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»

Levin D.R.

A new passenger terminal of the airport with comfort zones in Astana.

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.

«10» 06 2025

EXPLANATORY NOTE

to the diploma project

Topic: A new passenger terminal of the airport with comfort zones in Astana

6B07302 – «Civil Engineering»

Performed by

Levin D.R.

Reviewer
Master of technical sciences, Chief Engineer of the Architectural and Construction Section
JSC "Mega Center Management"
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«04» 06 2025

Scientific supervisor
Master of Technical Sciences

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«09» 06 2025

Mega Center Management (Мега Центр Менеджмент)

Almaty 2025

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6B07302 – «Civil Engineering»

Утверждаю

Head of the Department

Doctor of Technical Sciences,
Professor

S.B. Shayakhmetov

«29» 01 2025

Diploma the project to perform TASK for

Education recipient Levin D.R

Topic: A new passenger terminal of the airport with comfort zones in Astana.

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 - Astana.
Structural system of the building – metal frame with sub-roof trusses

Diploma in the project to develop belonging problems list:

a) Architectural solutions and structural analysis. Description of the construction site and its natural and climatic parameters.;
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. AR
2. RR
3. OTR

*is shown in slides*_____

Recommended main literature:

СП РК 2.04-01-2017 «Строительная климатология»;
СП РК EN 1991-1-1:2002/2011 «ВОЗДЕЙСТВИЯ НА НЕСУЩИЕ КОНСТРУКЦИИ Часть 1-1. Собственный вес, постоянные и временные нагрузки на здания»;
НТП РК 03-01-2.1-2012 – «Проектирование стальных конструкций с учетом воздействия пожара»

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	Sakhi A.K. Master of Technical Sciences, Lecturer	07.01.2025	
Calculation and construction	Sakhi A.K. Master of Technical Sciences, Lecturer	20.02.2025	
Organizational and technological	Sakhi A.K. Master of Technical Sciences, Lecturer	03.04.2025	
Economic	Sakhi A.K. Master of Technical Sciences, Lecturer	17.04.2025	
Norm control	A.A. Yessembayeva, Master of Technical Sciences, Lecturer	09.06.25 г.	
Quality control	N.V. Kozyukova, Master of Engineering Sciences, Senior Lecturer	10.06.2025	

Scientific supervisor _____ Sakhi A.K.

The student was able to complete the task _____ Levin D.R.

Date «03» 02 _____2025

АҢДАТПА

Әуежайдың жаңа жолаушылар терминалы-ел астанасының логистикалық әлеуетін дамытудың жаңа жолдарын ашу мүмкіндігі. Жобада күрделі құрылымдар мен ғимараттың үлкен аралықтарының болуына көп көңіл бөлінеді. Сондай-ақ, топырақтың геологиялық күрделі құрылымына байланысты қадалардың іргетасын қалыптастыру жұмыстары қарастырылды. Әзірленген жобада ғимараттың архитектуралық келбетін, дизайн ерекшеліктерін, технологиялық тәсілді және сметалық құнын қарастыратын барлық бөлімдер толық ұсынылған.

АННТОАЦИЯ

Новый пассажирский терминал аэропорта — это возможность открыть новые пути развития логистическое потенциала столицы нашей страны. В проекте больше внимание уделено наличию сложных конструкций и больших пролетов здания. Также рассмотрены работы по формированию свайного фундамента, ввиду геологически сложной структуры грунта. В разработанном проекте в полной мере представлены все разделены, затрагивающие как архитектурный облик здания, конструктивные особенности, технологический подход и сметная стоимость.

ABSTRACT

The designed passenger terminal in the city of Almaty is a multifunctional complex, made considering all modern design standards. Particular attention was paid to the creation of a comfortable and safe environment for visitors and employees of the terminal. Separately, the project considers issues of increasing energy efficiency and the most favorable ecological integration with the environment. The presented diploma project contains a complex of all necessary documentation, starting from the analysis of the prerequisites for construction in the architectural and analytical section and ending with the conclusions of financial investments and benefits in the economic section.

CONTENT

INTRODUCTION

The development of modern transport infrastructure is a key indicator of a country's economic growth and its integration into the global network. In recent years, the city of Astana, the capital of Kazakhstan, has experienced rapid urban and economic development, resulting in an increased demand for high-quality public services, including air transportation. The growing flow of domestic and international passengers necessitates the creation of a new, advanced passenger terminal that meets international standards and ensures maximum comfort, efficiency, and safety for travelers.

This diploma project is focused on the architectural and functional design of a new passenger terminal in Astana. The project aims not only to accommodate the projected increase in passenger traffic but also to offer a comfortable and pleasant experience for all users. Special attention is given to creating well-thought-out zoning solutions, including waiting areas, commercial spaces, baggage handling systems, and passenger service points, in line with current trends in airport terminal design. The implementation of this project is expected to contribute significantly to the modernization of Kazakhstan’s aviation infrastructure, promote tourism, and support the socio-economic development of the region. Moreover, the design concept emphasizes energy efficiency, accessibility, and adaptability to future expansion, making the terminal a model of sustainable and user-oriented public architecture.

In addition, the project incorporates smart technologies for real-time passenger flow monitoring, automated check-in and security systems, and digital information panels to enhance user experience and operational efficiency.

Green infrastructure elements such as, rainwater harvesting systems, and the use of renewable energy sources are also introduced to reduce the environmental impact of the terminal.

1 Architectural and analytical section

In this section, the characteristics of the projected airport building in Astana will be considered. They can be divided into two main subsections, including architectural and constructive-analytical.

1.1 Architectural subsection

1.1.1 Characteristics of the construction area

Astana, which is a transport hub connecting the north with the south and the west with the east, was chosen as the construction site. This location opens up great opportunities and prospects for the development of the logistics industry, and therefore this project has been developed. The layout of the object on the territory of the city is shown in Figures 1 and 2.

Figure 1 – Situational scheme 1

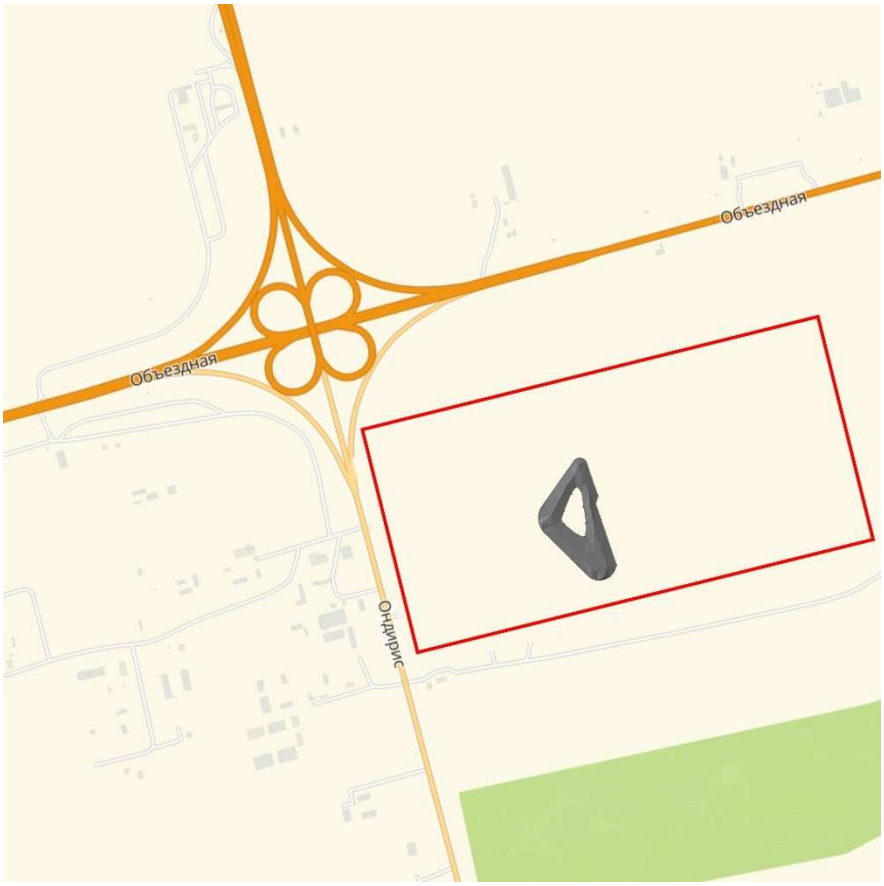


Figure 2 – Situational scheme 2

First of all, we will deal with the climatic conditions. According to [1], the city belongs to the climatic subdistrict IB. Based on this fact, it is possible to draw conclusions about low temperatures in winter, as well as strong winds. The city is located in the IV wind region with a base wind speed of 35 m/s. Figure 3 shows a diagram of the wind rose at the construction site.

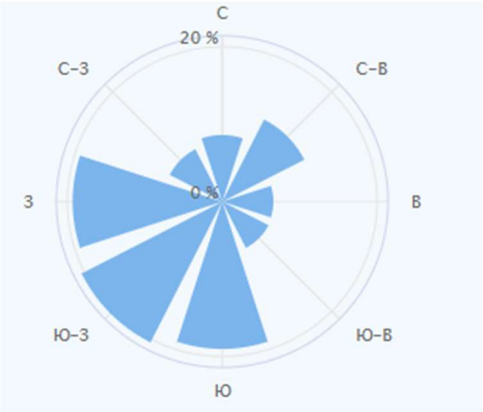


Figure 3 – Wind rose in Astana

The next important aspect is to consider the engineering and geological conditions for the selected construction site. Based on the visual field description, confirmed by the results of laboratory soil studies, it was found that up to the studied depth, the survey site consists of medium-quaternary-modern deposits represented by loams with frequent layers of sand and sandy loam and eluvial formations of lower carbon siltstones – dry soils. From above, these deposits are overlain by bulk soils. According to drilling data, groundwater was uncovered at depths of 3.8-3.9m.

1.1.2 Architectural and planning solutions

The airport project includes a multi-stage design approach that combines beauty and functionality. This facility is of high economic and strategic importance for the city and its infrastructure.

Architectural solutions were dictated by modern quality standards, as well as the project to create a single Astana city code. The object under development includes the ideas of sustainable architecture development, as well as the government's goals to reduce the carbon footprint.

The project is made in a non-linear composition, which can be briefly described as a soft triangle. This shape is perfect both aesthetically and functionally. The building itself is divided into four parts by expansion joints due to its size and the need to increase safety measures during operation. The building has two floors, the movement between which is organized using a system of escalators, as well as staircases and elevator blocks.

The roof plays a leading role in the compositional picture of the object. It has a domed structure, which adds volume to the shape and highlights this project with its architectural idea. This form of roof is extremely effective against the winds, which are frequent in the area of construction.

The dimensions of the building in terms of axes are 165x83 m. Such dimensions are due to the need for high throughput, as well as the need to accommodate complex technical equipment. The total area of the premises is more than 8000 m2. The height of the floors of the building is determined by the peculiarities of movement and loading of passengers on airliners. Thus, the height of the first floor is 4.2 m, while the lower level of the trusses is 10.6 m, which makes the space more free and open. Due to its size, the building is divided into 4 blocks by expansion joints to avoid rolling and uneven precipitation.

1.1.3 Engineering subsection

The airport building has a large area and requires a special approach to the selection of heating and ventilation systems due to the high number of people interacting with the facility. A forced supply and exhaust ventilation system becomes the solution for such a spacious environment. These systems are based on ceiling-mounted air supply and extraction units, which do not interfere with the architectural design concepts. The city's water-based heating system is not suitable for the building, so to maintain a comfortable temperature level, it is necessary to use heat recovery systems and electric air conditioners equipped with temperature sensors.

In addition, automated climate control systems play an important role in ensuring the efficient operation of the airport’s engineering systems in Astana, allowing regulation of microclimate parameters in different zones of the building, depending on the time of day and passenger flow. Given the harsh climate conditions of the region, external engineering communications are additionally insulated, and the equipment is selected for its high resistance to temperature fluctuations. Power supply is organized with the use of backup energy sources, which ensures the uninterrupted operation of all critical systems, including lighting, navigation equipment, and security systems. Water supply and drainage systems are also a key focus: the airport is equipped with modern pumping stations, automated leak detection systems, and water filtration units. All these measures are aimed at creating a safe, energy-efficient, and comfortable environment for passengers and staff.

1.1.4 Energy efficient solutions

To increase the profitability and efficiency of the project, various energy-efficient solutions are implemented. One of the main features is the large number of electric vehicle charging stations powered by solar panels. The project also includes a system for collecting and reusing rainwater and snow, which reduces the demand for water for technical needs.

The airport building is equipped with intelligent lighting control systems based on motion and natural light sensors, which significantly reduce electricity consumption. LED lighting is used throughout all terminal areas, including runways and parking zones, ensuring long service life and low energy use. Additionally, the building facade incorporates energy-efficient double-glazed windows with high thermal insulation, which reduces heat loss during the winter season and minimizes energy consumption for indoor heating. All engineering systems are integrated into a centralized Building Management System (BMS), allowing real-time monitoring and optimization of energy use based on current loads and weather conditions. These comprehensive solutions make the airport in Astana a modern example of sustainable and environmentally responsible infrastructure.

1.2 Analytical subsection

It was decided to choose a pile foundation as the foundation for the facility. This is due to the geological composition of the selected area. Due to the large number of compressible and subsident soils, which can lead to uneven precipitation when using traditional foundation design methods. Piles, in turn, greatly reduce shrinkage, because they work on the principle of friction and even in the presence of subsidence soils will ensure the stability of the structure.

Based on the above facts, it is possible to decide on choosing the type of foundation and the depth of its laying. Due to the high compressibility of soils, piles will take over the main bearing capacity, which will be connected to bushes using a columnar grillage. To begin with, we will determine the depth of the grillage using the formula.

$$d_{fn} = d_0 \cdot \sqrt{|M_t|} = 0.4 \cdot \sqrt{|-23|} = 1.91\ m$$

where $M_t = -23^oC$ - a dimensionless coefficient numerically equal to the sum of the absolute values of monthly average negative temperatures;

d_0 - The value for loams is assumed to be 0.4 m.

The piles are selected in the top format from [3]. In cross-section, they represent a square with sides 300x300 mm, and the length is 10 m. Due to the size of the grillage and the bearing capacity of one pile, the arrangement of piles was chosen for bushes of 6 units per grillage with a 300 mm edge kit on each side, the preliminary dimensions of the grillage are determined by the formulas.

$$a_{gr} = 2l + 3d + 2d = 2 \cdot 0.3 + 0.3 \cdot 3 + 0.6 = 2.1\ m;$$

$$b_{gr} = l + 2d + 2d = 0.6 + 0.3 \cdot 2 + 0.6 = 1.8\ m;$$

Thus, the depth of the bottom of the grillage will be 1.9 m, and its dimensions will be 2.1 x 1.8 m.

1.3 Architectural technical and economic indicators

Table 1 - Architectural technical and economic indicators

Indicators	Units of measurement	Quantity
The area of the projected building	m^2	125625
Building area	m^2	9555
Building coefficient	m^2	0,076
The area occupied by highways and paved areas	m^2	48594
The length of above-ground and underground utilities	m^2	370
Paving surface area	m^2	4038
Landscaping area	m^2	57741
The area of the used territory	m^2	62187
Territory utilization rate	m^2	0,49

1.4 Design and calculation subsection

1.4.1 Structural diagram of the building

An airport is a technically complex facility that has its own unique features. Such a building has large dimensions, as well as wide, open spaces. To ensure these characteristics, as well as the convenience of visitors' movement, the metal frame of the building was chosen.

All structures will be based on metal columns and connecting trusses. Due to the large spans, as well as ensuring rigidity, both straight belt and inclined trusses are used in the project. Since the building's layout is a complex geometric shape, each span of the farm is unique.

The project uses both support trusses and sub-trusses. These structures provide the spatial volume of the building and allow you to cover large spans between the columns. Figures 4 and 5 show analogues of the structures used in the project.

The coating structure plays a special role in the structural scheme of the building. To ensure large spans, as well as a non-linear shape, it is necessary to use a shotcrete surface with a complex concrete composite composition. This technology is applied using a non-removable formwork, on which a composition is applied that hardens and takes the necessary shape after a given time.

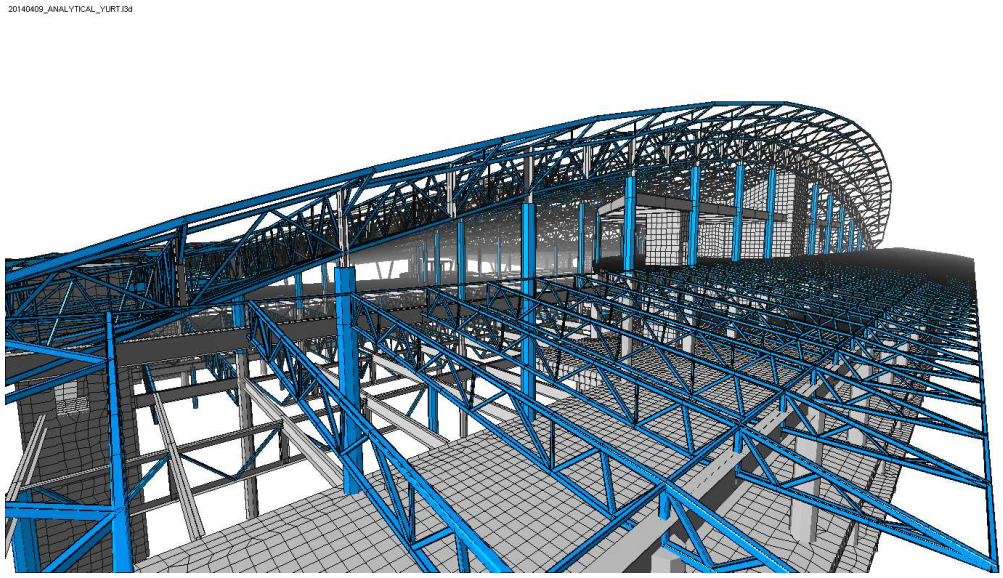


Figure 4 - Analog structures

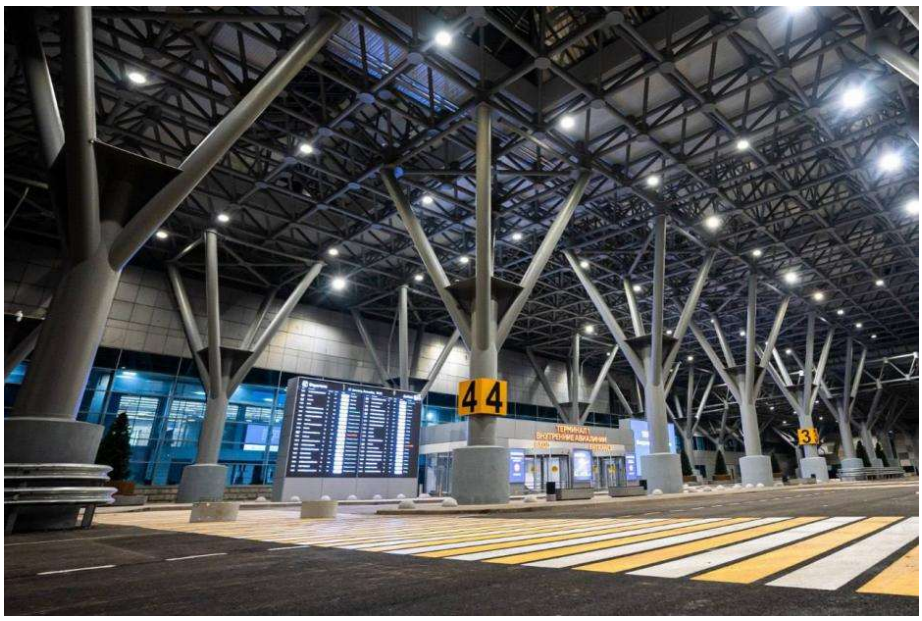


Figure 5 - Analog structures

1.4.2 Calculation of thermal engineering parameters of structures

Due to the absence of load-bearing and enclosing walls, the calculation of thermal characteristics will be carried out to cover the zero level. It must meet the requirements for thermal protection and prevent the surface of the finished floor from freezing. The construction of the floors is shown in Figure 6, and is also presented in Table 2.

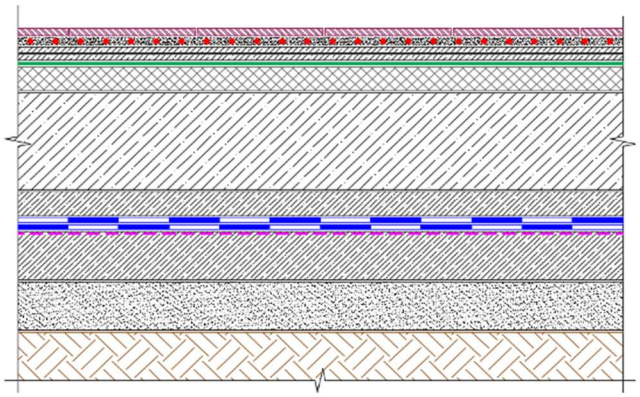


Figure 6 – Floor designs

Table 2 – Floor construction elements

Layer name	Layer thickness, m	Coefficient of thermal conductivity, W/(m·ºC)
Cement-sand mixture	0,04	0,76
Vapor barrier	0,001	0,17
Extruded Polystyrene Foam	0,02	0,0034
Reinforced concrete slab	0,2	1,92
Cement-sand mixture	0.04	0,76
Roll-up waterproofing	0,04	0,22
Concrete preparation	0,1	1,74

We will start checking the thermal characteristics by determining the degree-day indicator of the heating season using the formula from [2].

$$ГСОП = (t_в - t_н) \cdot z_{от} = (18 + 31.2) \cdot 210 = 10332 \text{ ℃} \cdot day/year$$

The data on climatic characteristics are taken from [1]. Based on the data obtained, we will find the normalized value of the specific thermal protection of the building. It is determined based on the volume of the heated building and the GSOP indicator and is equal to 4.8 m^2·ºC/W.

