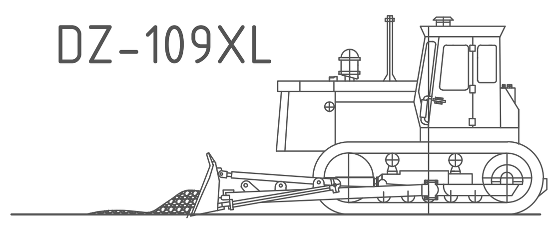
Reinforcement schemes for column by length and width, Section a-a, Specification of reinforcement, Steel consumption statement

"CEaBM" department, CaDoBaS-21-4ar group

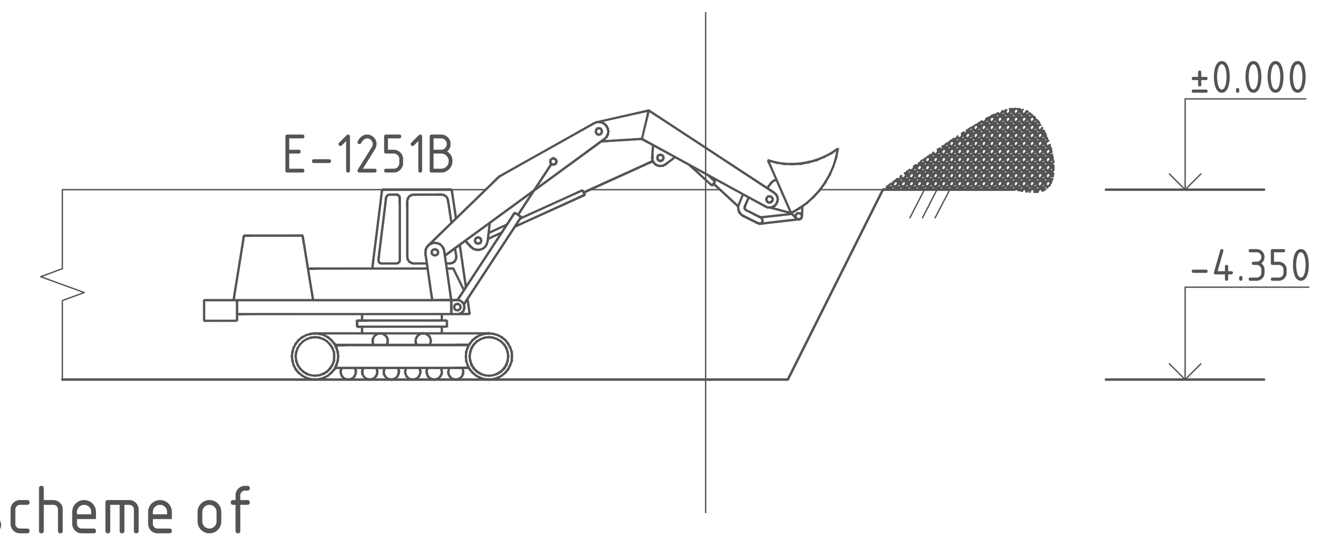
Plan of work of excavator 1:200



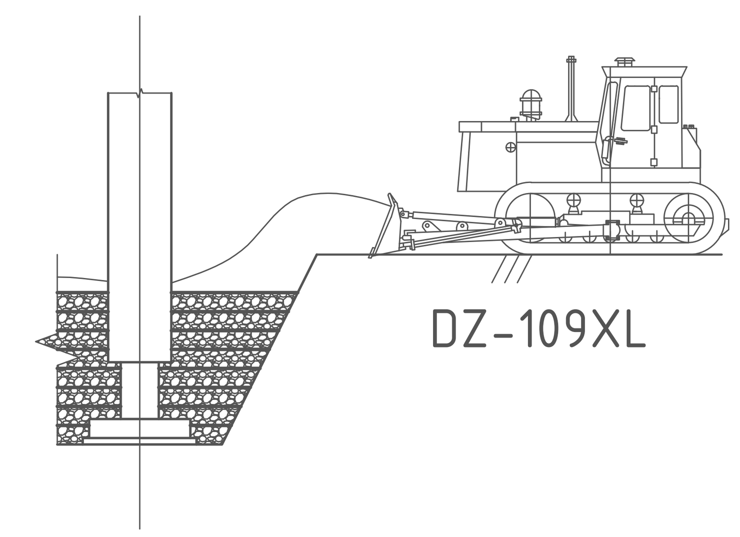
Scheme of removal of top soil 1:100



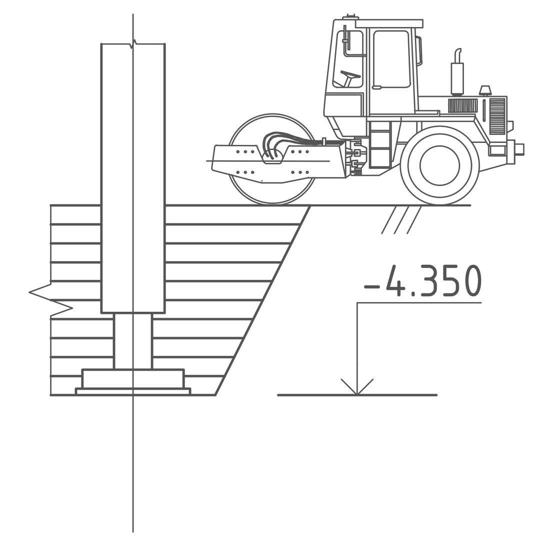
Section with scheme of creation the pit by excavator 1:100



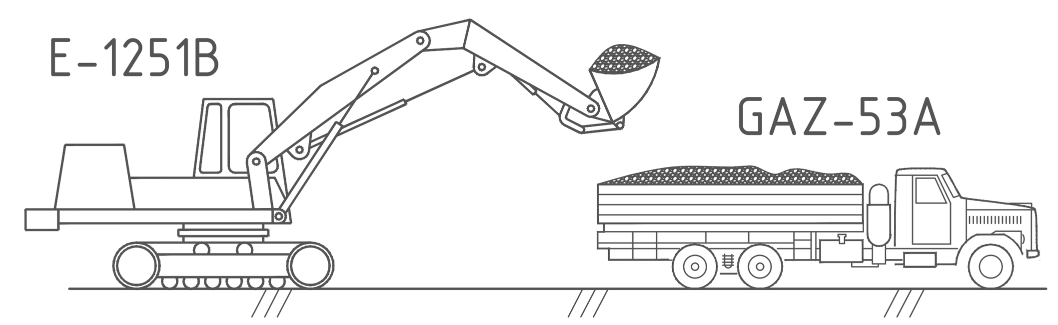
Section with scheme of backfilling by buldozer 1:100