Next, we will determine the thermal protection characteristics of the structure based on the method of layer-by-layer summation of the thermal characteristics of the material according to the formula from [2].

$$R = \frac{1}{\alpha_в} + \frac{1}{\alpha_н} + \sum \frac{\delta_i}{\lambda_i} \quad (1.1)$$

where $\alpha_в$ - heat transfer coefficient of the inner surface of the enclosing structure, W/(m2°C)

$\alpha_н$ - heat transfer coefficient of the outer surface of the enclosing structure, W/(m2°C)

$$R = \frac{1}{8.7} + \frac{1}{23} + \frac{0.04}{0.76} + \frac{0.001}{0.17} + \frac{0.02}{0.0034} + \frac{0.2}{1.92} + \\ + \frac{0.04}{0.76} + \frac{0.04}{0.22} + \frac{0.1}{1.74} = 6.49 \frac{m^2 \cdot °C}{W}$$

Based on the data obtained, it can be concluded that the selected floor design satisfies the requirement for thermal protection of buildings.

1.4.3 Lighting engineering calculation

A waiting room with an area of 1,571 m2 will be selected for the calculation. According to [3], the required illumination of this type of room is 500 lux. Let's find the value of the total illumination requirement using the formula.

$$E_{sum} = E \cdot S = 1571 \cdot 500 = 785\,500\ lx$$

Next, we will calculate the required number of lamps from the conditions of dustiness of space and refraction of light according to the formula. For the calculation, we will take LGT-Prom-Solar lamps with a power of 200 watts as lighting devices.

$$N = \frac{E_{sum}}{F \cdot k} = \frac{785\,500}{20000 \cdot 0.7} = 56$$

Thus, 60 LGT-Prom-Solar lamps will be used in the waiting room to ensure a comfortable stay for passengers.

2 Computational and constructive section

2.1 Creating a calculation scheme

As mentioned earlier, the structural scheme of the building is a metal frame. Thus, columns and various types of farms will act as supporting elements for modeling. The building was chosen for the calculation due to the presence of special equipment for handling luggage there, as well as its location downwind, which maximizes the value of the wind load. In addition, due to the location of the building in Astana, where there are weak soils, the foundation is piled with a columnar grillage. Based on the parameters of the construction site and preliminary calculations, the grillwork measures 2.1 x 1.8 m. The piles were selected in the top format from [4]. In cross-section, they represent a square with sides 300x300 mm, and the length is 10 m. Due to the size of the grillage and the bearing capacity of one pile, the arrangement of piles for bushes of 6 units per grillage with a 300 mm edge weight on each side was chosen. Based on all the data obtained, the design scheme of the building will look like Figure 7.

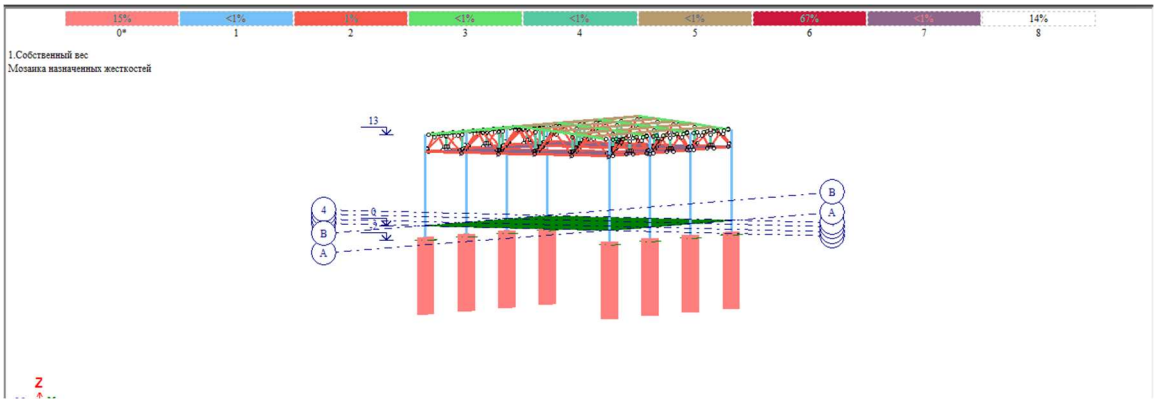


Figure 7 – Building design scheme

The stiffness used in the scheme is shown in Table 3.

Table 3 – Stiffness of the elements

№	Name	Characteristics, Modulus of elasticity (t/m2), Dimensions (cm)
1	I-beam 40K10S	E=2.10*10^7; H=48.4, Bf=37.4, Tw=4, Tf=7
2	Two corners 110x110x8	E=2.10*10^7; H=11, Bf=11, Tw=0.8, Tf=0.8, R1=1.2, R2=0.4
3	Two corners 140x140x9	E=2.10*10^7; H=14, Bf=14, Tw=0.9, Tf=0.9, R1=1.4, R2=0.46
4	Two corners 80x80x10	E=2.10*10^7; H=80, Bf=80, Tw=1, Tf=1, R1=0.9, R2=0.3
5	Channel 20a	E=2.10*10^7; H=20, Bf=8, Tw=0.52, Tf=0.97, R1=0,95, R2=0.4
6	Plate H40	E=2.75*10^6; V=0.2; H=40, R=2.5
7	Two corners 160x160x10	E=2.10*10^7; H=160, Bf=160, Tw=1, Tf=1, R1=0.9, R2=0.3
8	Timber 30x30	E=3.06*10^6; V=0.25; H=30, B=30, R=2.5

2.1.1 Creating loads

The loads acting on the building will be calculated in the formulas below and presented in tabular format in Table 3.

The first load is the self-weight of the elements, which is created automatically based on the material of the elements, as well as their cross-section. Next comes the weight from the floor structure. Its design is shown in Figure 4. Based on them, we will calculate the load on 1 m2 of the plate..

$$P = \sum \rho_i \cdot \delta_i = 1.8 \cdot 0.04 + 0.1 \cdot 0.001 + 0.25 \cdot 0.02 + \\ +2.5 \cdot 0.2 = 0.572 \frac{t}{m^2}$$

where ρ_i – specific gravity of the i-th layer of the slab structure, t/m2;

δ_i – thickness of the i-th layer of the plate structure, m.

The following load is normative and is accepted according to [7]. Since the airport building accommodates a large number of people, C was chosen as the category for temporary loads. Specifically, C3, based on the description of the categories. Thus, based on [7], the temporary load on the floors will be 0.509 t/m2.

Next, the snow load on the roof will be calculated in the project, which will be set for girders on top of the trusses. The calculation is performed according to [7]. To start the calculation, it is necessary to determine the basic parameters. The snow area of the construction site is III, based on this, the value of the characteristic snow load on the ground will be 1.2 kPa. Next, it is necessary to determine the coefficient of the shape of the snow load, its choice is determined by the shape of the roof and the magnitude of its slope. In the project, the roof is a two-pitched structure with a slope of 15 degrees on each side. Thus, the coefficient value will be 0.8. It remains to determine the value of the last two coefficients, their value will be taken according to the tables from [7]. Thus, the value of the snow load can be calculated using the formula from [7].

$$s = \mu \cdot C_e \cdot C_t \cdot s_k = 0.8 \cdot 0.8 \cdot 1 \cdot 1.2 = 0.768\ kPa$$

The last type of load is wind. Its calculation, as well as the snow one, is based on [7]. For the calculation, it is necessary to determine the ratio of the building dimensions. Due to the low number of floors and the latitude of the facility, it will be insignificant, therefore, based on the diagram in Figure 6, the wind load will be created by a single high-speed flow.

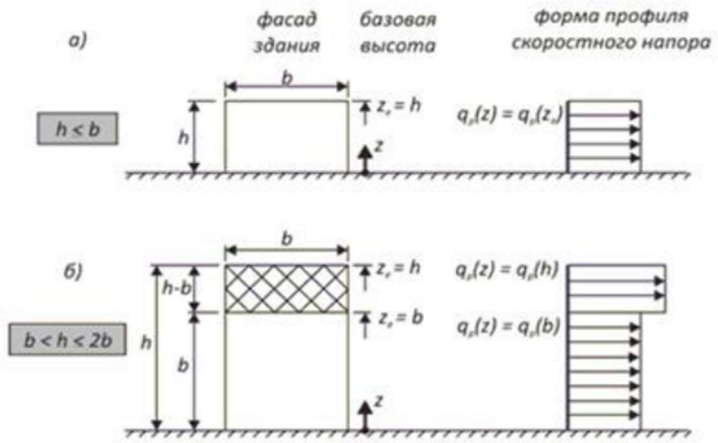


Figure 8 – Wind load separation scheme

The base value of the wind speed in the construction area is 35 m/s. According to the type of terrain, the object can be classified into the second category due to its openness on the ground. We will take 13 m for the estimated height. Based on this, we will calculate the wind load according to [7].

$$c_r(z) = k_r \cdot \ln\left(\frac{z}{z_0}\right) = 0.246 \cdot 1.872 = 0.46;$$

$$v_m(z) = c_r(z) \cdot c_o(z_1) \cdot v_b = 0.59 \cdot 1 \cdot 25 = 16.1\ m/s;$$

$$l_v(z) = \frac{k_i}{c_o(z) \cdot \ln\left(\frac{z}{z_0}\right)} = \frac{1}{1 \cdot \ln\left(\frac{13}{0.05}\right)} = 0.534;$$

$$q_p(z) = [1 + 7 \cdot l_v(z)] \cdot 0.5 \cdot \rho \cdot v_m^2(z) = 1.53\ kPa$$

Having received the wind pressure value, it must be applied taking into account the external pressure coefficients and based on the diagram in the figure 9.

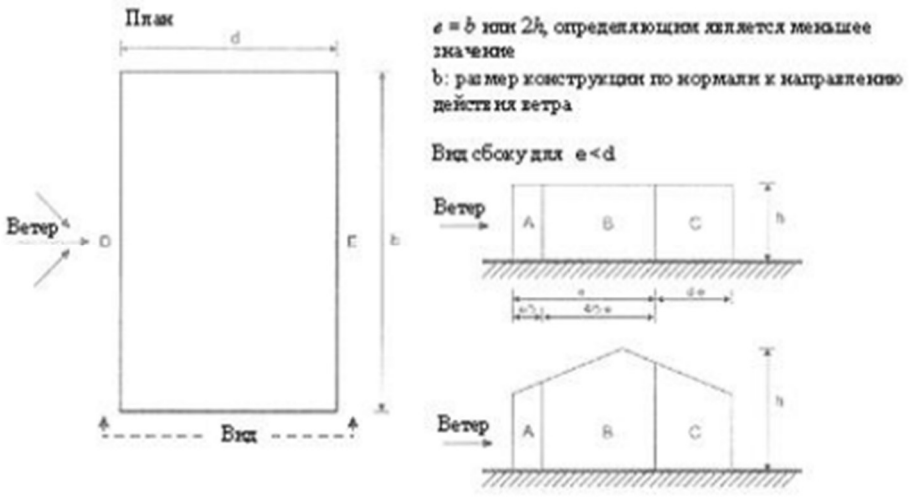


Figure 9 – The scheme of division into wind zones

All loads have been calculated; we will enter all the values obtained in the table 4.

Table 4 – Loads

№	Name	Value, t/m2
1	Own weight	- -
2	Floor designs	0.572
4	Temporary loads by category	0.509
5	Snow	0.078
6	Wind	0.156

2.1.2 Modeling of the soil base

For the full-fledged operation of the building, it needs to simulate an underground foundation. It is formed on the basis of reports on the geological structure of the soils of the construction area. It is also necessary to calculate the value of the distributed load from the building on the ground and assign it to the slab on the ground. Calculated from using the formula.

$$P_z = \frac{P}{S} = \frac{1211}{1080} = 1.12 \frac{t}{m^2}$$

where P – total load from all structures, t;

S – base area, m2.

2.2 Combination of loads

The combination of loads plays an important role in calculations using the LIRA calculation complex. This function is organized through calculated combinations of loads. The rules of combination are prescribed in [5] and take into account various factors of interaction of loads with each other. The wind load plays a leading role in the projected building, due to the large spans. Thus, combinations are made based on this fact. A complete table of load combinations is provided in Appendix A.

2.3 Analysis of calculation results

After making calculations in the program, it is necessary to analyze them and correctly interpret the results. All values obtained as a result of calculations are set out in Appendix A. In this section, we will analyze them and draw the necessary conclusions.

The first check will be the building's draft. According to the design standards, for a frame-type building, the maximum allowable draft is 10 cm. Having analyzed the maximum dangerous value shown in Figure A.7, we can conclude that favorable conditions for the design of foundations by the chosen method.

Next, consider the deflection of structures. Due to the length of the spans and the material of the supporting structures, this parameter has a high value. It is calculated using the formula.

$$H_{max} = \frac{L}{250} = \frac{12000}{250} = 48\ mm$$

Having studied the results shown in Figure A.8, we can conclude that the selected sections satisfy this test and can be used for further calculations.

2.4 Manual calculation of structures

Two elements have been selected for the manual calculation of structures – the column and the truss parts. All necessary loads are selected from calculations obtained from the LIRA-CAD calculation complex. All calculations of the elements are performed according to [7].

2.4.1 Column calculation

Let's start the calculation with the column. To do this, it is necessary to determine the values of internal forces in the structure. They are shown in Figures 10, 11 and 12.

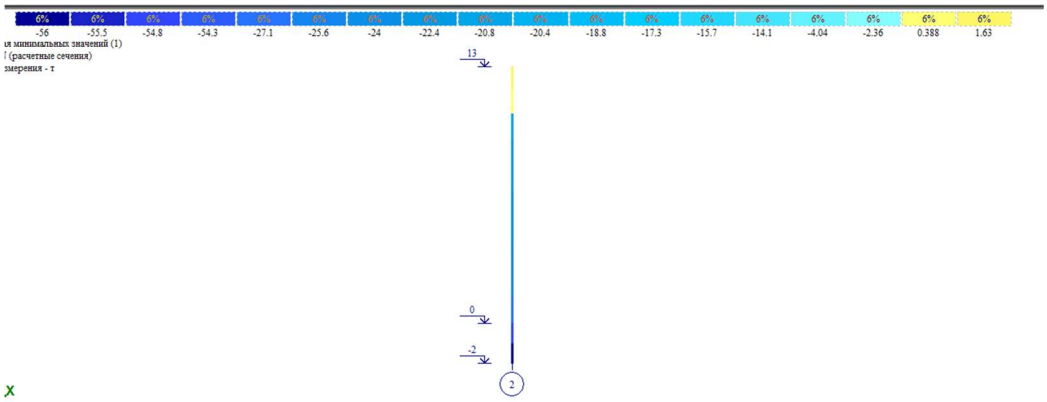


Figure 10 – The value of the longitudinal force

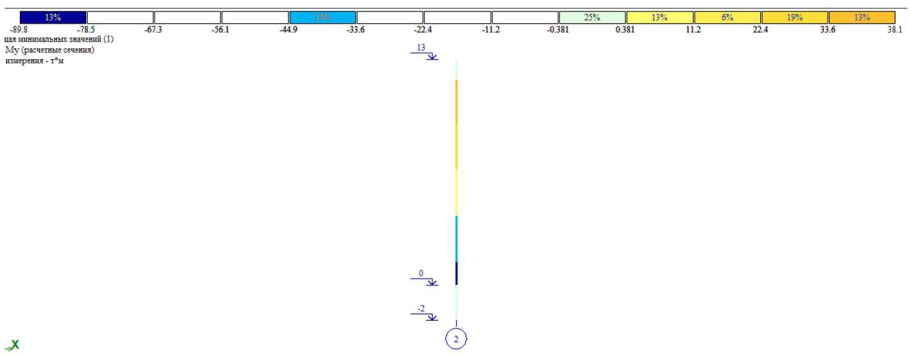


Figure 11 – The significance of the moment

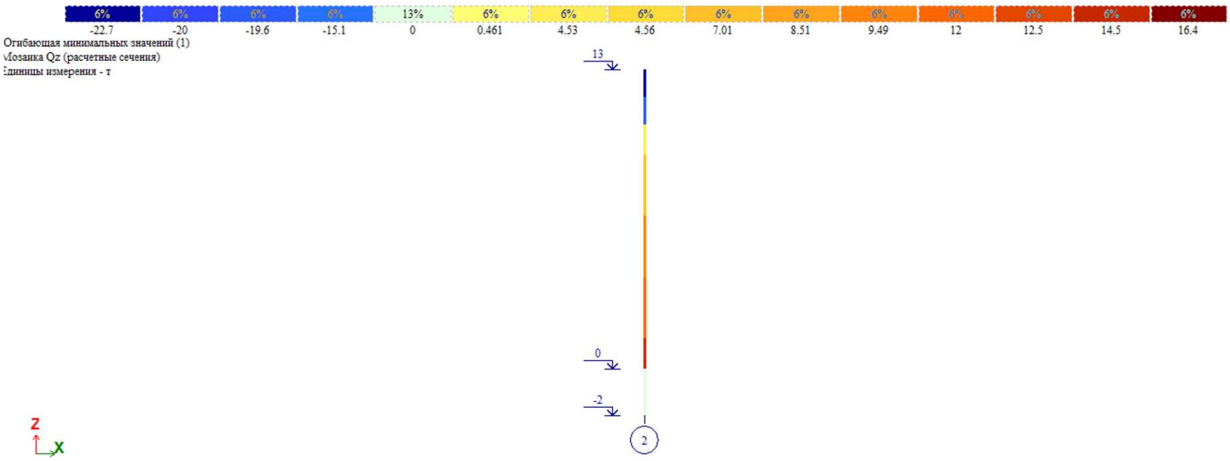


Figure 12 – The value of the transverse force

For example, the following value is: N=56 t, M=89.8 t*m, Q=22.7 t. The speaker set consists of two 50X1 models with geometric dimensions: h=482 mm, B=300 mm, s=110 mm, t=15 mm, A=145.52 cm2, Ix= 60371 cm4, Wx= 2505 cm3.

First, we determine the coefficient, which depends on the yield strength of the steel according to the formula from [7].

$$\varepsilon = \sqrt{\frac{235}{f_y}} = \sqrt{\frac{235}{335}} = 0.84$$

Now let's define the cross-section class of the I-beam parts. The section class is determined for the shelves and walls of the I-beam separately. First, we define the class of the section wall according to [7].

$$\frac{c}{t_w} = \frac{0.4}{0.011} = 36.364 \leq 72\varepsilon = 60.304$$

First class is at the wall. Next, we define the shelf class by the formula [7].

$$\frac{d}{t_f} = \frac{118.5}{15} = 7.9 \leq 10\varepsilon = 8.376$$

According to the data received, the regiment belongs to the second class. Thus, the entire section will be classified according to the second class. Now it is necessary to check the cross section for the action of external forces. Let's determine the bearing capacity under the longitudinal compressive force. To do this, the condition must be satisfied.

$$\frac{N_{Ed}}{N_{c.Rd}} \leq 1 \qquad (2.1)$$

The bearing capacity of the section is determined by the formula [7].

$$N_{c.Rd} = \frac{A \cdot f_y}{\gamma_{M0}} = 497.1\ t;$$

$$\frac{56}{497.1} = 0.113$$

The condition is met, then we will check the bearing capacity at the bending moment. Verification also consists in satisfying the condition.

$$\frac{M_{Ed}}{M_{pl,Rd}} \leq 1 \qquad (2.2)$$

Let's determine the calculated value of the bearing capacity of the section using the formula [7].

$$M_{pl,Rd} = \frac{W_x \cdot f_y}{\gamma_{M0}} = \frac{2505 \cdot 335}{1} = 95.82\ t \cdot m;$$

$$\frac{M_{Ed}}{M_{pl,Rd}} = \frac{89.8}{95.82} = 0.93$$

The condition is met, then we will check the bearing capacity under the condition.

$$\frac{V_{Ed}}{V_{c,Rd}} \leq 1 \qquad (2.3)$$

The shear bearing capacity of the section is determined by the formula [7].

$$V_{c,Rd} = \frac{A_v * \frac{f_y}{\sqrt{3}}}{\gamma_{M0}} = 42.5\ t;$$

$$\frac{V_{Ed}}{V_{c,Rd}} = \frac{22.7}{42.5} = 0.53$$

All the conditions have been met, now it is necessary to check the stability of the column. First, let's define the value of critical strength and conditional flexibility. [7].

$$N_{cr,i} = \frac{\pi^2 \cdot E \cdot I}{L_{cr}^2} = 7403.903\ kN;$$

$$\lambda_i = \sqrt{\frac{A \cdot f_y}{N_{cr,i}}} = 0.262$$

Next, we calculate the stability coefficient in accordance with the stability loss curve using the formula from [7].

$$\chi_z = \frac{1}{\Phi_z + \sqrt{\Phi_z^2 - \lambda_z^2}} = 0.968$$

The calculated value of the bearing capacity of the compressed element in terms of stability is determined by the formula [7].

$$\frac{N_{Ed}}{N_{b,Rd} * \chi_z} = \frac{56}{497.1 \cdot 0.968} = 0.118 \leq 1$$

All checks have been passed, so the column section passes through the load-bearing capacity and can be used in the project.

2.4.2 Calculation of the lower and upper farm belts

The calculation of the truss elements will be performed for the lower and upper belts. First, let's look at the upper belt of the farm and the values of its internal forces from Figures 13 and 14.