Section with scheme of compaction soil by roller 1:100



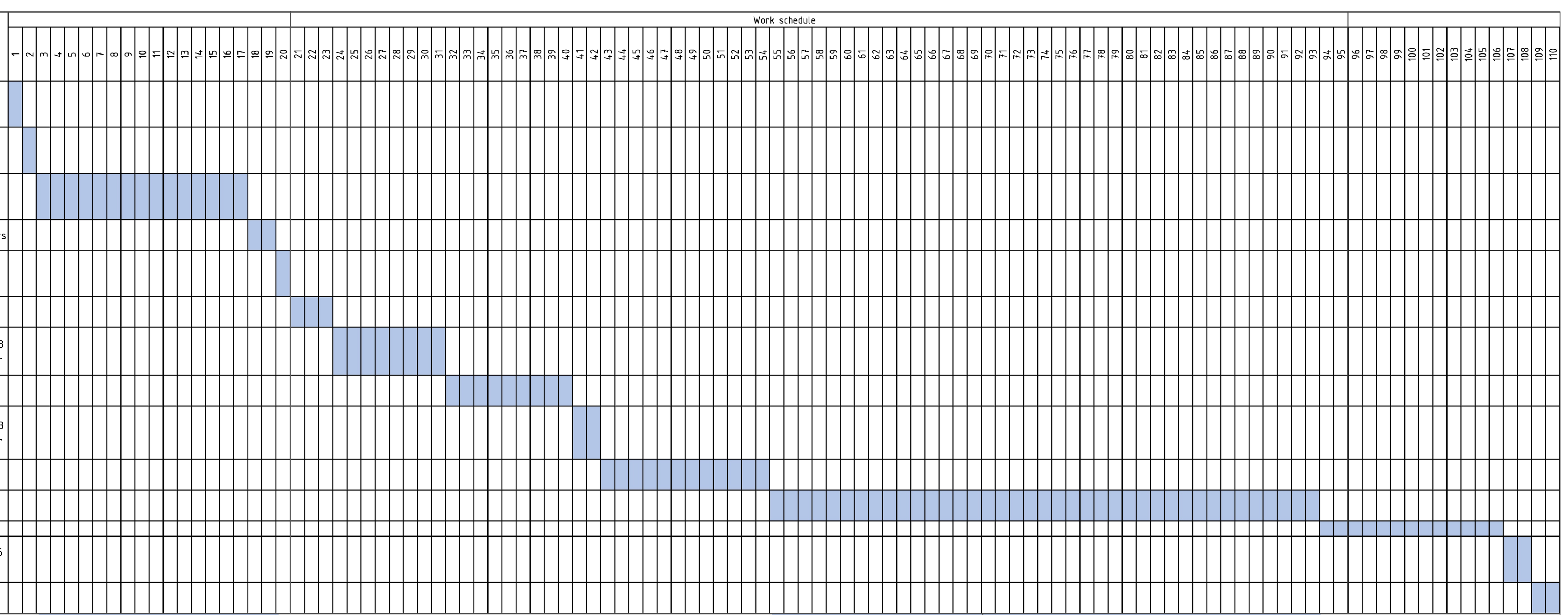
Scheme of working truck and excavator 1:100

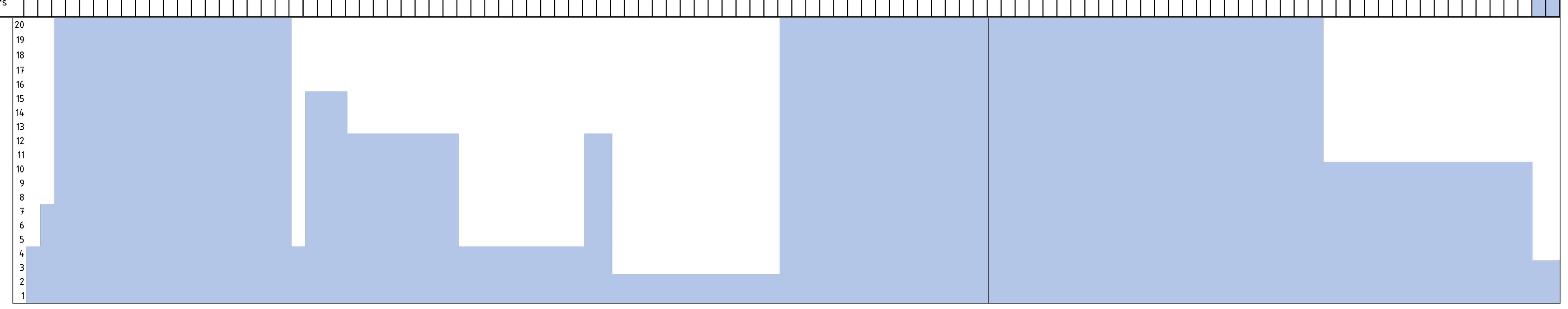


Calendar plan for zero-cycle work

Name of the process	Volume of work according to course work	Volume of work: Measurement	Volume of work: Number	Labor cost, hum-day	The required machines: Name	The required machines: Number of machine-shift	Duration, day	Number of shifts	Number of workers per shift	Structure of crew
The construction of temporary fencing	369,20	m	36,92	5,40	Bulldozer DZ-190XL	–	1,35	1	4	1 machinist, 3 workers
Removal of top soil	9 973,74	m2	9,97	5,59	Excavator E-1251B, truck GAZ-53A	5,59	0,80	1	7	7 machinists
Soil excavation in the trench	8 377,38	m3	83,77	326,84	Excavator E-1251B, truck GAZ-53A	298,23	14,91	1	20	20 machinists
Excavation of soil underrun	143,79	m3	143,79	28,76		–	1,44	1	20	20 earthworkers
Concrete preparation for foundations	23,11	m3	23,11	2,23	KamAZ 65201	–	0,56	1	4	1 machinist, 3 workers
Reinforcement installation	14,78	t	14,78	39,97	Crane XCMG QY25K5	–	2,66	1	15	12 fitters, 3 welder