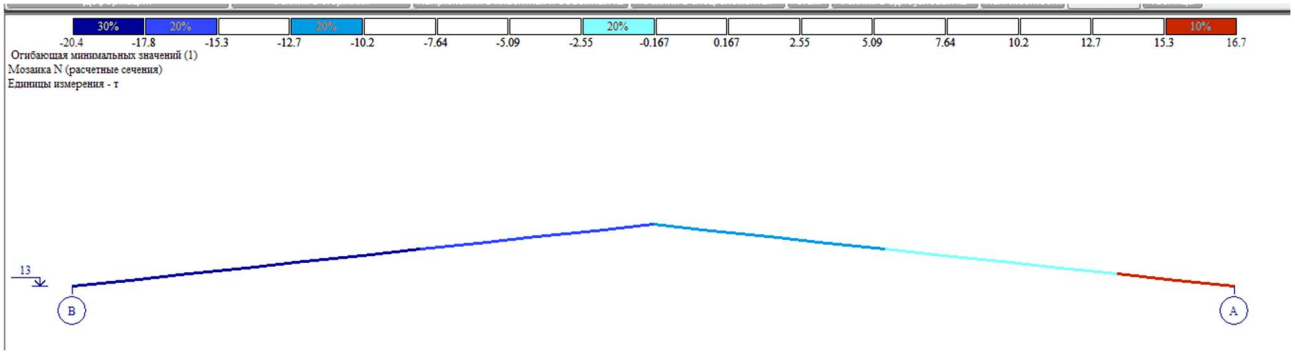


Figure 13 – The value of the longitudinal force

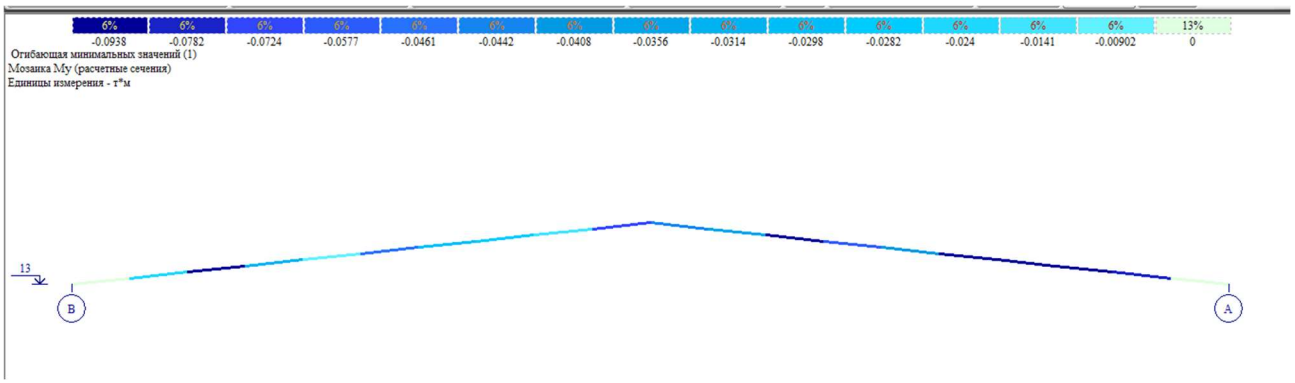


Figure 14 – The value of the transverse moment

The section of the upper belt consists of two corners with a section of 140x140x9mm. Geometric characteristics of the section: l=140 mm, t=9 mm, A=24.72 cm^2, R=14 mm, I=465.72 cm^4, W=45.55 cm^3.

Let's define the class of the cross section of the upper belt by [7].

$$\varepsilon = \sqrt{\frac{235}{f_y}} = \sqrt{\frac{235}{245}} = 0.97$$

For corners, the class definition formula has the form:

$$\frac{h+b}{2t} = 15.556 \leq 11.5\varepsilon = 11.263$$

Therefore, the section belongs to the 3rd class. Next, it is necessary to determine the critical force of the effective cross-section. This calculation is similar to the one in the column and is performed according to the formula [7].

$$N_{cr,i} = \frac{\pi^2 \cdot E \cdot I}{L_{cr}^2} = 2103.568\ kN$$

Next, calculate the eccentricity of the stability loss curve using the formula.

$$e = \frac{L}{250} = \frac{3000}{250} = 12\ mm$$

Having obtained the value of the eccentricity, we determine the value of the effective moment from the longitudinal force according to the formula.

$$M_{Ed} = N_{Ed} \cdot e = 200 \cdot 0.12 = 2.4\ kN \cdot m$$

Next, the strength is checked for a Class 3 cross section under the action of longitudinal force and moment according to the formula from [7].

$$\sigma = \frac{N_{Ed}}{\frac{A}{\gamma}} + \frac{M_{Ed} + M_y}{\frac{W}{\gamma}} = 76.914\ MPa$$

This value is significantly less than the limit value for this steel grade, which means that the test has been passed.

Further, to check the stability of the elements of the upper belt of the truss during longitudinal bending, a general method is used in accordance with [7].

$$I_t = 2 \cdot \frac{(h \cdot t^3 + (h - t) \cdot t^3)}{3} = 13.171\ cm^4;$$

$$M_{cr} = \frac{\pi^2 \cdot E \cdot I}{L_{cr}^2} \cdot \sqrt{\frac{L_{cr}^2 \cdot G \cdot I_t}{\pi^2 \cdot E \cdot I}} = 149.8\ kN \cdot m;$$

$$\lambda_{LT} = \sqrt{\frac{W \cdot f_y}{M_{cr}}} = 0.386$$

Next, we define conditional flexibility in compression.

$$\lambda_i = \sqrt{\frac{A \cdot f_y}{N_{cr,i}}} = 0.759;$$

$$\chi_i = \frac{1}{\Phi_i + \sqrt{\Phi_i^2 - \lambda_i^2}} = 0.688$$

We check the overall stability of the elements using the formula [7].

$$\frac{N_{Ed}}{\chi \cdot N_{Rk}} + \frac{M_y}{\chi_{LT} \cdot M_{y.Rk}} + \frac{M_{Ed.y}}{\chi_{LT} \cdot M_{y.Rk}} = 0.395$$

The verification condition is passed, which means that the selected value is suitable for the project.

Next, let's start calculating the lower belt. Its cross-section consists of two corners with a cross-section of 110x110x8 mm. Geometric characteristics of the section: l=110 mm, t=8 mm, A=17.2 cm^2, R=12 mm, I=198.17 cm^4, W=24.77 cm^3.

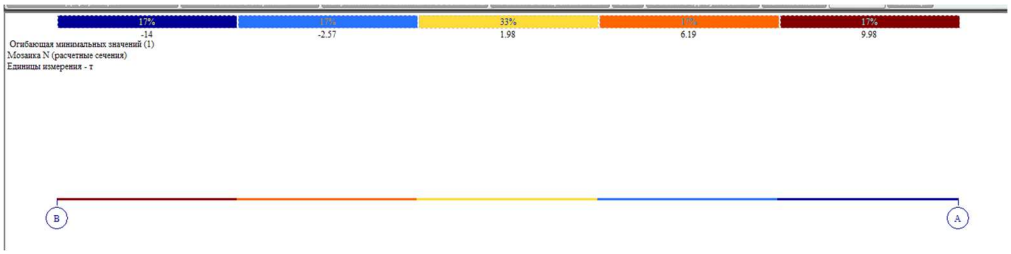


Figure 15 – The longitudinal force of the lower belt of the farm

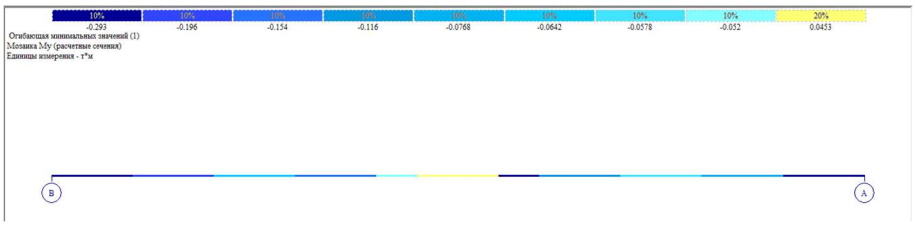


Figure 16 – Bending moment of the lower belt of the farm

Let's define the class of the cross section of the upper belt by [7].

$$\varepsilon = \sqrt{\frac{235}{f_y}} = \sqrt{\frac{235}{245}} = 0.97$$

For corners, the class definition formula has the form:

$$\frac{h+b}{2t} = 13.75 \leq 11.5\varepsilon = 11.263$$

Therefore, the section belongs to the 3rd class. Next, it is necessary to determine the critical force of the effective cross-section. This calculation is similar to the one in the column and is performed according to the formula [7].

$$N_{cr,i} = \frac{\pi^2 \cdot E \cdot I}{L_{cr}^2} = 228.18\ kN$$

Next, by calculating the eccentricity at the stability loss curve using the formula.

$$e = \frac{L}{250} = \frac{6000}{250} = 24\ mm$$

Having obtained the value of the eccentricity, we determine the value of the effective moment from the longitudinal force using the formula.

$$M_{Ed} = N_{Ed} \cdot e = 137.29 \cdot 0.24 = 3.29\ kN \cdot m$$

Next, the strength is checked for a class 3 cross section under the action of a longitudinal force and a moment according to the formula from [7].

$$\sigma = \frac{N_{Ed}}{\frac{A}{\gamma}} + \frac{M_{Ed} + M_y}{\frac{W}{\gamma}} = 164.424\ MPa$$

This value is significantly less than the limit value for this steel grade, which means that the test has been passed.

Further, to check the stability of the elements of the upper belt of the truss during longitudinal bending, a general method is used in accordance with [7].

$$I_t = 2 \cdot \frac{(h \cdot t^3 + (h - t) \cdot t^3)}{3} = 7.24\ cm^4;$$

$$M_{cr} = \frac{\pi^2 \cdot E \cdot I}{L_{cr}^2} \cdot \sqrt{\frac{L_{cr}^2 \cdot G \cdot I_t}{\pi^2 \cdot E \cdot I}} = 73.14\ kN \cdot m;$$

$$\lambda_{LT} = \sqrt{\frac{W \cdot f_y}{M_{cr}}} = 0.407$$

Next, we define conditional flexibility in compression.

$$\lambda_i = \sqrt{\frac{A \cdot f_y}{N_{cr,i}}} = 1.922;$$

$$\chi_i = \frac{1}{\Phi_i + \sqrt{\Phi_i^2 - \lambda_i^2}} = 0.21$$

We check the overall stability of the elements using the formula [7].

$$\frac{N_{Ed}}{\chi \cdot N_{Rk}} + \frac{M_y}{\chi_{LT} \cdot M_{y.Rk}} + \frac{M_{Ed.y}}{\chi_{LT} \cdot M_{y.Rk}} = 0.305$$

The verification condition is passed, which means that the selected value is suitable for the project.

3 Organizational and technological section

This section includes two subsections that reveal the essence of construction work and the formation of a construction site. The first subsection will identify the needs of the construction site and the principles of its organization. Next, we will consider the types of work required for the construction of the projected building, determine their volumes and draw up a calendar schedule.

3.1 Technological subsection

In this subsection, the total amount of work for the construction of the project will be calculated. We will also provide a detailed description of the work shown on the technological map in Appendix C. It shows the work on the formation of pile foundations using a columnar grillage.

3.1.1 Earthwork

To hammer piles, you first need to prepare the space and dig trenches. For this, an excavator with a reverse shovel will be used, the brand of which must be selected based on the scope of work. We will take the lower mark of the bottom based on the depth of freezing of the soil according to [1]. For the design city, it will be 1.9m. The width of the trench must be selected based on the dimensions of the pile-driving unit. Based on the average size of the devices at 4 meters, we assume a trench width of 7 meters at the bottom. The width of the trench at the top is determined based on the size of the slopes according to the formula from [8].

$$l_2 = l_1 + h \cdot m \cdot 2 = 7 + 1.9 \cdot 1 \cdot 2 = 10{,}8\ m$$

Next, we will determine the area of the trenches and their volume. The area is calculated as the area of a trapezoid using the formula from [8].

$$F = \frac{(l_1 + l_2) \cdot h}{2} = \frac{(7 + 10.8) \cdot 1.9}{2} = 16.91\ m^2$$

We calculate the volume, knowing that the length of the trenches is 430 meters according to the formula from [8].

$$V = \sum L \cdot F = 430 \cdot 16.91 = 7271.3\ m^3$$

Based on the obtained volumes and technological needs, it is necessary to use an excavator with a bucket volume of 0.65 m3. After analyzing the existing models, their technical and economic characteristics, presented in [8], an excavator of the E-651 brand was chosen for the work. Its characteristics are presented in Appendix B.

Soil shortage is carried out manually due to the impossibility of forming an even cut using excavators. The volume of manual finishing of the soil is determined by formula [8].

$$V = F_{\text{K}} \cdot \Delta h_H = 2950 \cdot 0.3 = 885\ m^3$$

3.1.2 Pile driving

We will select the mechanical means for the production of work on driving piles into the ground. First, we will determine the technical means for driving piles. The main parameters are the depth of pile driving, its cross section and weight. From the above sections, we know that the piles are a rectangle with sides of 30 cm, and also have a length of 10m. To perform the work, you need equipment with high efficiency due to the large number of jobs, as well as with high movement speed due to the large spread of pile fields. Thus, a Junttan PM-20 tracked pile driver was chosen for this type of work. Its full characteristics are presented in Appendix B.

Next, we will select the lifting mechanism. This mechanism will be used throughout the construction period, both for feeding piles and for mounting truss elements and metal columns. Due to this and the low dimensions of the building, a crane will be used to lift the piles. The crane brand is selected according to several parameters. The first of them is the load capacity, then the boom reaches and lifts. Having determined these parameters, it will be possible to select a crane of the appropriate brand. Let's determine the required load capacity according to the formula [8].

$$Q_{cr} = (q_1 + q_2) \cdot k = (2.25 + 0.2) \cdot 1.1 = 2.69\ t$$

Next, we determine the required reach of the crane hook using the formula [8].

$$L_{cr} = l_1 + l_2 + l_3 = 4 + 3 + 5 = 12\ m$$

Having received these parameters and based on the technical characteristics for the supply of piles and other elements during the construction of the building, the MKG-40 crawler crane was selected - a crane with a diesel-electric power plant on a tracked track. Its full characteristics are presented in Appendix B..

3.1.3 Grillage installation works

Initially, we will determine the amount of necessary concrete preparation for the foundation. Its thickness will be 200 mm, the total volume will be calculated according to the formula [8].

$$\mathrm{V} = n \cdot v = 42 \cdot 0.756 = 31.75\ \mathrm{m}^3$$

Now it is necessary to determine the required amount of concrete work using the formula [8].

$$G = n \cdot c = 42 \cdot 5.2 = 218.4\ m^3$$

Next, consider the amount of reinforcement required for each grillage. The weight of the frame per foundation is assumed to be 1% of the concreting volume, which will amount to 4.4 tons. The weight of the frames is determined by the formula [8].

$$G = n \cdot g = 42 \cdot 4.4 = 184.8\ t$$

3.2 Organizational subsection

This subsection is necessary for the formation of a construction plan for the organization of the workplace at the facility, as well as the optimal use of limited space, taking into account safety standards, sanitary and technical requirements and fire safety..

3.2.1 Construction of temporary roads

Based on the shape and dimensions of the building, the temporary roads will have a ring shape with two lanes of traffic. Thus, following the regulations, the width of the roadway will be 6 m with an extension for parking cars during unloading. Also, the radius of the rounding will be 12 m due to the latitude of the construction site. Due to unfavorable geological conditions, reinforced concrete slabs laid on a sandy substrate will become the basis for roads. The dimensions of the plates will be 3x1.5 m.

3.2.2 Arrangement of storage facilities

Storage rooms exist for storing materials, structures, and other elements needed on the construction site. In the project under consideration, metal frame elements will be stored in warehouses. Materials for insulation and engineering systems. The required area for warehouses is calculated based on the duration of construction according to the formula [9].

$$Q = \frac{Q_0}{T} \cdot \alpha \cdot n \cdot k = \frac{10000}{356} \cdot 1.1 \cdot 3 \cdot 1.2 = 70.7$$

Next, we calculate the useful area of the warehouses, assuming that 1 ton of materials can be placed on 1m2 of the warehouse. Thus, the usable area will be calculated using the formula [9].

$$F = \frac{Q}{q} = \frac{70.7}{1} = 70.7\ m^2$$

Now let's calculate the total area of the warehouse, including the aisles using the formula [9].

$$S = \frac{F}{\beta} = \frac{70.7}{0.5} = 141.4\ m^2$$

3.2.3 Construction of temporary structures

The household camp includes the following rooms per employee: dressing room — 0.89 m2; washroom — 0.07 m2; shower room — 0.54 m2; heating room — 0.1 m2, with the minimum allowable area of such a room being 8 m2; drying room for special clothes and shoes — 0.2 m2; toilet - 0.07 m2. If there are fewer than 100 women in the team, it is planned to install a cabin with an ascending shower area of 2.88 m2. Recreation and smoking areas are designed at the rate of 0.2 m2 per employee.

To provide first aid, a health center is located on the territory of the household town, the area of which, with a total number of employees up to 300 people, should be 12 m2.

Catering is carried out by means of a canteen and buffet. The design of the dining room is carried out at the rate of one seat for every four employees, with an estimated attendance of 75% of the number of employees in the largest shift. The installed area per seat is 1.02 m2. The buffet is designed to serve 25% of the shift staff, also at the rate of one seat for four people, with an area of 0.7 m2 per seat. The total area required to accommodate catering facilities is 15 m2.

Administrative buildings include facilities for engineering and technical personnel, as well as maintenance personnel (offices of site managers and foremen). The area of such premises is calculated according to the standard of 4 m2 per employee, provided that 50% of the total number of these categories of employees is taken into account. In addition to the calculated area, 10% is added for the construction of corridors, passageways and vestibules.

3.2.4 Communication device

Let's start the calculation of the communication connection by determining the water needs of the construction site. Let's determine the maximum hourly water consumption for production needs using the formula [10].

$$Q_1 = S \cdot A \cdot \frac{K}{n} \cdot 1000 = 4 \cdot 400 \cdot \frac{2}{8} \cdot 1000 = 4000000\, m^3$$

Next, we calculate the maximum hourly water consumption for household and drinking needs using the formula [10].

$$Q_2 = N \cdot A \cdot \frac{K}{n} \cdot 1000 = 20 \cdot 20 \cdot \frac{2}{8} \cdot 1000 = 100000\, m^3$$

The last one is to calculate the hourly water consumption for cooling internal combustion engines..

$$Q_3 = W_t \cdot N \cdot 1.2 = 1 \cdot 200 \cdot 1.2 = 240\, m^3$$

Now it is necessary to calculate the water consumption per second based on all water needs.

$$Q = \frac{4000000 + 100000 + 240}{3600} = 1138.9 \frac{l}{s}$$

As a result, we will determine the size of the required pipe, in particular its diameter.

$$D = \sqrt{\frac{4Q}{\Pi \cdot V}} = \sqrt{\frac{4 \cdot 1138.9}{400 \cdot 1.2}} = 3\, m$$

Next, we will determine the required number of floodlights to illuminate the construction site through specific power. Let's use a CCD-45 searchlight with a power of 1,500 watts to calculate it. Then the number of spotlights will be calculated using the formula.

$$N = \frac{\rho \cdot E \cdot S}{P} = \frac{0.25 \cdot 20 \cdot 20000}{1500} = 67$$

Based on these calculations, 70 floodlights will be selected for illumination around the perimeter of the construction site.

4 Economic Section

4.1 Preparation of cost estimates

The cost estimate documentation for the construction of the facility is prepared based on design data and the applicable regulatory framework.

When developing the design (design and estimate) documentation, priority is given to selecting materials, products, structures, and equipment from domestic manufacturers.

It is a mandatory requirement to use construction materials, structures, equipment, furniture, and inventory produced in Kazakhstan and included in the database of goods, works, and services and their suppliers, maintained in accordance with the relevant regulatory procedures.

If applicable norms are missing from the current budget and regulatory framework of the Republic of Kazakhstan, individual cost estimate standards are developed. These individual standards must be approved and agreed upon as prescribed by law, in accordance with SN RK 1.02-03-2011.

Individual cost estimates are developed considering the specific working conditions and all complicating factors. No additional coefficients are applied when using these individual standards.

Estimate norms are tailored to the conditions of a particular construction site and region, with consideration for the requirements, conditions, and restrictions provided in the technical parts of regulatory documents and approved collections of elemental estimate norms.

These norms are based on technological maps, timekeeping studies, standard labor norms (unified, intersectoral, industry-specific), adaptation of advanced international standards, and analytical methods, which determine resource needs at the level of elemental norms and define limited cost rates as a percentage of the accepted base.

The estimate norms reflect the average level of equipment and technology used and include the full range of operations needed for a particular type of work under standard conditions. In special conditions (such as confined spaces, gas contamination, or proximity to operating equipment), coefficients from the relevant technical documentation are applied to the norms.

When preparing estimates, material prices are selected based on the nearest city to the construction site, or from nearby quarries or manufacturers, regardless of

administrative boundaries, to ensure efficient logistics. Transport schemes are approved by the customer.

The names of materials include brand, key parameters, technical characteristics, and standardized designations to ensure clear identification. The estimated cost of construction at current prices is determined using applicable estimate norms, current resource prices, and aggregated indicators for structures and types of work.

4.2 Object estimates

Object estimates are prepared for entire facilities by aggregating data from local resource estimates, grouping work and associated costs under relevant categories such as "construction and installation works," "equipment," "other expenses," and others. These object-level estimates consolidate information from multiple local estimates and serve as foundational documents for determining the total estimated cost of individual construction projects.

In Kazakhstan, pricing in the construction sector is governed by regulatory documents approved by the Committee for Construction and Housing and Communal Services under the Ministry of Industry and Infrastructure Development. These documents establish the methodologies and rules for calculating construction costs, including those for object estimates.

While local estimates are developed for specific types and volumes of work based on design documents and working drawings, object estimates (OEs) compile data from several local estimates related to a particular construction site or project component.

If the cost of a project can be fully covered by a single local estimate, there is no need to prepare a separate object estimate. In such cases, the local estimate itself assumes the function of an object estimate, with provisions for limited costs added at the end in the same manner as in a formal object estimate.