Formwork installation	783,77	m2	783,77	128,46	Crane XCMG QY25K5	94,05	7,84	1	12	9 carpenters, 3 crane operator
Concreting of foundations	96,06	m3	96,06	99,56	Concrete pump	85,50	8,55	1	4	1 machinist, 3 workers
Formwork removal	783,77	m2	783,77	29,63	Crane XCMG QY25K5	–	2,47	1	12	9 carpenters, 3 crane operator
Foundation waterproofing	2 021,77	m2	20,22	24,66		–	12,33	1	2	2 workers
Backfilling	4 020,06	m3	4 020,06	1 567,82	Bulldozer DZ-190XL	1 567,82	39,20	2	20	20 machinist
Soil compaction	13 400,19	m2	134,00	123,28	DU-126	123,28	13,40	1	10	10 machinist
Final land planning	7 120,73	m2	71,21	37,76	Excavator E-1251B, truck GAZ-53A	34,89	1,74	1	10	4 machinists, 6 workers
Removal of temporary fencing	369,20	m	36,92	4,05		–	1,35	1	3	3 workers

Work schedule





Nº	Name	Measurement	Number
1	Duration	day	109
2	Labor intensity	hum-day	2424

$n_{average}=19.23$
$n_{max}=20$

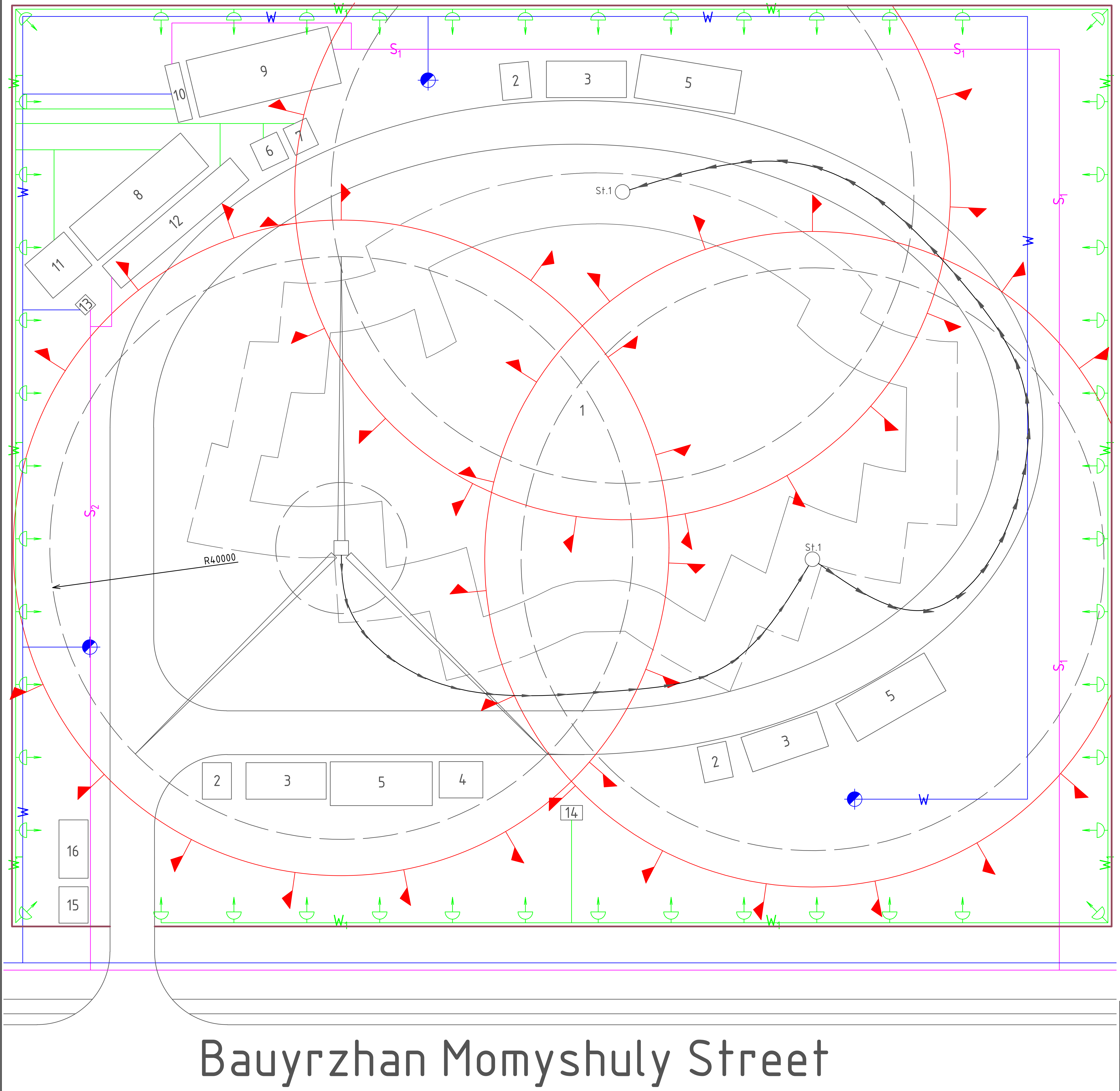
$K_{uneven}=n_{max}/n_{average}$
$K_{uneven}=20/19.23$
$K_{uneven}\approx1$

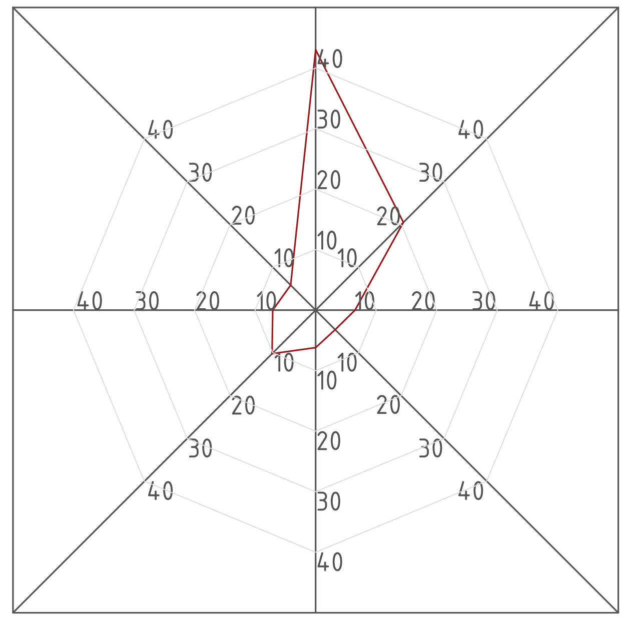
Safety rules

During the excavation work, it is necessary to comply with the safety requirements provided for in the SNIP and the work project. Prior to the start of excavation work, it is necessary to establish the exact location
of all existing underground utilities. Near them, soil development should be carried out only with the permission of the organization operating these communications, in the presence of a representative of the organization and under the supervision of a foreman and a foreman.
In the immediate vicinity of electric cables, pressure pipelines and gas pipelines, soil mining should be carried out without the use of percussion instruments.
When developing a pit and trench, construct slopes in accordance with current regulatory documents. When working with an excavator, it is forbidden to be under its bucket or boom, to work from the side of the face. Loading of soil into a dump truck with an excavator is carried out from the rear or side side, the presence of people between the excavator and the car is prohibited.
When loosening frozen soils by explosive means, it is necessary to observe a safe distance that protects people, buildings, structures and mechanisms from the dangerous effects of an explosion.
During installation work , the following requirements must be strictly observed. Special precautions should be taken in windy weather. At negative outdoor temperatures
, anti-icing measures should be applied, and a room should be equipped for heating,
bringing them as close as possible to the place of work. Conduct proper operation
of the crane to ensure its stability, which is ensured by proper installation on a reliable base strictly in horizontal and vertical positions.