According to methodological guidelines, object estimates must reflect current market prices. The grouping of work and expenditures in these estimates is typically categorized as follows:

- Construction and repair work;
- Installation work;
- Equipment, furniture, and inventory costs;
- Miscellaneous expenses.

At the conclusion of the estimate, additional costs are included to cover limited (overhead) expenses at current price levels. These include:

1. Reserve funds allocated for unforeseen works or expenses, in accordance with amounts agreed upon by the client and contractor to be included in the fixed contract price;
2. Additional costs associated with performing work during the winter season;
3. Expenses for temporary facilities;
4. Other costs outlined in the corresponding chapter of the consolidated budget estimate.

The object estimate is presented in full for the projected object in Appendix C.

4.3 Local estimates

Local estimates are developed in accordance with approved design solutions outlined in the finalized design and estimate documentation. These estimates are prepared separately by type of work, as well as by buildings and structures, following the division by structural components, work types, and installations, in line with guidelines provided in the normative document on the structural and technological organization of estimate data.

During the preparation of local estimates, construction resources are selected based on applicable estimate norms and project specifications. The standard resources are analyzed and aligned with project-specific requirements, making adjustments where necessary to replace any materials that do not conform to the design solutions.

A local estimate serves as a primary cost document, detailing specific types of work or expenditures based on volumes determined during the development of working documentation. These estimates form the basis for more comprehensive estimates such as object-level or summary estimates. Local estimates are particularly important when the final cost or work scope is not fully defined or cannot be accurately determined during the design stage, requiring further refinement during construction.

Local estimates can either be created as standalone documents or incorporated into the broader set of project estimate documentation. Each local estimate should provide a detailed breakdown of the scope of work, the materials and equipment to be used, associated costs, and expected timelines.

In Kazakhstan, local estimates are prepared in compliance with national design decisions and project documentation standards. They are subject to the pricing regulations issued by the Committee for Construction and Housing and Communal Services under the Ministry of Industry and Infrastructure Development of the Republic of Kazakhstan.

A typical local estimate is structured as a table listing types of work, their codes, and associated costs. It is based on:

1. Source data from the client;
2. Specifications and quantities of equipment or inventory derived from working drawings;
3. Volume lists for construction and installation work (CMP), equipment, materials, defect reports, and technical specifications;
4. Implementation details and installation plans based on design annotations;
5. Applicable estimate standards and current market prices, including transport and handling costs.

Kazakhstan utilizes various software tools for estimate generation, such as CMETA RK 2020. This software enables efficient and accurate preparation of all estimate types—local, object-level, consolidated—along with lists of material resources, equipment, completion certificates, and other financial documents.

CMETA RK 2020 applies the resource method for cost calculation in accordance with national regulations. It includes a comprehensive database of the Republic of Kazakhstan's base estimate norms (ESN RK 2015), current price collections, and aggregated norms (USN, MAF), all regularly updated through cooperation with JSC "KazNIISA".

Local estimates are typically compiled by qualified estimators or cost engineers, who may be employed by the client, the contractor, specialized estimating firms, or operate as independent professionals.

There are four main methods used for preparing local estimates, two of which are most commonly applied:

1. Resource Method – This method involves calculating the estimated cost based on current or projected prices of all required resources. It closely reflects actual market conditions. It typically results in the preparation of two documents: a local resource specification and a local resource estimate.
2. Base-Index Method – This involves applying updated index coefficients to base prices to bring them to current levels. It is mainly used for investor

documentation, pricing proposals, and budgeting for ongoing construction projects.

3. Resource-Index Method – A hybrid approach that combines the resource-based calculation with indexation of resource costs.
4. Method Based on Aggregated Standards – This includes using data from similar or analogous projects to estimate costs.

The local estimate is presented in full for the projected object in Appendix C.

4.4 General provisions on determining the cost of construction

The primary goals of cost estimation and pricing in the construction sector include:

- Strategic Financial Planning: Facilitating the effective planning, organization, and financing of construction projects.
- Accurate Cost Assessment: Ensuring the reliability of feasibility studies and precise determination of the estimated costs for various construction activities, including new builds, expansions, reconstructions, modernizations, technical upgrades, and major renovations of existing facilities.
- Regulatory Compliance: Utilizing a comprehensive system of regulatory documents to standardize pricing and estimation practices, thereby ensuring consistency and compliance across all construction projects.
- Investment Efficiency: Enhancing the efficiency of investments by optimizing the allocation and expenditure of financial resources.

These objectives are supported by a structured framework of estimation standards and pricing regulations, forming an integrated system that guides the determination of construction costs.

Prior to submitting a project for expert review, the estimated construction cost must be approved by the client. This involves the client submitting an application, including their details, for a comprehensive non-departmental examination. This process is governed by the Rules for Conducting Comprehensive Non-Departmental Examinations of Feasibility Studies and Design Estimates, as outlined in Order No. 299 of the Minister of National Economy of the Republic of Kazakhstan dated April 1, 2015 .

Upon receiving a positive conclusion from the comprehensive non-departmental examination, the estimated construction cost is formally approved by the client in accordance with the Rules for Approving Projects Financed by Budgetary Funds and Other Forms of Public Investment, as specified in Order No. 304 of the Minister of National Economy of the Republic of Kazakhstan dated April 2, 2015.

The contractual price for construction is established in line with procurement legislation, based on the outcomes of contract work procurements. This price reflects the contractor's winning bid, which must align with the client's approved estimate and budgetary constraints.

Upon contract signing, a detailed statement of the contract price is prepared and endorsed by both the client and the contractor. This document specifies the total contract amount derived from the procurement process and constitutes an integral part of the contractual agreement.

4.5 Technical and economic indicators

These indicators are a set of quantitative characteristics of construction in terms of its architectural and construction solutions, costs, functionality and resource efficiency.These indicators play an important role in assessing and justifying the estimated cost and profitability of construction. Using the example of the facility under development, it is possible to determine whether there is a need to build a new airport or whether it is possible to limit the expansion of the old one with an increase in its capacity. The indicators developed in the project are presented in tabular form with indicators, their units of measurement and the number in the table.

Table 5 - Technical and economic indicators

Indicators	Units of measurement	Quantity
Total labor costs	person/day	7025
Total cost	tg	377.309.278
Average output	tg	213531
The cost of 1 m2 of space	tg	394884
Duration	days	485

CONCLUSION

During the graduation project, the task of designing a new airport terminal in Astana that meets modern requirements for functionality, safety and comfort of passengers was considered. The design was carried out considering current regulations, climatic and urban conditions of the region, as well as the prospects for the development of the aviation infrastructure of the capital.

The work included the development of four main sections:

– Architectural and analytical, in which the analysis of existing analogues is carried out, the choice of design solutions is justified and the general concept of the terminal is formed.;

– Structural and computational, where the modeling of load-bearing structures is performed, the necessary calculations for strength and stability are performed, with the choice of rational building materials;

– Technological, containing planning and logistical solutions that ensure efficient movement of passenger traffic and baggage, using modern technical means and engineering systems;

– An estimate, including a feasibility study of the project, calculation of construction and operation costs, as well as an analysis of possible sources of financing.

The result of the thesis was a comprehensive project that can be used as a basis for the further development of the airport infrastructure in Astana. The project demonstrates a realistic and innovative approach to solving the challenges of modern urban planning and transport logistics.

LIST OF USED LITERATURE

1 СП РК 2.04-01-2017 «Строительная климатология»;
2 СП РК 2.04-107-2022 «Тепловая защита зданий»;
3 СП РК 2.04-104- 2012 «Естественное и искусственное освещение»;
4 Серия 1.011.1-10 Выпуск 1. Часть 1. Сваи цельные сплошного квадратного сечения с ненапрягаемой арматурой;
5 СП РК EN 1991-1-1:2002/2011 «ВОЗДЕЙСТВИЯ НА НЕСУЩИЕ КОНСТРУКЦИИ Часть 1-1. Собственный вес, постоянные и временные нагрузки на здания»;
6 НТП РК 01-01-3.1(4.1)-2012 – «Нагрузки и воздействия на здания. Снеговые нагрузки. Ветровые воздействия»
7 НТП РК 03-01-2.1-2012 – «Проектирование стальных конструкций с учетом воздействия пожара»
8 Учебное пособие к курсовому и дипломному проектированию строительных процессов при возведении подземной части здания, 2021, А.А. Брянцев.
9 «РАСЧЕТЫ ПРИ ПРОЕКТИР ОВАНИИ СТРОЙГЕНПЛАНА», 2023, С.В. Калошина, С.А. Сазонова, М.С. Казаков
10 Учебное пособие к выполнению курсовых и дипломных работ для студентов специальности 5В072900 – «Строительство», 2022, Брянцев А.А.

Appendix A

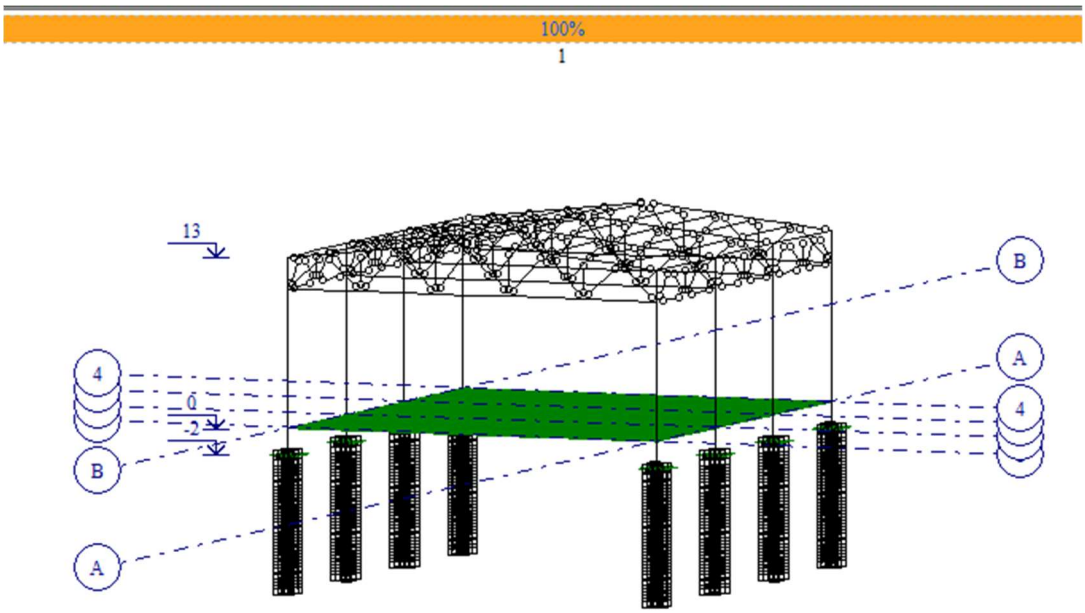


Figure A.1 - Net weight of the plates

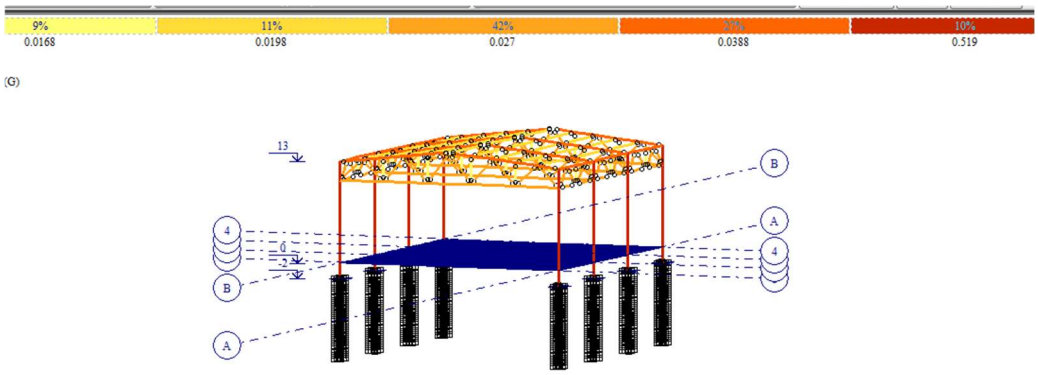


Figure A.2 - Net weight of rods

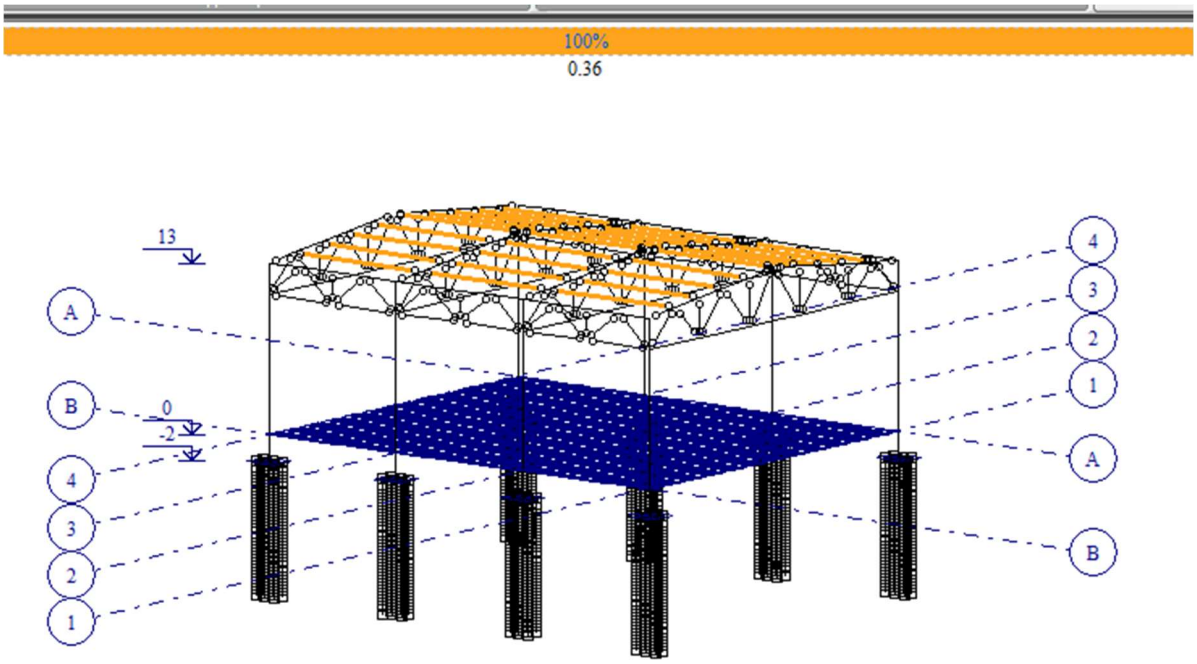


Figure A.3 - Snow load

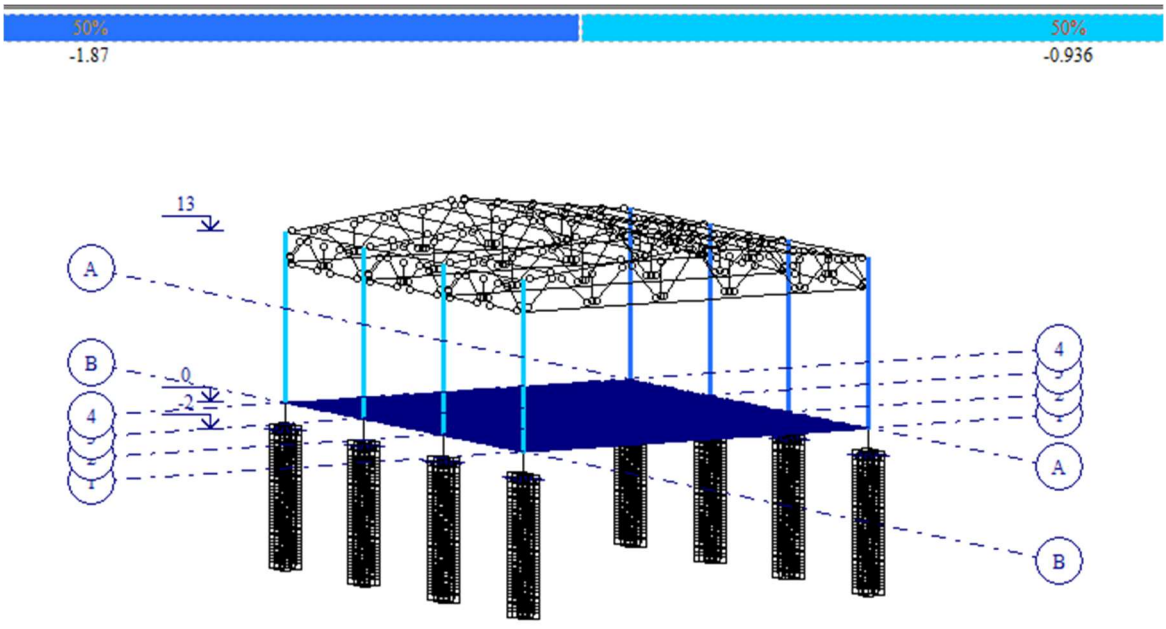


Figure A.4 - Wind load

Continuation of A

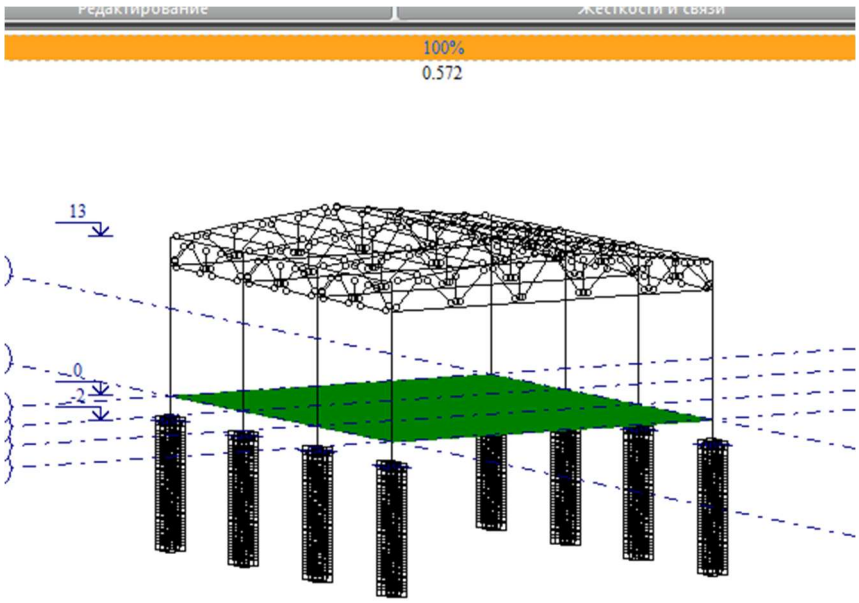


Figure A.5 - The load from the floor structure

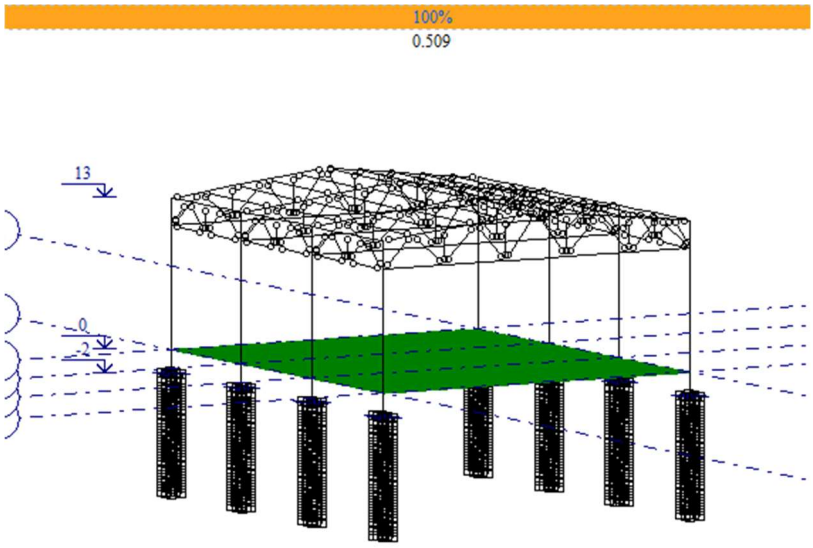


Figure A.6 - Temporary loads in category C

Continuation of A

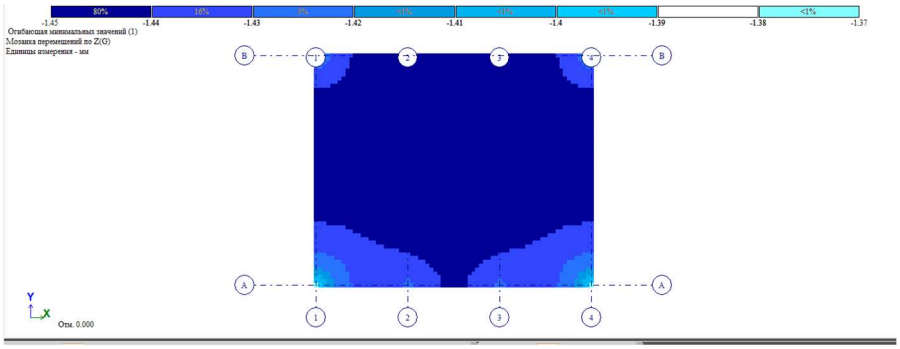


Figure A.7 - Building draft

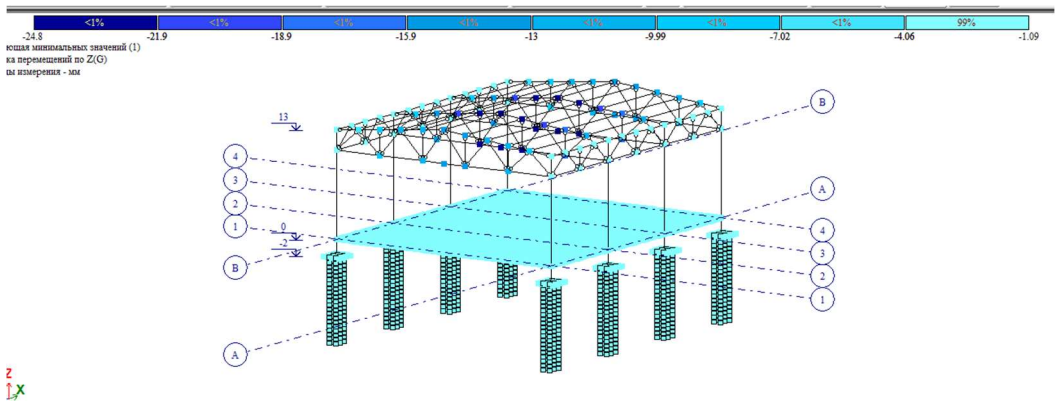


Figure A.8 - Deflection of structures

Table A.1 - Calculated load combinations

			I	II	III	IV	V	VI	VII	VIII	IX	X	XI
1	Own weight	1,35	1.	0.85	1.	1.	1.	1.	1.	0.85	1.	1.	1.
2	Snow load	1,50	0.	0.5	0.5	0.	0.	0.5	0.5	0.5	0.5	0.	0.
3	Wind load	1,50	0.	1.	1.	0.2	0.	1.	0.6	1.	1.	0.	0.2
4	Floor designs	1,35	1.	0.85	1.	1.	1.	1.	1.	0.85	1.	1.	1.
5	Temporary loads according to EN 0	1,50	0.	0.7	0.7	0.6	0.6	0.7	0.7	0.7	0.7	0.6	0.6