Meas.	N.part	Sheet	Doc.№	Sign.	Date	SU - 6B07302 - Civil Engineering - 2025 - DP			
						Oncological hospital with high-tech departments in Almaty			
Head of Dep.		Shayakhmetov S.B.			05.06	Organizational and technological section	Stage	Page	Sheets
Supervisor		Niyetbay S.Y.			02.06		DP	9	11
Norm Control		Yessembyeva A.A.			02.06				
Qual. Control		Kozyukova N.V.			2.06	Scemes of working of machines, Calendar plan for zero-cycle work	"CEaBM" department, CaDoBaS-21-4ar group		
Completed		Yessengeldinova A.K.			02.06				

General masterplan 1:400





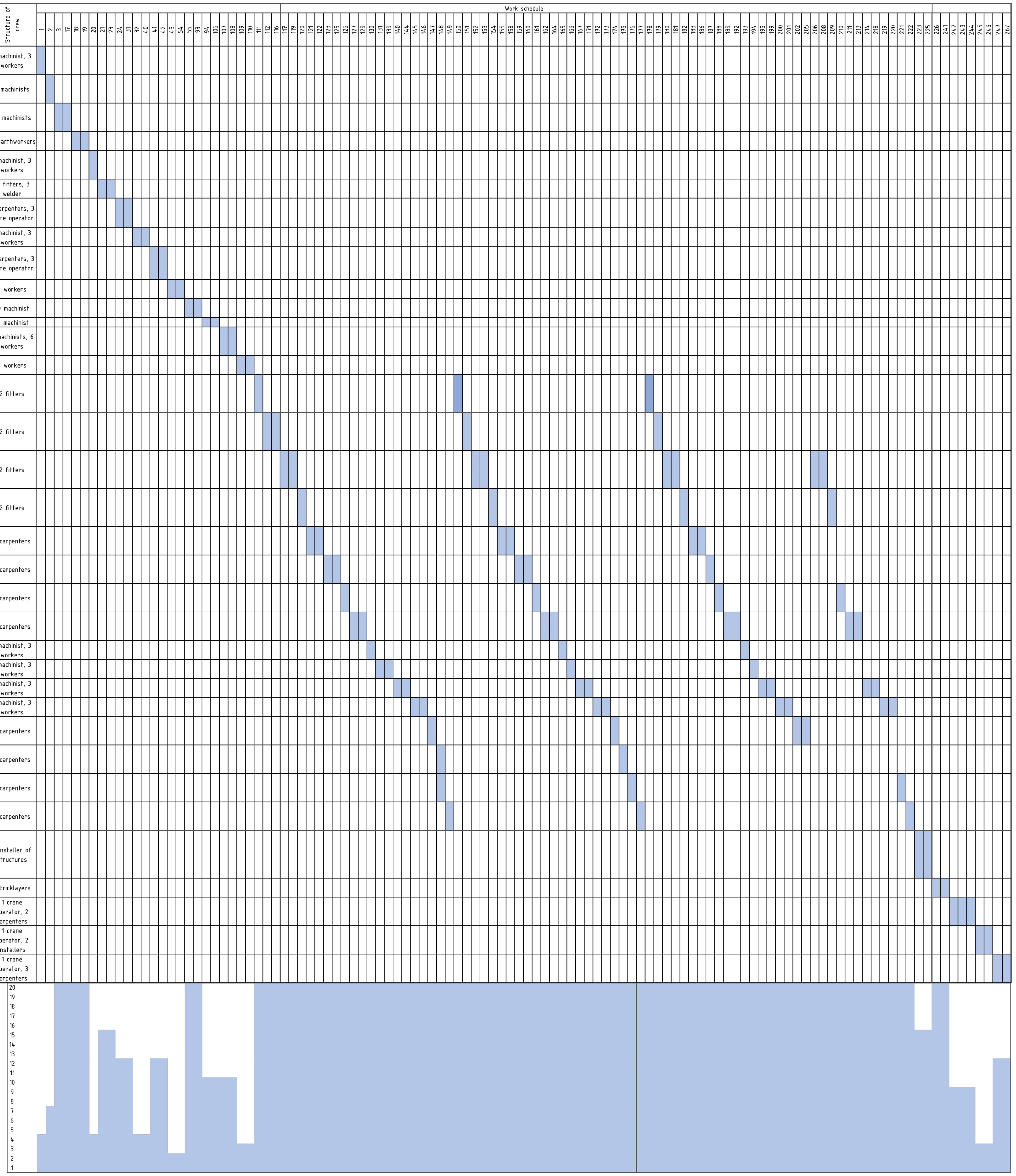
Explication of objects			
№	Name of the building	Area, m2	Notice
1	Oncological hospital		
2	Open warehouse	19.86	Reinforcement
3	Open warehouse	53.42	Sand, gravel
4	Closed warehouse	30.64	Cement
5	Shelter warehouse	80.04	Formwork
6	Administrative building	16	
7	Control room	14	
8	Dressing room	120	
9	Shower	164	
10	Washbasin	13	
11	Drying room	40	
12	Canteen	91	
13	Toilet	1.82	
14	Transformer station	6	
15	Checkpoint	20	
16	Wheel washing point	24	