Appendix B

Table B.1 - Calculation of labor costs

№	Process name	Justification (ENiR, №, table, item)	Unit of measurement	Scope of work	Time		Labor costs	
					Workers hum/ h	Machinists m –cm.	Workers hum/ days	Machinists m –cm.
1	Device temporary fence	ENIR №. 5, 5-1-3	10m	250	1,2		37,50	
2	Cut vegetation layer	ENIR №. 2, 2-1-5	1000m2	100		0,85		85,00
3	Excavation in trenches	ENIR №. 2 2-1-11	100m3	72,71	2,8	1,5	25,45	109,07
4	Development of a shortage of soil	ENIR №. 2 2-1-46	m3	885	1,64		181,43	
5	Pile driving	ENIR №. 12 12-20-5	pcs	252		0,52		131,04
6	Installation of formwork	ENIR №. 4 4-1-27	m2	504	0,36	0,06	22,68	30,24
7	Installation of rebar		t	148,8	2,2		40,92	0,00
8	Laying of concrete mix	ENIR №. 4, 4-1-37	m3	218,4	1,2	0,45	32,76	98,28
9	Disassembly of the formwork	ENIR №. 4, 4-1-27	m2	148,8	0,31		5,77	
10	Basement Waterproofing	ENIR №. 11 11-29	100m2	2,2	10		2,75	
11	Backfilling	ENIR №. 2, 2-1-44	100m3	70,5		0,66		46,53
12	Installation of formwork	ENIR №. 4 4-1-27	m2	8400	0,18	0,06	189,00	504,00
13	Installation of rebar		t	500	2,2		137,50	
14	Laying of concrete mix	ENIR №. 4, 4-1-37	m3	4150	0,6	0,26	311,25	1079,00
15	Disassembly of the formwork	ENIR №. 4, 4-1-27	m2	8400	0,31		325,50	
16	Installation of metal columns	ENIR №. 5, 5-1-6	pcs	42		3		126,00

Continuation of B

Continuation of the table B.1

17	Installation of metal trusses	ENIR №. 5, 5-1-6	pcs	92		0,87		80,04
18	Installation of metal scaffolding	ENIR №. 6, 6-2-8	100 m	42	0,25		1,31	
19	Installation of formwork	ENIR №. 4 4-1-27	m2	2000	0,36	0,06	90,00	120,00
20	Installation of rebar		t	55	2,2		15,13	
21	Laying of concrete mix	ENIR №. 4, 4-1-37	m3	420	0,06	0,29	3,15	121,80
22	Dismantling of metal scaffolding	ENIR №. 6, 6-2-8	100 m	42	0,15		0,79	
23	Watering the concrete surface with water at a time	ENIR №. 4, 4-3-11	100 m2	20	5,8		14,50	
24	Installation of partitions with a single metal frame	ENIR №. 4, 4-2-22	m2	3700	0,42		194,25	
25	Installation of door blocks	ENIR №. 6, 6-3-17	100m2	25	13,4	2,7	41,88	36,18
26	Finishing works	ENIR №. 8, 8-1-15	m2	2500	0,3		93,75	

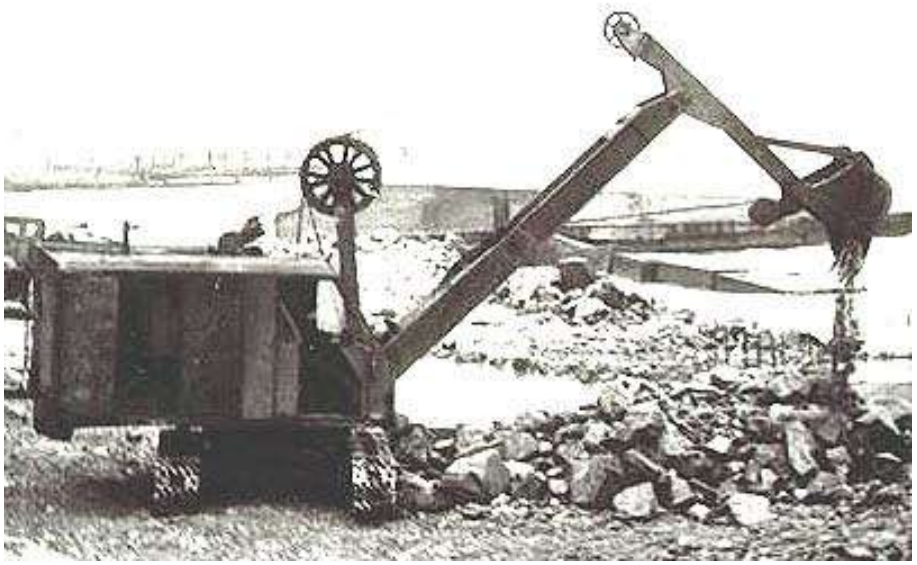


Figure B.2 - Excavator E-651

Table B.1 - Characteristics of the E-651 excavator

Parameter name	Quantity
Bucket capacity	0,65 m^3
Arrow length	5.5 m
The largest radius of digging	7.9 m
Digging radius at the level of the parking	4.8 m
The greatest height of digging	6.6 m
The largest radius of unloading	7.2 m
Power	80-100 kW
Mass of the excavator	20.5 t

Figure B.3 - Pile driving unit Junttan PM 20

Table B.2 - Characteristics of the Junttan PM 20

Parameter name	Quantity
Lots of equipment	57 t
Engine power	243 h.p.
Load capacity	16 t
Maximum pile length	16 m
Length	5 m
Width	4.7 m

Appendix C

СМЕТА РК 2025 Онлайн

643_лс 2--

ЕСЦ РК 2024, город Астана, г. Косшы введен с 01.01.2024
ЭСН РК 2024 И37 введен с 01.01.2024
ССЦ 2024, город Астана, г. Косшы введен с 01.01.2024
ССЦ Апрель 2025, город Астана, г. Косшы введен с 01.04.2025

Приложение Г
НДЦС РК 8.01-08-2022
Форма 4

Наименование стройки Новый пасажриский терминал с комфортными зонами в городе Астана

Наименование объекта Новый пассажирский терминал аэропорта с комфортными зонами в городе Астана

Локальная смета № 2--
(Локальный сметный расчет)

на Новый пассажирский терминал аэропорта с комфортными зонами в городе Астана.
(наименование работ и затрат)

Основание:

Сметная стоимость 320841,223 тыс. тенге

Средства на оплату труда 229912,296 тыс. тенге

Нормативная трудоемкость 50,27893 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				**320841223**
		из них				
		затраты на труд рабочих	тенге			205346394
		в том числе оплата труда рабочих	тенге			102194766
		машины и механизмы	тенге			92613949
		в том числе оплата труда машинистов	тенге			24565902
		материалы, изделия и конструкции	тенге			22880880
		оборудование	тенге			-
		перевозки	тенге			-
		Нормативная трудоемкость	чел.-ч.	50278,93		
	Раздел № 1	**Земляные работы**				**77589085**
		из них				

1	2	3	4	5	6	7
		затраты на труд рабочих	тенге			51638400
		в том числе оплата труда рабочих	тенге			25673755
		машины и механизмы	тенге			14596004
		в том числе оплата труда машинистов	тенге			3731655
		материалы, изделия и конструкции	тенге			11354681
		оборудование	тенге			-
		перевозки	тенге			-
		Нормативная трудоемкость	чел.-ч.	11452,07		
1	6101-0101-0112	Разработка грунта в котлованах объемом свыше 1000 до 3000 м3 в отвал экскаваторами "обратная лопата", вместимость ковша 0,65 м3, группа грунта 3	м3	7271	569	4137199
		из них:				
		затраты на труд рабочих	тенге		-	-
		в том числе оплата труда рабочих	тенге		-	-
		машины и механизмы	тенге		569	4137199
		в том числе оплата труда машинистов	тенге		125	908875
		материалы, изделия и конструкции	тенге		-	-
		Нормативная трудоемкость	чел.-ч.	212		
2	6101-0301-1302	Срезка кустарника и мелколесья кусторезами на тракторе, мощность 79 кW (108 л.с.), грунты естественного залегания, кустарники и мелколесья средние	га	100	29153	2915300

1	2	3	4	5	6	7
		из них:				
		затраты на труд рабочих	тенге		-	-
		в том числе оплата труда рабочих	тенге		-	-
		машины и механизмы	тенге		29153	2915300
		в том числе оплата труда машинистов	тенге		7599	759900
		материалы, изделия и конструкции	тенге		-	-
		Нормативная трудоемкость	чел.-ч.	212		
3	6106-0304-0204	Установка ограждения металлического без поручня	m	2500	3450	8625000
		из них:				
		затраты на труд рабочих	тенге		2715	6787500
		в том числе оплата труда рабочих	тенге		1352	3380000
		машины и механизмы	тенге		267	667500
		в том числе оплата труда машинистов	тенге		85	212500
		материалы, изделия и конструкции	тенге		468	1170000
		Нормативная трудоемкость	чел.-ч.	1235		
4	7101-0101-0502	Срезка недобора грунта в выемках, группа грунта 2	m3	885	3579	3167415
		из них:				
		затраты на труд рабочих	тенге		2580	2283300
		в том числе оплата труда рабочих	тенге		1243	1100055
		машины и механизмы	тенге		995	880575

1	2	3	4	5	6	7
		в том числе оплата труда машинистов	тенге		226	200010
		материалы, изделия и конструкции	тенге		4	3540
		Нормативная трудоемкость	чел.-ч.	523		
5	6101-0106-0104	Засыпка траншей и котлованов с перемещением грунта до 5 m бульдозерами, мощность 79 кW (108 л с), группа грунта 1	m3	7050	59	415950
		из них:				
		затраты на труд рабочих	тенге		-	-
		в том числе оплата труда рабочих	тенге		-	-
		машины и механизмы	тенге		59	415950
		в том числе оплата труда машинистов	тенге		15	105750
		материалы, изделия и конструкции	тенге		-	-
		Нормативная трудоемкость	чел.-ч.	25		
6	6107-0201-0401	Устройство гипсокартонной перегородки на одинарном каркасе из алюминиевых профилей с обшивкой гипсокартонными листами в 1 слой с двух сторон толщина 75-125 mm, глухой	m2	3700	8350	30895000
		из них:				
		затраты на труд рабочих	тенге		6240	23088000
		в том числе оплата труда рабочих	тенге		3107	11495900
		машины и механизмы	тенге		88	325600
		в том числе оплата труда машинистов	тенге		27	99900

1	2	3	4	5	6	7
		материалы, изделия и конструкции	тенге		2022	7481400
		Нормативная трудоемкость	чел.-ч.	4191		
7	6113-0101-0101	Планировка участка для озеленения, механизированным способом	m2	0	32	-
		из них:				
		затраты на труд рабочих	тенге		-	-
		в том числе оплата труда рабочих	тенге		-	-
		машины и механизмы	тенге		32	-
		в том числе оплата труда машинистов	тенге		8	-
		материалы, изделия и конструкции	тенге		-	-
		Нормативная трудоемкость	чел.-ч.	-		
8	6103-0501-0201	Монтаж и демонтаж опалубки объемно-переставной "тоннельной" перекрытия железобетонного	m2	4200	6011	25246200
		из них:				
		затраты на труд рабочих	тенге		4638	19479600
		в том числе оплата труда рабочих	тенге		2309	9697800
		машины и механизмы	тенге		811	3406200
		в том числе оплата труда машинистов	тенге		234	982800
		материалы, изделия и конструкции	тенге		562	2360400
		Нормативная трудоемкость	чел.-ч.	4892		

1	2	3	4	5	6	7
9	222-529-0302	Профиль стоечный ПС для гипсокартона, оцинкованный СТ РК 2621-2015 размерами 75 mm x 50 mm, толщиной стали от 0,4 до 0,45 mm	m	1025,2	331	339341
10	261-1050132	Плиты теплоизоляционные ГОСТ 16381-77	m2	515	-	-
11	6113-0101-0101	Планировка участка для озеленения, механизированным способом	m2	57740	32	1847680
		из них:				
		затраты на труд рабочих	тенге		-	-
		в том числе оплата труда рабочих	тенге		-	-
		машины и механизмы	тенге		32	1847680
		в том числе оплата труда машинистов	тенге		8	461920
		материалы, изделия и конструкции	тенге		-	-
		Нормативная трудоемкость	чел.-ч.	162		
	Раздел № 2	**Фундаменты**				**17528174**
		из них				
		затраты на труд рабочих	тенге			8203495
		в том числе оплата труда рабочих	тенге			4083965
		машины и механизмы	тенге			7571844
		в том числе оплата труда машинистов	тенге			1567477
		материалы, изделия и конструкции	тенге			1752835
		оборудование	тенге			-
		перевозки	тенге			-

1	2	3	4	5	6	7
		Нормативная трудоемкость	чел.-ч.	1984,27		
12	6102-0101-0210	Погружение дизель-молотом сваебойными установками на гусеничном ходу железобетонных свай колонного типа длина до 10 м, глубина до 6 м, грунты группы 2	m3	37,8	79292	2997238
		из них:				
		затраты на труд рабочих	тенге		18434	696805
		в том числе оплата труда рабочих	тенге		9177	346891
		машины и механизмы	тенге		45021	1701794
		в том числе оплата труда машинистов	тенге		9687	366169
		материалы, изделия и конструкции	тенге		15837	598639
		Нормативная трудоемкость	чел.-ч.	205		
13	261-1010363	Сборные железобетонные изделия и конструкции	m3	38,556	-	-
14	6103-0201-0103	Монтаж опалубки колонны железобетонной квадратного или прямоугольного сечения, периметр до 3 м	m2	504	5470	2756880
		из них:				
		затраты на труд рабочих	тенге		2560	1290240
		в том числе оплата труда рабочих	тенге		1275	642600
		машины и механизмы	тенге		2057	1036728
		в том числе оплата труда машинистов	тенге		418	210672
		материалы, изделия и конструкции	тенге		853	429912

1	2	3	4	5	6	7
		Нормативная трудоемкость	чел.-ч.	311		
15	6103-0201-0108	Армирование колонны железобетонной квадратного или прямоугольного сечения с установкой готовых пространственных арматурных каркасов, периметр до 2 m	т	148	41383	6124684
		из них:				
		затраты на труд рабочих	тенге		23963	3546524
		в том числе оплата труда рабочих	тенге		11929	1765492
		машины и механизмы	тенге		12809	1895732
		в том числе оплата труда машинистов	тенге		2675	395900
		материалы, изделия и конструкции	тенге		4611	682428
		Нормативная трудоемкость	чел.-ч.	781		
16	6103-0201-0114	Бетонирование колонны железобетонной по схеме «Кран-бадья» квадратного или прямоугольного сечения, периметр до 3 m	m3	218	20070	4375260
		из них:				
		затраты на труд рабочих	тенге		9695	2113510
		в том числе оплата труда рабочих	тенге		4827	1052286
		машины и механизмы	тенге		10183	2219894
		в том числе оплата труда машинистов	тенге		2060	449080
		материалы, изделия и конструкции	тенге		192	41856
		Нормативная трудоемкость	чел.-ч.	531		

1	2	3	4	5	6	7
17	261-1010210	Бетон	m3	221,27	-	-
18	6103-0201-0117	Демонтаж опалубки колонны железобетонной квадратного или прямоугольного сечения, периметр до 3 m	m2	504	2528	1274112
		из них:				
		затраты на труд рабочих	тенге		1104	556416
		в том числе оплата труда рабочих	тенге		549	276696
		машины и механизмы	тенге		1424	717696
		в том числе оплата труда машинистов	тенге		289	145656
		материалы, изделия и конструкции	тенге		-	-
		Нормативная трудоемкость	чел.-ч.	157		
	Раздел № 3	**Перекрытие**				**198312550**
		из них				
		затраты на труд рабочих	тенге			134055785
		в том числе оплата труда рабочих	тенге			66737720
		машины и механизмы	тенге			59010105
		в том числе оплата труда машинистов	тенге			16358190
		материалы, изделия и конструкции	тенге			5246660
		оборудование	тенге			-

1	2	3	4	5	6	7
		перевозки	тенге			-
		Нормативная трудоемкость	чел.-ч.	34082,83		
19	6103-0501-0201	Монтаж и демонтаж опалубки объемно-переставной "тоннельной" перекрытия железобетонного	m2	4200	6011	25246200
		из них:				
		затраты на труд рабочих	тенге		4638	19479600
		в том числе оплата труда рабочих	тенге		2309	9697800
		машины и механизмы	тенге		811	3406200
		в том числе оплата труда машинистов	тенге		234	982800
		материалы, изделия и конструкции	тенге		562	2360400
		Нормативная трудоемкость	чел.-ч.	4892		
20	6103-0501-0116	Бетонирование перекрытия железобетонного балочного с капителями на высоте от опорной поверхности до 6 m бетононасосом	m3	4150	21645	89826750
		из них:				
		затраты на труд рабочих	тенге		11096	46048400
		в том числе оплата труда рабочих	тенге		5524	22924600
		машины и механизмы	тенге		10501	43579150
		в том числе оплата труда машинистов	тенге		2955	12263250
		материалы, изделия и конструкции	тенге		48	199200
		Нормативная трудоемкость	чел.-ч.	12695		

1	2	3	4	5	6	7
21	6103-0501-0202	Установка каркасов и сеток в перекрытии в объемно-переставной "тоннельной" опалубке, масса одного элемента до 20 кг	т	500	111940	55970000
		из них:				
		затраты на труд рабочих	тенге		98363	49181500
		в том числе оплата труда рабочих	тенге		48968	24484000
		машины и механизмы	тенге		10797	5398500
		в том числе оплата труда машинистов	тенге		2528	1264000
		материалы, изделия и конструкции	тенге		2780	1390000
		Нормативная трудоемкость	чел.-ч.	11605		
22	6103-0501-0201	Монтаж и демонтаж опалубки объемно-переставной "тоннельной" перекрытия железобетонного	m2	2000	6011	12022000
		из них:				
		затраты на труд рабочих	тенге		4638	9276000
		в том числе оплата труда рабочих	тенге		2309	4618000
		машины и механизмы	тенге		811	1622000
		в том числе оплата труда машинистов	тенге		234	468000
		материалы, изделия и конструкции	тенге		562	1124000
		Нормативная трудоемкость	чел.-ч.	2330		
23	6103-0501-0116	Бетонирование перекрытия железобетонного балочного с капителями на высоте от опорной поверхности до 6 m бетононасосом	m3	420	21645	9090900

1	2	3	4	5	6	7
		из них:				
		затраты на труд рабочих	тенге		11096	4660320
		в том числе оплата труда рабочих	тенге		5524	2320080
		машины и механизмы	тенге		10501	4410420
		в том числе оплата труда машинистов	тенге		2955	1241100
		материалы, изделия и конструкции	тенге		48	20160
		Нормативная трудоемкость	чел.-ч.	1285		
24	6103-0501-0202	Установка каркасов и сеток в перекрытии в объемно-переставной "тоннельной" опалубке, масса одного элемента до 20 кг	т	55	111940	6156700
		из них:				
		затраты на труд рабочих	тенге		98363	5409965
		в том числе оплата труда рабочих	тенге		48968	2693240
		машины и механизмы	тенге		10797	593835
		в том числе оплата труда машинистов	тенге		2528	139040
		материалы, изделия и конструкции	тенге		2780	152900
		Нормативная трудоемкость	чел.-ч.	1277		
	Раздел № 4	**Металлоконструкции**				**27411414**
		из них				
		затраты на труд рабочих	тенге			11448714
		в том числе оплата труда рабочих	тенге			5699326

1	2	3	4	5	6	7
		машины и механизмы	тенге			11435996
		в том числе оплата труда машинистов	тенге			2908580
		материалы, изделия и конструкции	тенге			4526704
		оборудование	тенге			-
		перевозки	тенге			-
		Нормативная трудоемкость	чел.-ч.	2759,76		
25	6106-0302-0110	Монтаж стропильной фермы, подстропильной фермы: пролет до 48 м, масса до15 т, высота до 25 м	т	150	142258	21338700
		из них:				
		затраты на труд рабочих	тенге		59431	8914650
		в том числе оплата труда рабочих	тенге		29585	4437750
		машины и механизмы	тенге		56686	8502900
		в том числе оплата труда машинистов	тенге		15499	2324850
		материалы, изделия и конструкции	тенге		26141	3921150
		Нормативная трудоемкость	чел.-ч.	2233		
26	261-1020322	Конструкции стальные	т	150	-	-
27	261-1020322	Конструкции стальные	т	150	-	-
28	261-1020122	Арматура ГОСТ 10922-2012	т	150	-	-
29	261-1010210	Бетон	м3	152,25	-	-

1	2	3	4	5	6	7
30	6106-0301-0201	Монтаж колонны многоэтажного здания различного назначения, высота: до 25 м	т	62	97947	6072714
		из них:				
		затраты на труд рабочих	тенге		40872	2534064
		в том числе оплата труда рабочих	тенге		20348	1261576
		машины и механизмы	тенге		47308	2933096
		в том числе оплата труда машинистов	тенге		9415	583730
		материалы, изделия и конструкции	тенге		9767	605554
		Нормативная трудоемкость	чел.-ч.	527		

Составил Левин Д.Р

должность, подпись (инициалы, фамилия)

Проверил

должность, подпись (инициалы, фамилия)

ЕСЦ РК 2024, город Астана, г. Косшы введен с 01.01.2024
ЭСН РК 2024 И37 введен с 01.01.2024
ССЦ 2024, город Астана, г. Косшы введен с 01.01.2024
ССЦ Апрель 2025, город Астана, г. Косшы введен с 01.04.2025

Объектная смета № 2-
(Объектный сметный расчет)

на строительство Новый пассажирский терминал аэропорта с комфортными зонами в городе Астана
(наименование объекта)

Сметная стоимость работ и затрат 320841,223 тыс. тенге

Нормативная трудоемкость 50,27893 тыс. чел.-ч

Средства на оплату труда 229912,296 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	3	4	5	6	7	8	9	10
1	2--	Новый пассажирский терминал аэропорта с комфортными зонами в городе Астана.	320841,223			320841,223	50,27893	229912,296	
		Итого по смете	320841,223			320841,223	50,27893	229912,296	

Составил Студент Левин Д.Р

должность, подпись (инициалы, фамилия)

Проверил

должность, подпись (инициалы, фамилия)

ЕСЦ РК 2024, город Астана, г. Косшы введен с 01.01.2024
ЭСН РК 2024 И37 введен с 01.01.2024
ССЦ 2024, город Астана, г. Косшы введен с 01.01.2024
ССЦ Апрель 2025, город Астана, г. Косшы введен с 01.04.2025

Приложение Г
НДЦС РК 8.01-08-2022
Форма 1

Наименование инвестиционного проекта Новый пасажриский терминал с комфортными зонами в городе Астана

Заказчик Satbayev University
(наименование организации)

Утверждена

общая сметная стоимость по Сводному сметному расчету в сумме 377309,278 тыс. тенге

в том числе:
возвратных сумм - тыс. тенге

налог на добавленную стоимость 40425,994 тыс. тенге

(ссылка на документ об утверждении)

"____"_____20____ год.