Symbols and graphics		Symbols and graphics (continuation)	
Symbol	Meaning	Symbol	Meaning
	Fire Hydrant	S_2	Sewerage system 2
	Spotlight	W_1	Electric line
W	Water supply system		Fencing
S_1	Sewerage system 1		Dangerous zone
			Radius of crane working area

Meas.	N.part	Sheet	Doc.№	Sign.	Date	SU - 6B07302 - Civil Engineering - 2025 - DP
Head of Dep.		Shayakhmetov S.B.			05.06	Oncological hospital with high-tech departments in Almaty
Supervisor		Niyetbay S.Y.			02.06	Organizational and technological section — Stage: DP; Page: 11; Sheets: 11
Norm Control		Yessembyeva A.A.			02.06	
Qual. Control		Kozyukova N.V.			2.06	General master plan, Explication of objects, Symbols and graphics
Completed		Yessengeldinova A.K.			02.06	"CEaBM" department, CaDoBaS-21-4ar group

Calendar plan

Name of the process	Volume of work: Measurement	Volume of work: Number	Labor cost, hum-day	The required machines: Name	The required machines: Number of machine-shift	Duration, day	Number of shifts	Number of workers per shift	Structure of crew
The construction of temporary fencing	m	36,92	5,40	Bulldozer DZ-190XL	-	1,35	1	4	1 machinist, 3 workers
Removal of top soil	m2	9,97	5,59	Excavator E-1251B, truck GAZ-53A	5,59	0,80	1	7	7 machinists
Soil excavation in the trench	m3	83,77	326,84	Excavator E-1251B, truck GAZ-53A	298,23	14,91	1	20	20 machinists
Excavation of soil underrun	m3	143,79	28,76		-	1,44	1	20	20 earthworkers
Concrete preparation for foundations	m3	23,11	2,23	KamAZ 65201	-	0,56	1	4	1 machinist, 3 workers
Reinforcement installation	t	14,78	39,97	Crane XCMG QY25K5	-	2,66	1	15	12 fitters, 3 welder
Formwork installation	m2	783,77	128,46	Crane XCMG QY25K5	94,05	7,84	1	12	9 carpenters, 3 crane operator
Concreting of foundations	m3	96,06	99,56	Concrete pump	85,50	8,55	1	4	1 machinist, 3 workers
Formwork removal	m2	783,77	29,63	Crane XCMG QY25K5	-	2,47	1	12	9 carpenters, 3 crane operator
Foundation waterproofing	m2	20,22	24,66		-	12,33	1	2	2 workers
Backfilling	m3	4 020,06	1 567,82	Bulldozer DZ-190XL	1 567,82	39,20	2	20	20 machinist
Soil compaction	m2	134,00	123,28	DU-126	123,28	13,40	1	10	10 machinist
Final land planning	m2	71,21	37,76	Excavator E-1251B, truck GAZ-53A	34,89	1,74	1	10	4 machinists, 6 workers
Removal of temporary fencing	m	36,92	4,05		-	1,35	1	3	3 workers
Installation and tying of reinforcement cages for columns	t	42,98	45,60		-	2,28	1	20	2 fitters
Installation and tying of reinforcement cages for walls	t	125,43	133,08		-	6,65	1	20	2 fitters
Installation and tying of reinforcement cages for slab	t	224,71	238,41		-	11,92	1	20	2 fitters
Installation and tying of reinforcement cages for beams	t	54,95	58,30		-	2,91	1	20	2 fitters
Installation of formwork for columns	m2	3 981,24	194,21		-	9,71	1	20	2 carpenters
Installation of formwork for walls	m2	2 999,80	146,33		-	7,32	1	20	2 carpenters
Installation of formwork for slab	m2	584,48	28,51		-	1,43	1	20	2 carpenters
Installation of formwork for beams	m2	5 988,00	292,10		-	14,60	1	20	2 carpenters
Concreting of columns	m3	429,78	78,62	KamAZ 65201	-	3,93	1	20	1 machinist, 3 workers
Concreting of walls	m3	1 254,28	229,44	KamAZ 65202	-	11,47	1	20	1 machinist, 3 workers
Concreting of slab	m3	2 247,05	411,05	KamAZ 65203	-	20,55	1	20	1 machinist, 3 workers
Concreting of beams	m3	715,45	130,88	KamAZ 65204	-	6,54	1	20	1 machinist, 3 workers
Dismantling of formwork for columns	m2	6 645,44	121,56		-	6,08	1	20	2 carpenters
Dismantling of formwork for walls	m2	2 139,80	39,14		-	1,96	1	20	2 carpenters
Dismantling of formwork for slab	m2	430,28	7,87		-	0,39	1	20	2 carpenters
Dismantling of formwork for beams	m2	4 338,00	79,35		-	3,97	1	20	2 carpenters
Installation of partitions with a single metal frame (height less than 5 m)	m2	666,32	47,94		-	3,20	1	15	3 installer of structures
Laying brick walls	m3	836,60	326,48		-	16,32	1	20	2 bricklayers
Doors installation	m2	18,58	30,37	Crane XCMG QY25K5	223,00	3,37	1	9	1 crane operator, 2 carpenters
Installation of metal frames	t	17,20	6,08	Crane XCMG QY25K5	25,80	2,03	1	3	1 crane operator, 2 installers
Installation of stained glass windows	m2	135,81	250,09	Crane XCMG QY25K5	1 860,60	20,84	1	12	1 crane operator, 3 carpenters



Nº	Name	Measurement	Number
1	Duration	day	267
2	Labor intensity	hum-day	5337

$n_{average}=19.992$

$n_{max}=20$

$K_{uneven}=n_{max}/n_{average}$

$K_{uneven}=20/19.992$

$K_{uneven}\approx 1$

General instructions on how to perform the work

Before the excavation begins, it is necessary to break up the site, remove the axes, and clear the area of debris, vegetation, and unnecessary structures. If necessary, lower the groundwater level.
Excavation work must be carried out in accordance with the design documentation, in compliance with safety regulations and occupational safety regulations. The work should be carried out in layers, with the control of marks and compliance with the design slopes.
The development of the soil is carried out by a mechanized method (excavators, bulldozers, etc.), taking into account its category. When working near existing communications, use manual engineering. Excavation should be carried out with minimal disruption of the natural structure of the soil being left.
The soil is removed to specially designated areas or used for backfilling. Temporary dumps should be placed outside the area of movement of machinery and works.
Backfilling should be carried out in layers (20–30 cm each), with mandatory compaction of each layer in a mechanized manner. Use suitable soil for filling, without organic inclusions and construction debris.
The control includes checking the depths and marks of the recesses, the degree of compaction, and compliance with design solutions. If necessary– laboratory tests of the soil.

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Supervisor		Niyetbay S.Y.			02.06		DP	10	11
Norm Control		Yessembyeva A.A.			02.06				
Qual. Control		Kozyukova N.V.			2.06	Calendar plan for the whole volume of work	"CEaBM" department, CaDoBaS-21-4ar group		
Completed		Yessengeldinova A.K.			02.06				