Сводный сметный расчет стоимости строительства

Новый пасажриский терминал с комфортными зонами в городе Астана
(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 2. Основные объекты строительства				
2	2-	Новый пассажирский терминал аэропорта с комфортными зонами в городе Астана	320841,223			320841,223
		Итого по главе № 2	320841,223			320841,223
		Итого по главам № 1 - 7	320841,223			320841,223
3	НДЦС РК 8.01-08-2022 п.8.2.65	Сметная прибыль - 5 %	16042,061			16042,061
		Итого со сметной прибылью	336883,284			336883,284
		Итого по части II	336883,284			336883,284
		Часть III. Инжиниринговые услуги				
		Итого по части III				
		Итого по частям I-III	336883,284			336883,284
	Налоговый Кодекс РК от 25.12.2017 № 120-VI, ст.422	**Налог на добавленную стоимость (НДС) - 12 %**			40425,994	40425,994

3D visualisation

					SU-6B07302-Construction Engineering-2025 DP	
					New passenger terminal of the airport with comfortable areas in Astana	
Chan.	Numb.	Sheet	№ doc.	Signature	Date	
Head of Dep.		Sharakhmetov S.B.			10.06	Architectural section
Supervisor		Sakhi A.K.			09.06	
Norm control		Yesembayeva A.A.			09.06	
Quality contr.		Kozyukova N.V.			10.06	3d visualization
Created		Levin D. R.			09.06	

Stage	Sheet	Sheets
DP	1	11

"CEaBM" Department
COBS-21-4er

Формат А2

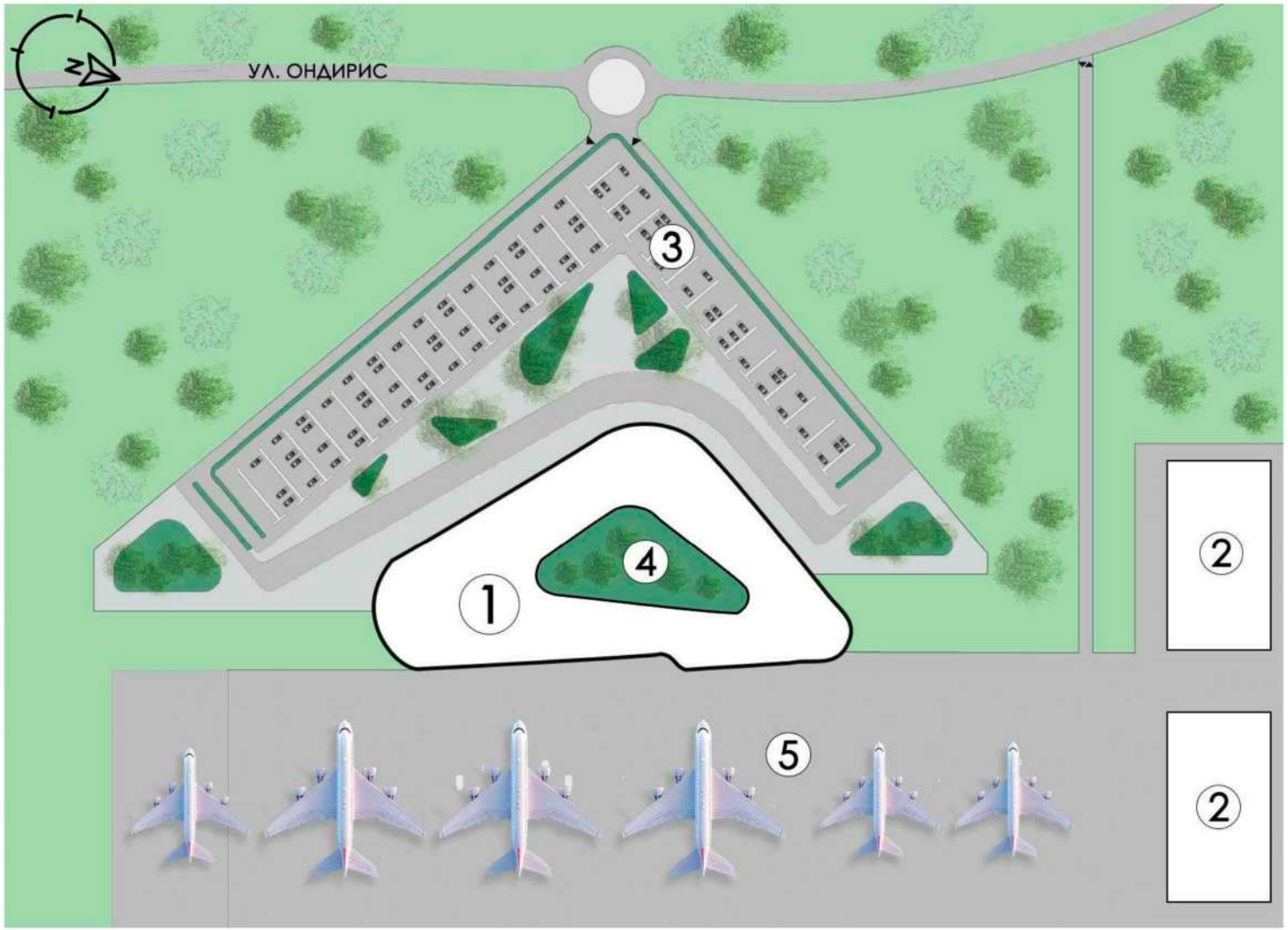
Согласовано

Взам. инв. №

Подпись и дата

Инв. № подл.

General plan (M 1:500)



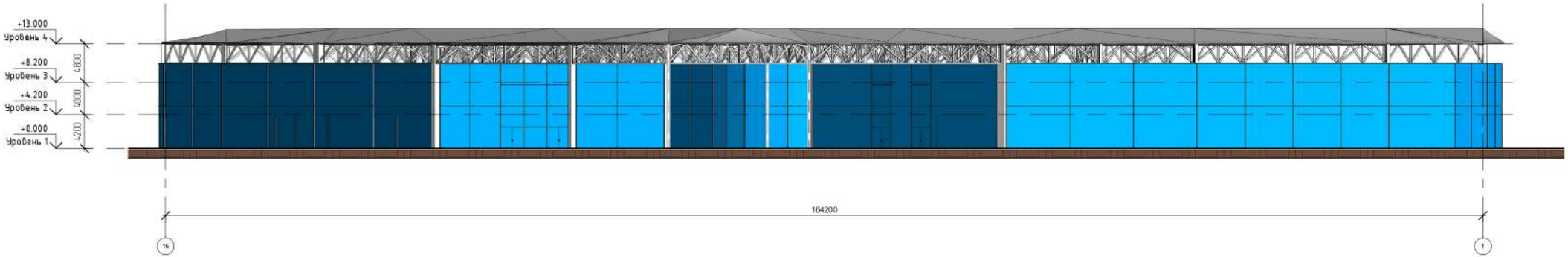
Explication		
№	Name	Notes
1	Airport building	
2	Hardware building	
3	Parking	
4	Inner garden	
5	Parking for airplanes	

						SU-6B07302-Civil Engineering-2025 DP	
						New passenger terminal of the airport with comfortable areas in Astana	
Chan.	Numb.	Sheet	№ doc.	Signature	Date		
Head of Dep.		Shayakhmetov S.B.			10.06	Technical and organizational section	Stage: DP; Sheet: 2; Sheets: 11
Supervisor		Sakhi A.K.			09.06		
Norm control		Yesembayeva A.A.			09.06		
Quality contr		Kozyukova N.V.			10.06	General plan	"CEaBM" Department CDBS-21-4er
Created		Levin D.R.			09.06		

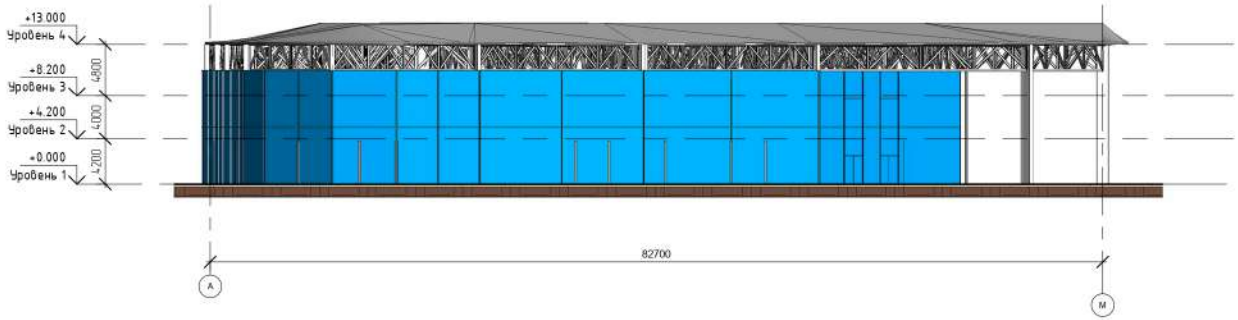
Формат А2

Инв. № подл. | Подпись и дата | Взам. инв. №

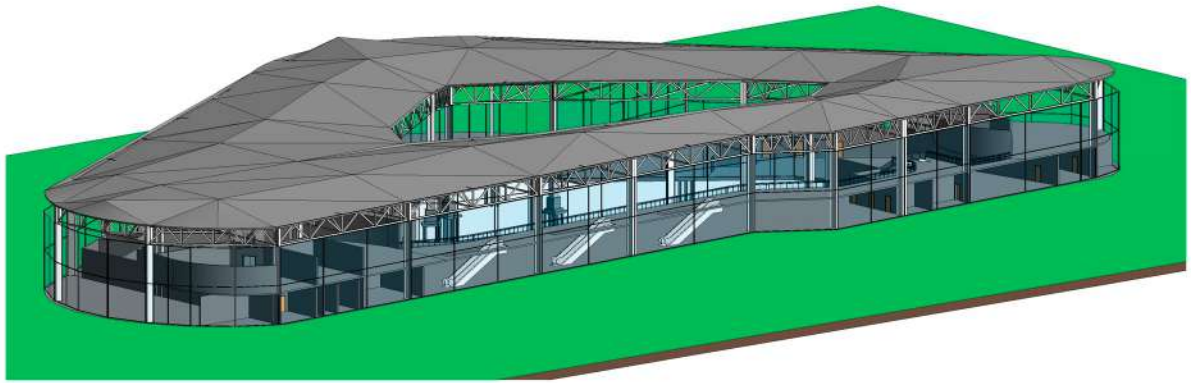
Facade in axes 16-1 (M 1:300)



Facade in axes A-M (M 1:300)



3D view



				SU-6B07302-Construction Engineering-2025 DP	
				New passenger terminal of the airport with comfortable areas in Astana	
Chan.	Numb.	Sheet	№ doc	Signature	Date
Head of Dep.		Shayakhmetov S.B.			10.06
Supervisor		Sakhi A.K.			09.06
Norm control		Yesenbayeva A.A.			23.05
Quality contr.		Kozyukova N.V.			10.06
Created		Levin D. R.			09.06
Architectural section				Stage: DP	Sheet: 3	Sheets: 11
Facades in axes A-M, 16-1, 3D view				"CEaBM" Department CDBS-21-4er	
				Формат А2	

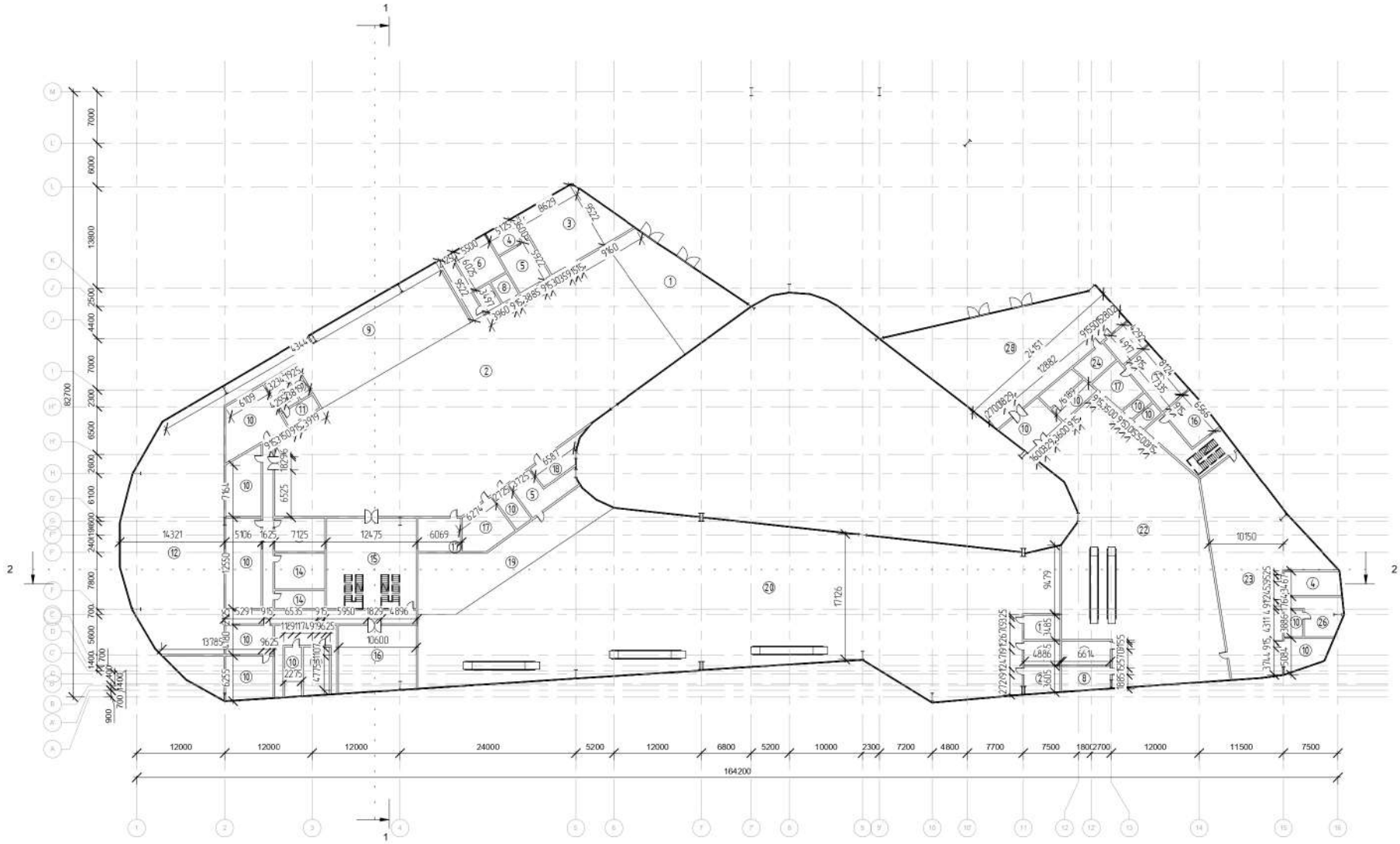
Согласовано

Взам. инв. №

Подпись и дата

Инв. № подл.

The plan is at the level of 0.000 (M 1:300)



Explication of rooms on the 1st floor		
№	Name	Area
1	initial inspection	143 м²
2	check-in waiting zone	1089 м²
3	cafe	102 м²
4	baggage loading area	42 м²
5	kitchen	57 м²
6	mother and child room	31 м²
7	luggage storage	8 м²
8	storage room	51 м²
9	check-in desks	248 м²
10	service space	380 м²
11	sales registers	10 м²
12	baggage unloading area	414 м²
13	police	31 м²
14	Aviation Security Service	50 м²
15	security screening area	150 м²
16	VIP zone	125 м²
17	toilet	116 м²
18	medical service	22 м²
19	duty free	159 м²
20	departure lounge	1571 м²
21	children room	18 м²
22	baggage claim hall	677 м²
23	baggage unloading area	289 м²
24	info/taxi	15 м²
25	info desk	18 м²
26	service checkpoint	32 м²
27	VIP arrival area	37 м²
28	exit area	308 м²
		6195 м²

					SU-6B07302-Civil Engineering-2025 DP	
					New passenger terminal of the airport with comfortable areas in Astana	
Chan.	Numb.	Sheet	№ doc.	Signature	Date	
Head of Dep.		Shayakhmetov S.B.			10.06	
Supervisor		Sakhi A.K.			09.06	Architectural section
Norm control		Yesembayeva A.A.			09.06	
Quality contr.		Kozyukova N.V.			10.06	1st floor plan
Created		Levin D.R.			09.06	

Stage	Sheet	Sheets
DP	4	11

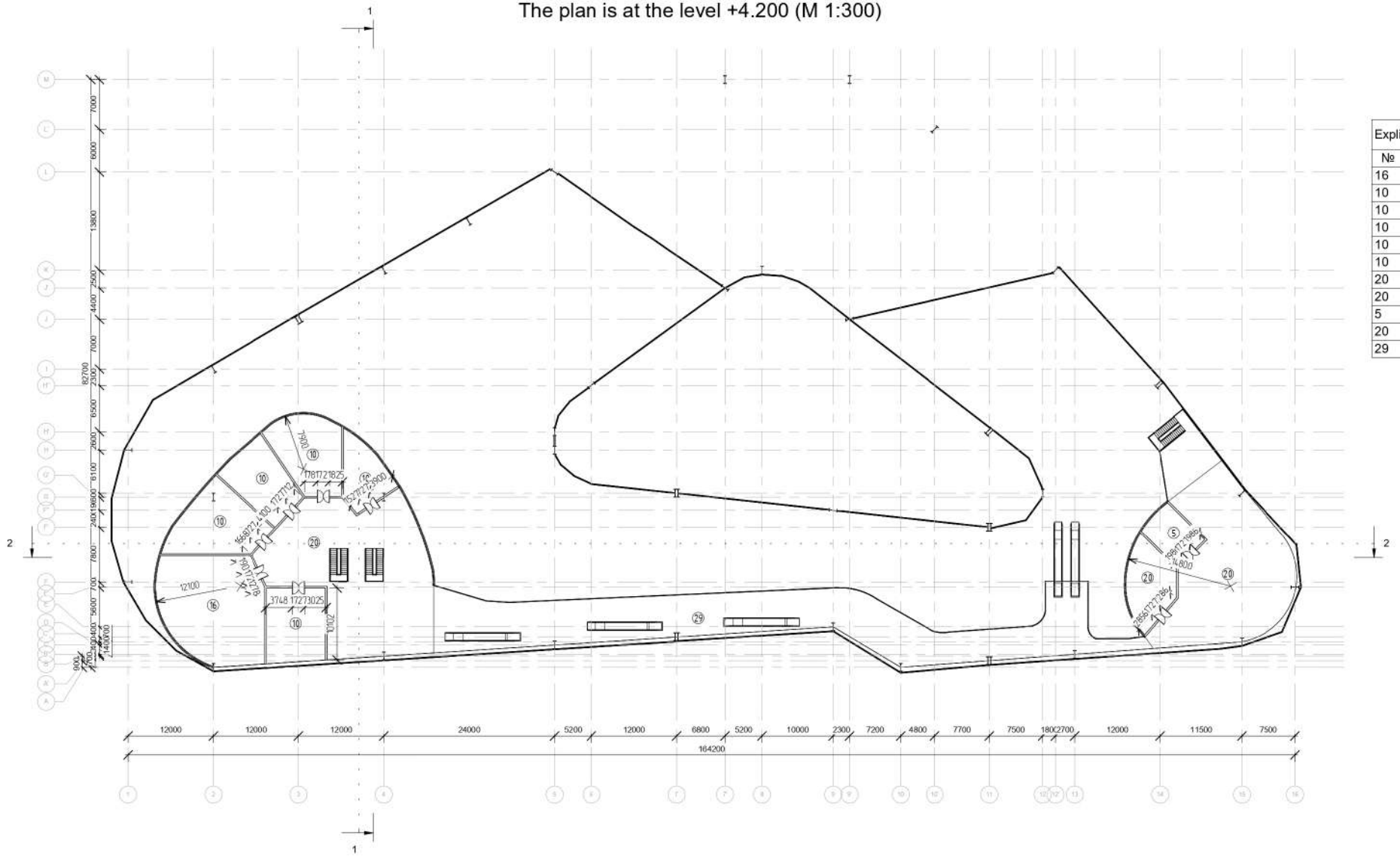
"CEaBM" Department
CDBS-21-4er

Формат А2

Согласовано

Инв. № подл. | Подп. и дата | Взам. инв. №

The plan is at the level +4.200 (M 1:300)



Explication of rooms on the 2nd floor		
№	Name	Area
16	high-comfort lounge	209 м²
10	service space	86 м²
10	service space	104 м²
10	service space	77 м²
10	service space	95 м²
10	service space	53 м²
20	departure lounge	407 м²
20	departure lounge	438 м²
5	kitchen	40 м²
20	departure lounge	67 м²
29	arrival area	597 м²

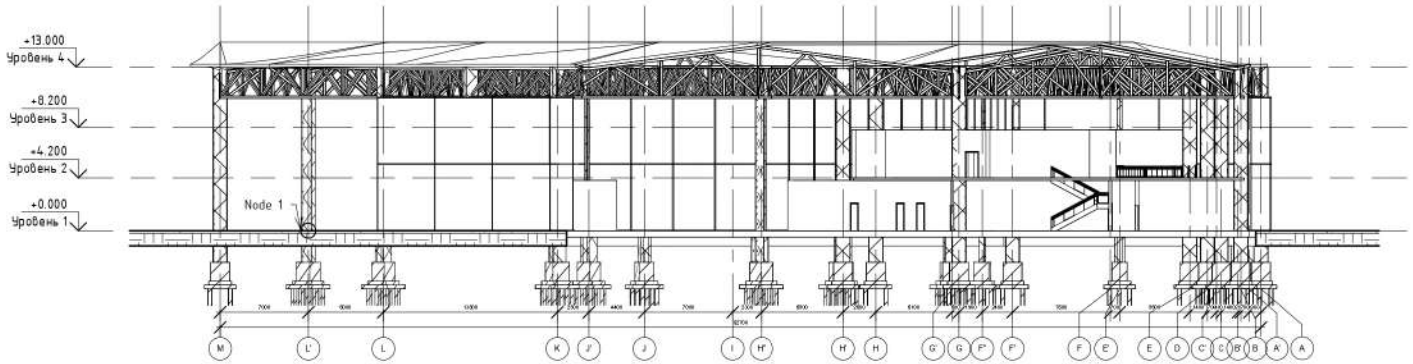
						SU-6B07302-Civil Engineering-2025 DP	
						New passenger terminal of the airport with comfortable areas in Astana	
Chan.	Numb.	Sheet	№ doc.	Signature	Date		
Head of Dep.		Sharakhmetov S.B.			10.06	Architectural section	Stage: DP; Sheet: 5; Sheets: 11
Supervisor		Sakhi A.K.			09.06		
Norm control		Yesembayeva A.A.			09.06		
Quality contr.		Kozyukova N.V.			10.06	2nd floor plan	"CEaBM" Department CDBS-21-4er
Created		Levin D. R.			09.06		

Формат А2

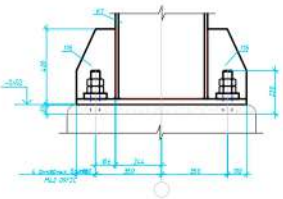
Согласовано

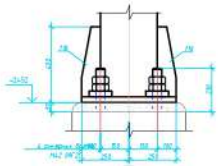
Инв. № подл. | Подп. и дата | Взам. инв. №

Section 1-1 (M 1:300)

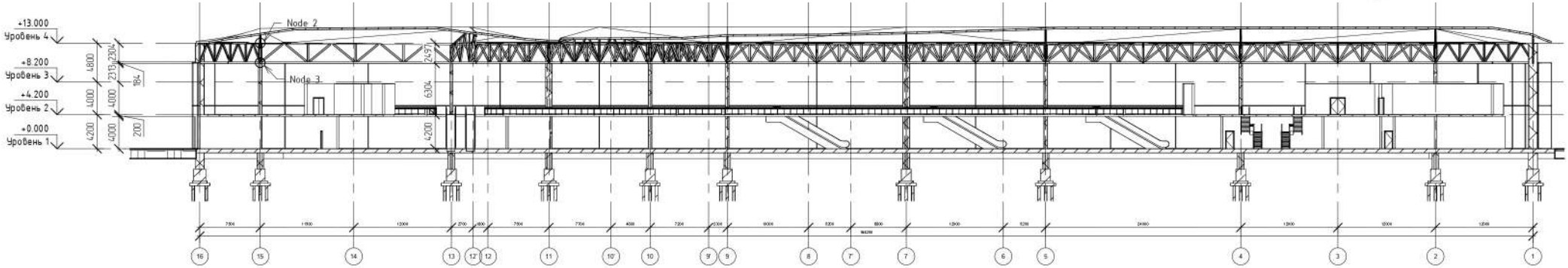


Node 1 (M 1:10)

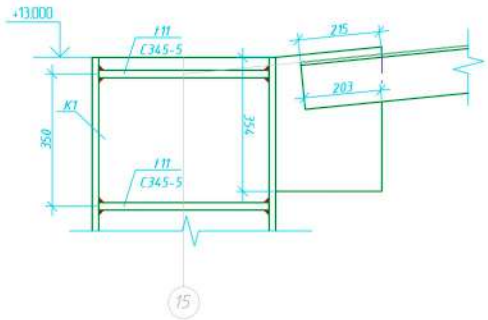




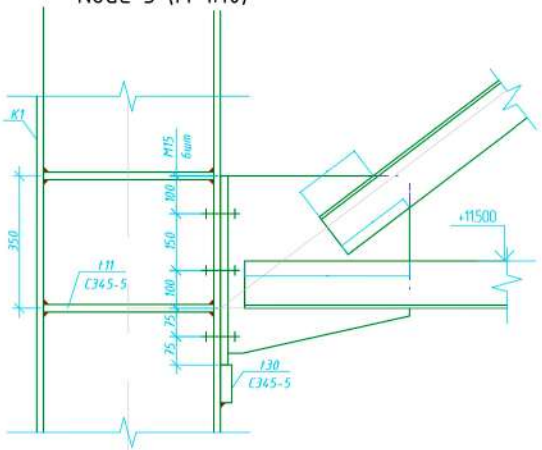
Section 2-2 (M 1:300)



Node 2 (M 1:10)



Node 3 (M 1:10)



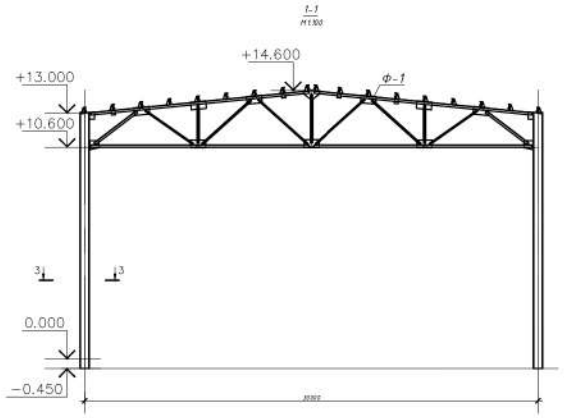
					SU-6B07302-Construction Engineering-2025 DP		
					New passenger terminal of the airport with comfortable areas in Astana		
Chan.	Numb.	Sheet	№ doc.	Signature	Date		
Head of Dep		Shayakhmetov S.B.			10.06	Architectural section	Stage: DP; Sheet: 6; Sheets: 11
Supervisor		Sakhi A.K.			09.06		
Norm contro		Yesenbayeva A.A.			09.06		
Quality contr		Kozyukova N.V.			10.06	Section 1-1, 2-2	"CEaBM" Department CDBS-21-4er
Created		Levin D.R.			09.06		
							Формат А2

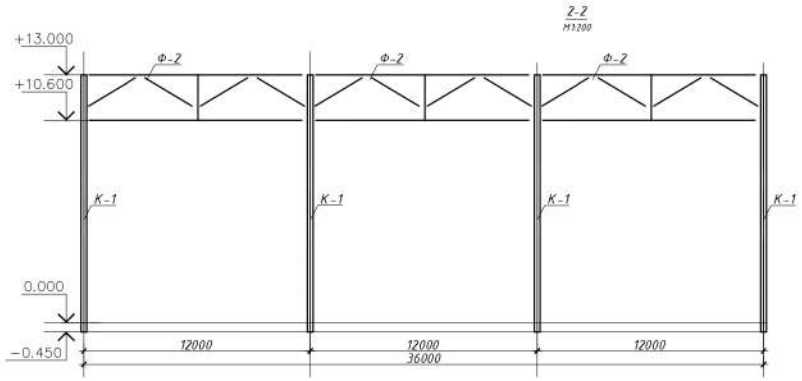
Согласовано

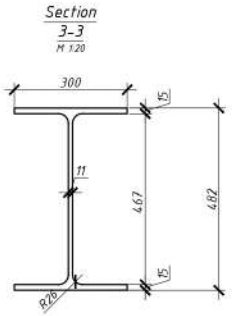
Взам. инв. №

Подпись и дата

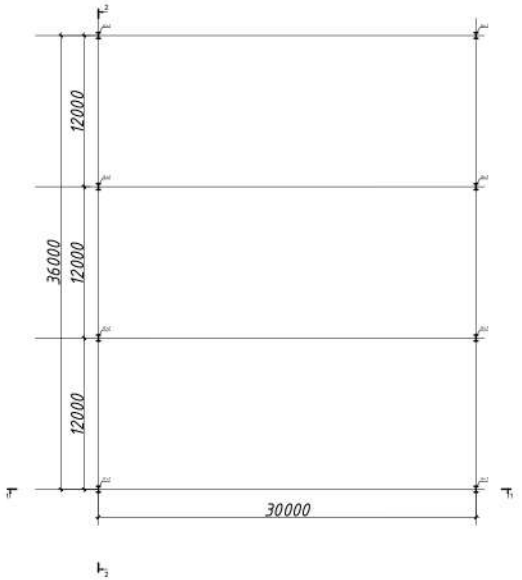
Инв. № подл.



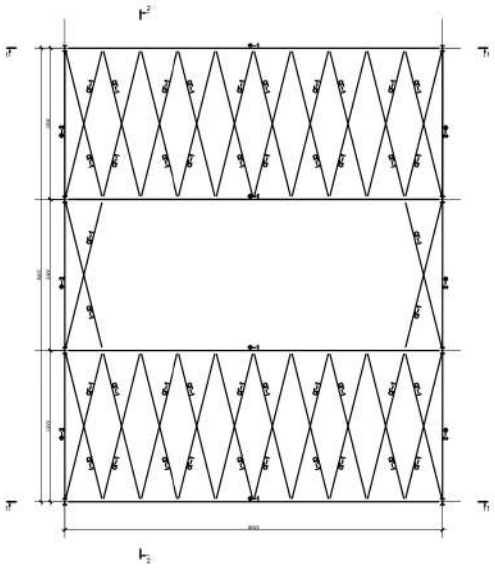


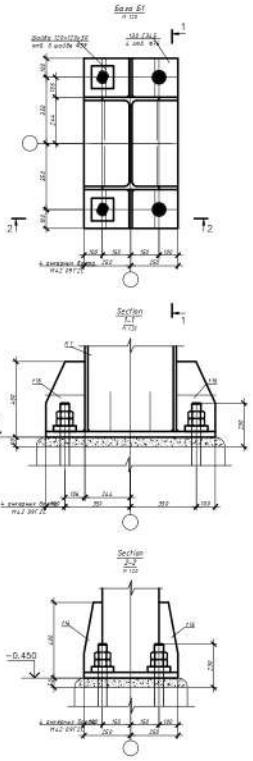


The layout of the elements on the level ±0.000
M1:400

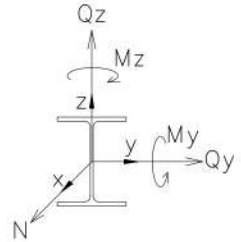


The layout of the elements of the lower belt
M1:400





List of elements

Pos	Section		Stell mar k
	Drawing	Elements	
К–1		I 50Ш1	С345–5
СГ–1	L	2L 160x160x10	С345–5
П1	C	20а	С345–5

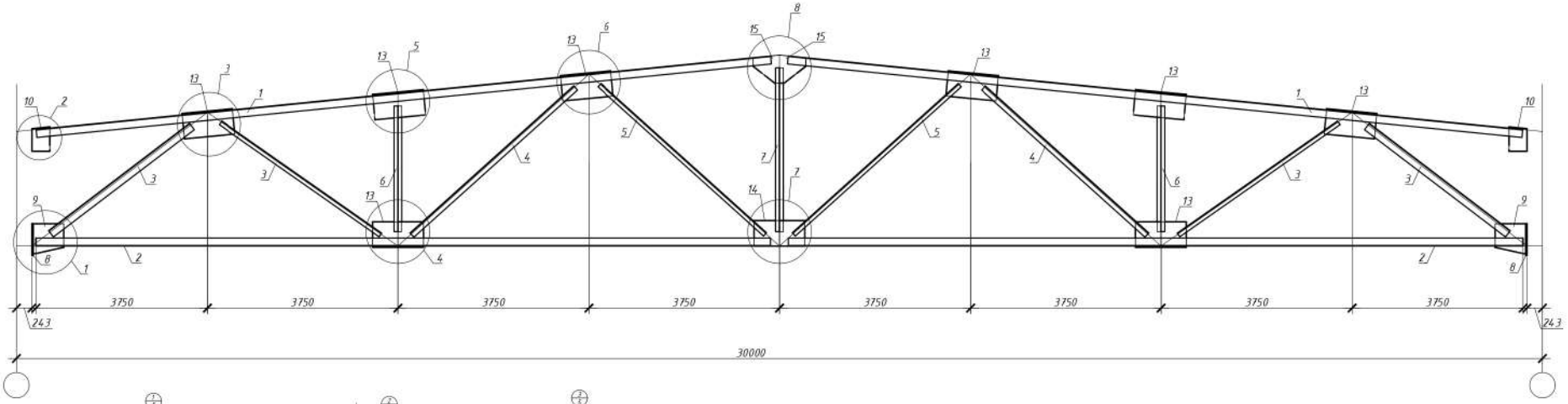
						SU-6B07302-Civil Engineering-2025 DP	
						New passenger terminal of the airport with comfortable areas in Astana	
Chan.	Numb.	Sheet	№ doc.	Signature	Date		
Head of Dep.		Shayakhmetov S.B.			10.06	Technical and organizational section	Stage: DP; Sheet: 8; Sheets: 11
Supervisor		Sakhi A.K.			05.06		
Norm control		Yesembayeva K.A.			07.06		
Quality contr		Kozyukova N.V.			10.06	Arrangement of elements at ±0.000, Section 1-1, Section 2-2, Arrangement of elements of the lower belt	"CEaBM" Department CDBS-21-4er
Created		Levin D.R.			09.06		

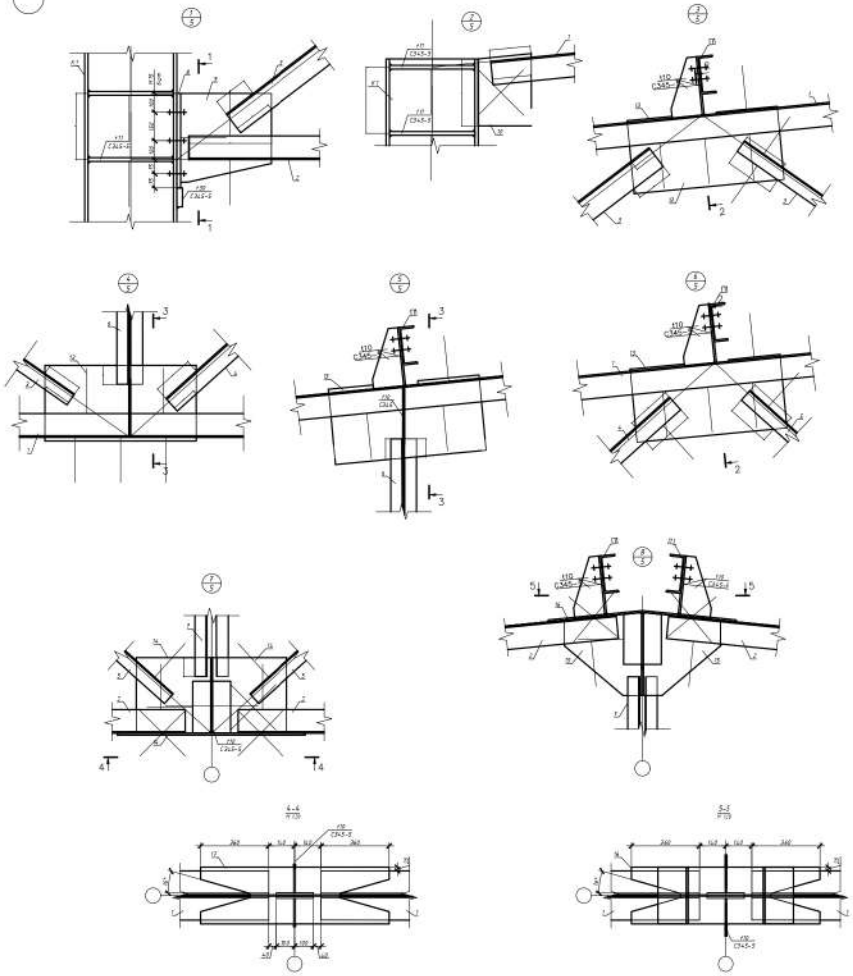
Формат А2

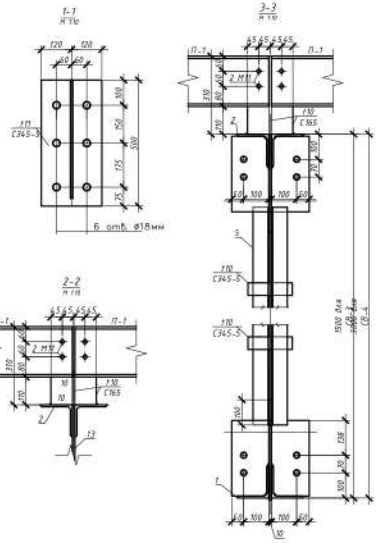
Инв. № подл. | Подпись и дата | Взам. инв. №

Rafter trusses ФС-1

M 1:50







RT-1 Rafter Truss Specification

Pos.	Designation	Name	Num	Mass per unit, kg	Notes
		Upper belt			
1	GOST 8509-93	2L 140x140x9 L=15080мм	2	359,6	719.20
		Lower belt			0.000000
2	GOST 8509-93	2L 110x110x8 L=15000мм	2	359,9	719.80
		Braces and struts			0.000000
3	GOST 8509-93	2L 110x110x8 L=4050мм	4	86,2	344.80
4	GOST 8509-93	2L 110x110x8 L=4500мм	4	39,7	158.80
5	GOST 8509-93	2L 110x110x8 L=5000мм	2	19,5	39.00
6	GOST 8509-93	2L 80x80x10 L=3050мм	2	75,42	150.84
7	GOST 8509-93	2L 80x80x10 L=3680мм	1	45,45	45.45
		Chamfers			
8	GOST 19903-2021	- t20 500x240x20	2	18,84	37.68
9	GOST 19903-2021	- t10 480x470x10	2	17,71	35.42
10	GOST 19903-2021	- t10 350x280x10	2	7,69	15.38
11	GOST 19903-2021	- t10 250x200x10	8	3,93	31.44
12	GOST 19903-2021	- t10 300x263x10	8	6,2	49.60
13	GOST 19903-2021	- t10 400x800x10	8	25,12	200.96
14	GOST 19903-2021	- t10 400x400x10	2	12,56	25.12
15	GOST 19903-2021	- t10 400x450x10	2	14,2	28.40
16	GOST 19903-2021	- t10 1000x300x10	1	23,6	23.60
17	GOST 19903-2021	- t10 1000x300x10	1	23,6	23.60
18	GOST 19903-2021	- t10 275x300x10	2	6,5	13.00

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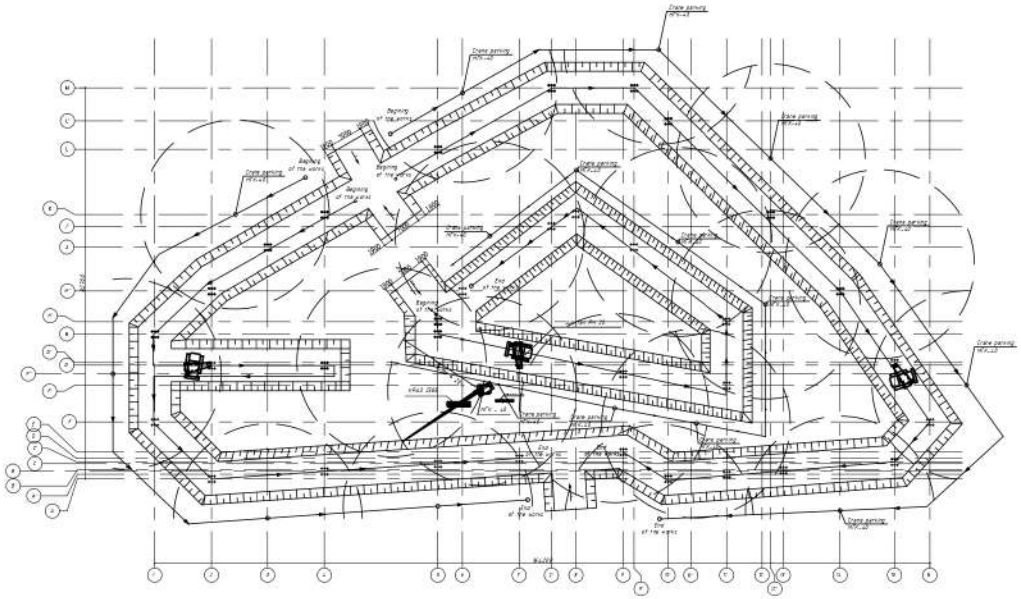
Supervisor	Sakhi A.K.				09.06
Norm control	Tesembayeva A.A.				09.06
Quality contr.	Kozyukova N.V.				10.06
Created	Levin D.R.				09.06
Technical and organizational section			Stage: DP	Sheet: 9	Sheets: 11
Rafter trusses			"CEaBM" Department CDBS-21-4er		

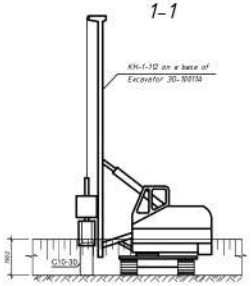
Формат А2

Инв. № подл. | Подпись и дата | Взам. инв. №

Technological map (M 1:400)



1-1

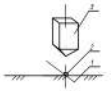


Symbols

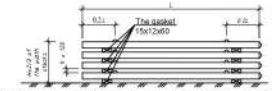
- Submerged piles
- Места погружения свай
- The direction of movement of cars

Pile slinging scheme for lifting the cap

Pile installation scheme to the dive point

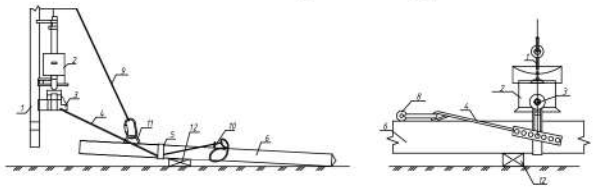


The scheme of stacking piles in a stack



The height of the stack H should not exceed 2.0 m. Each pile is supported by two wooden gaskets, located near the lifting loops along the same vertical. The thickness of the gaskets h should be 2-3 cm greater than the height of the pile hinges, and the width b should be at least 15 cm.

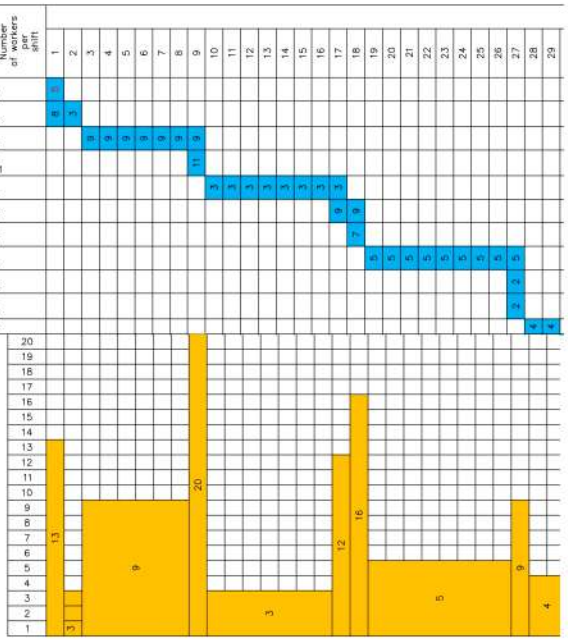
A device for lifting and installing piles



Symbols

1. The spear arrow
2. Hammer C-955
3. Headrest
4. Yoke suspension ropes
5. The yoke
6. The pile
7. Unversal sling
8. Pile cable
9. Suspension with hook
10. Locking pin
11. The loop
12. Lining

The name of the processes	Unit of measurement	Scope of work	Labor costs	Required machines		Duration, days	Number of shifts	Number of workers per shift
			Workers, h-days	Name	Number m-sh.			
Device temporary fence	10m	250	37,50		0,00	3,75	2	5
Cut vegetation layer	1000m2	100	0,00	ДЗ-104	85,00	14,17	2	3
Excavation in trenches	100m3	72,71	25,45	Е-651	109,07	36,36	1	9
Development of a shortage of soil	m3	885	181,43		0,00	8,25	2	11
Pile driving	pcs	252	0,00	Junttan PM 20	131,04	43,68	1	3
Installation of formwork	m2	504	22,68	МКГ-40	30,24	11,97	2	9
Installation of rebar	t	148,8	40,92		0,00	2,92	2	7
Laying of concrete mix	m3	218,4	32,76	МКТ-40	98,28	54,60	2	5
Disassembly of the formwork	m2	148,8	5,77		0,00	1,44	2	2
Basement Waterproofing	100m2	2,2	2,75		0,00	0,69	1	2
Backfilling	100m3	70,5	0,00	ДЗ-104	46,53	11,63	1	4



List of machines, mechanisms, and equipment

№ п/п	Name of mech	Type, brand	Technical characteristics	Appointment	Количество на звено, шт
1	The drilling rig	Junttan PM 20		Vertical immersion of piles	3
2	Diesel Hammer	С-995	Р=19 кДж	The working body of the coping equipment	3
3	Crawler Crane	МГК-40	Q=20 т. Lстр=23 м.	Unloading, warehousing, and piling	3
4	Jackhammer	МО-10П	pneumatic	Felling of pile heads	3
5	The cutter	РВД-1-57		For cutting rebar	3
6	Tractor unit	Краз-2585-1		Delivery of piles to the facility	5

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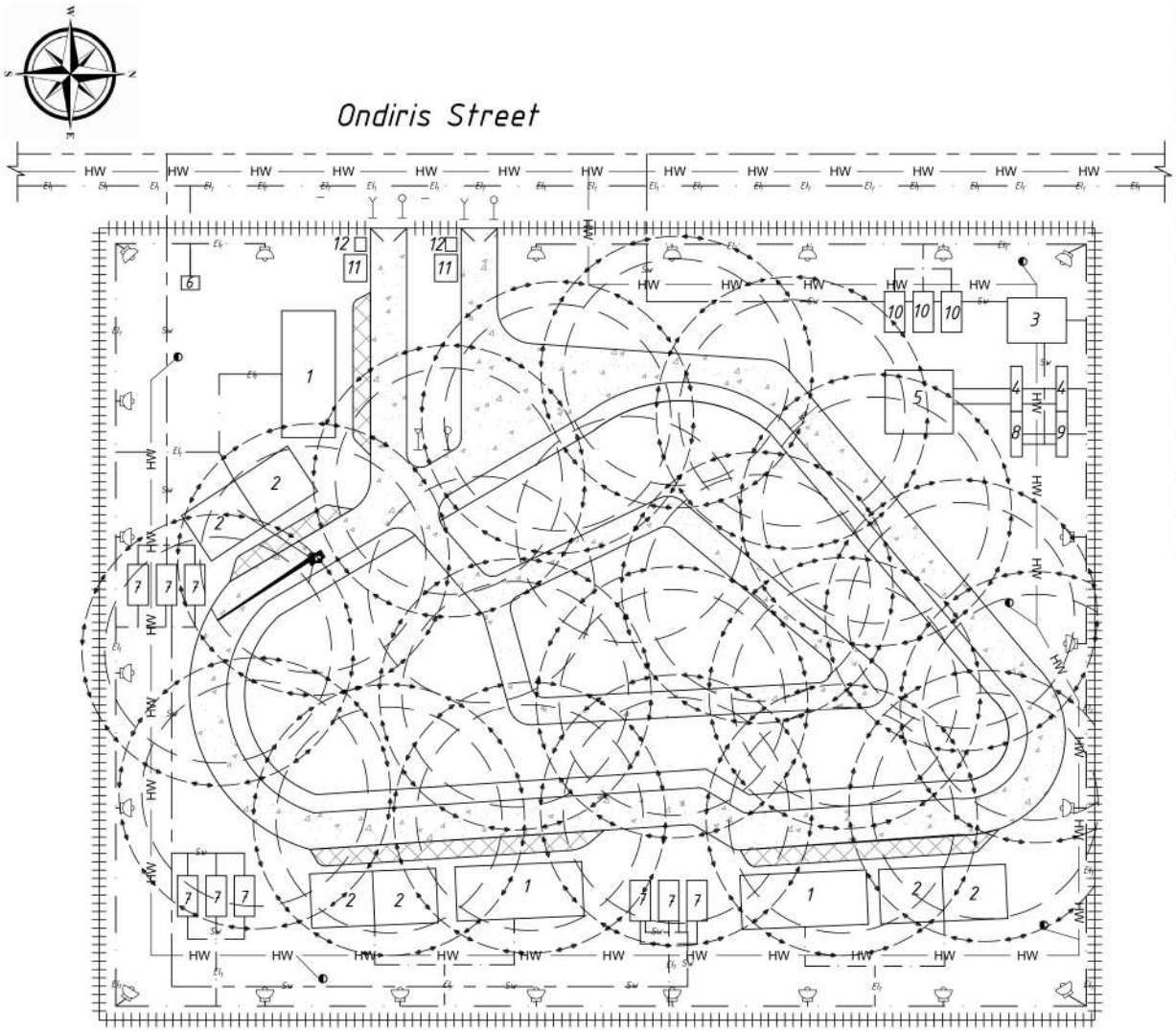
Head of Dep.		Shayakhmetov S.B.			10.06		
Supervisor		Sakhi A.K.			09.06	Technical and organizational section	Stage: DP; Sheet: 2; Sheets: 11
Norm control		Yesenbayeva A.A.			09.06		
Quality contr		Kozyukova N.V.			10.06	Technological map	"CEaBM" Department CDBS-21-4er
Created		Levin D.R.			09.06		

Формат А2

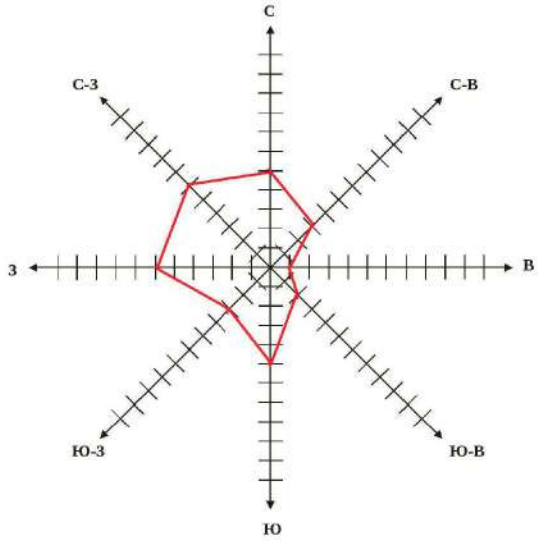
Инв. № подл. | Подпись и дата | Взам. инв. №



Symbols and graphics	
Symbol	Meaning
◐	Fire Hydrant
	Spotlight
HW	Water supply system
Sw	Sewerage system
EL	Electric line
Symbols and graphics (continuation)	
	Dangerous zone
	Radius of crane working area
	Temporary fences
	Temporary roads
	Unloading area
	Traffic signs

Explication of objects

№	Name of the building	Area, m2	Notice
1	Closed warehouse	1008	
2	Open warehouse	1008	
3	Canteen	130	
4	Administrative building	50	
5	The site for the solution	210	
6	Transformer station	12	
7	Inventory pricing	365	
8	Cloakroom	25	
9	Shower	25	
10	Residential premises	121.0	
11	Wheel washing point	20.0	
12	Control room	15.0	



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.

						SU-6B07302-Civil Engineering-2025 DP
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Chan.	Numb.	Sheet	№ doc.	Signature	Date	
Head of Dep.		Shayakhmetov S.B.			10.06	Technical and organizational section
Supervisor		Sakhi A.K.			09.06	
Norm control		Yesembayeva A.A.			09.06	
Quality contr.		Kozyukova N.V.			10.06	Construction master plan
Created		Levin D.R.			09.06	

Stage	Sheet	Sheets
DP	10	11

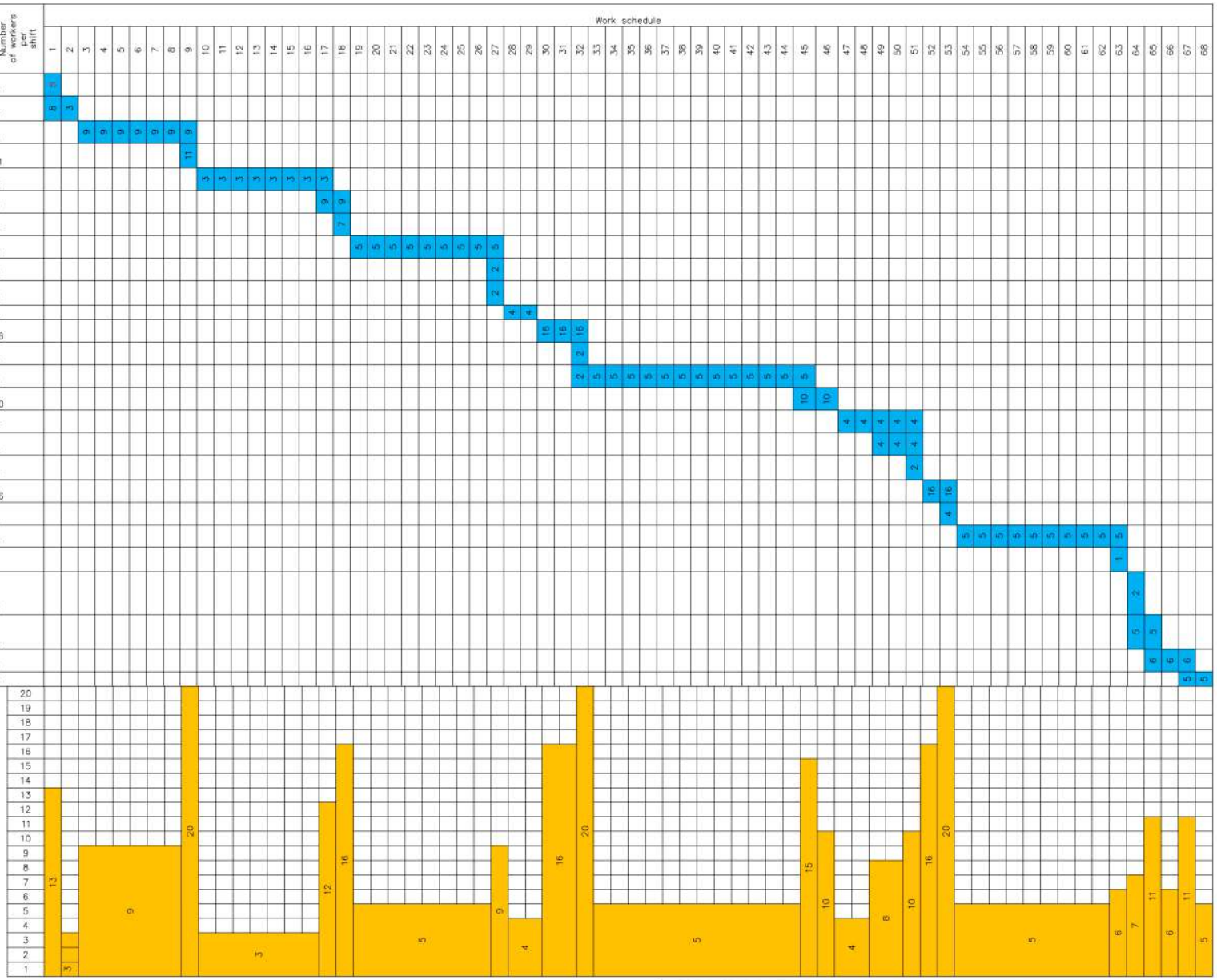
"CEaBM" Department CDBS-21-4er

Формат А2

Инв. № подл. | Подпись и дата | Взам. инв. №

Calendar plan

The name of the processes	Unit of measurement	Scope of work	Labor costs	Required machines		Duration, days	Number of shifts	Number of workers per shift
			Workers, h-days.	Name	Number m-sh.			
Device temporary fence	10m	250	37,50		0,00	3,75	2	5
Cut vegetation layer	1000m2	100	0,00	ДЗ-104	85,00	14,17	2	3
Excavation in trenches	100m3	72,71	25,45	Е-651	109,07	36,36	1	9
Development of a shortage of soil	m3	885	181,43		0,00	8,25	2	11
Pile driving	pcs	252	0,00	Junttan PM 20	131,04	43,68	1	3
Installation of formwork	m2	504	22,68	МКГ-40	30,24	11,97	2	9
Installation of rebar	t	148,8	40,92		0,00	2,92	2	7
Laying of concrete mix	m3	218,4	32,76	МКТ-40	98,28	54,60	2	5
Disassembly of the formwork	m2	148,8	5,77		0,00	1,44	2	2
Basement Waterproofing	100m2	2,2	2,75		0,00	0,69	1	2
Backfilling	100m3	70,5	0,00	ДЗ-104	46,53	11,63	1	4
Installation of formwork	m2	8400	189,00		50,40	20,48	2	16
Installation of rebar	t	500	137,50		0,00	9,82	2	2
Laying of concrete mix	m3	4150	31,13	МКТ-40	157,70	84,04	2	2
Disassembly of the formwork	m2	8400	157,50		0,00	7,88	2	10
Installation of metal columns	pcs	42	0,00	МКГ-40	126,00	31,50	1	4
Installation of metal trusses	pcs	92	0,00	МКГ-40	80,04	20,01	1	4
Installation of metal scaffolding	100 m	42	1,31		0,00	0,66	1	2
Installation of formwork	m2	2000	90,00	МКГ-40	40,00	13,75	2	16
Installation of rebar	t	55	15,13		0,00	1,08	2	4
Laying of concrete mix	m3	420	3,15	МКТ-40	105,00	53,03	2	5
Dismantling of metal scaffolding	100 m	42	0,79		0,00	0,39	2	1
Watering the concrete surface with water at a time	100 m2	20	14,50		0,00	3,63	2	2
Installation of partitions with a single metal frame	m2	3700	194,25		0,00	19,43	2	5
Installation of door blocks	100m2	25	41,88	МКГ-40	36,18	23,32	2	6
Finishing works	m2	2500	93,75		0,00	9,38	2	5



Coefficient of unevenness

$N_{av}=Q/D=7165,2/485=14.77$

$K=N_{max}/N_{av}=20/14.77=1.35$

					SU-6B07302-Civil Engineering-2025 DP	
					New passenger terminal of the airport with comfortable areas in Astana	
Chan.	Numb.	Sheet	№ doc.	Signature	Date	
Head of Dep.		Shayakhmetov S.B.			10.06	
Supervisor		Sakhi A.K.			09.06	Technical and organizational section
Norm control		Yesembayeva A.A.			09.06	
Quality contr.		Kozyukova N.V.			10.06	Calendar plan
Created		Levin D.R.			09.06	

Stage	Sheet	Sheets
DP	11	11

"CEaBM" Department
EDBS-21-4er

Формат А2

Инв. № подл. | Подпись и дата | Взам. инв. №

НЕКОММЕРЧЕСКОЕ АКЦИОНЕРНОЕ ОБЩЕСТВО «КАЗАХСКИЙ НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ ТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ имени К.И.САТПАЕВА»

РЕЦЕНЗИЯ
на Дипломный Проект
Левина Даниил Романовича
6В07302 – Строительная инженерия

На тему: Новый пассажирский терминал аэропорта с комфортными зонами в городе Астана.
Выполнено:
а) графическая часть на 11 листах
б) пояснительная записка на 77 страницах

ЗАМЕЧАНИЯ К РАБОТЕ

- Текст не одинакового размера
- Календарный план плохо читаем
- Штампы на чертежах отличаются

Оценка работы

Дипломный проект включает 77 листа расчетно-пояснительной записки и 11 листов графического материала.

Дипломная работа представляет собой комплексное архитектурно-строительное проектирование современного аэропортового терминала, в котором особое внимание уделено созданию комфортной среды для пассажиров. Архитектурно-планировочный раздел демонстрирует уверенное владение принципами функционального зонирования и рационального использования пространства. Расчетно-конструктивная часть выполнена на высоком профессиональном уровне. Использование актуального программного комплекса ЛИРА-САПР 2024, а также САПФИР 2024 подтверждает техническую компетентность автора, а демонстрация навыков ручного расчета конструктивных элементов — его инженерную подготовку. Раздел по технологии строительства отличается системным подходом. Приведённая технологическая карта, обоснованный выбор техники, а также последовательность и координация работ — всё это указывает на хорошее понимание производственного процесса. Экономическая часть проекта также заслуживает высокой оценки. Применение программного обеспечения СМЕТА РК и использование действующих нормативов обеспечивают актуальность и точность расчётов, что особенно важно в условиях постоянно меняющегося строительного рынка.
Работа соответствует требованиям предъявляемым к дипломным проектам, заслуживает оценки «отлично», а его автор Левин Даниил Романович — присвоения академической степени «бакалавра техники и технологий» по Образовательной программе 6В07302 — «Строительная инженерия».

Рецензент
Магистр технических наук,
главный инженер архитектурно-строительной
части АО «Mega Center Management»
_____ Рудняев Р.Г.
(подпись) «04» 06 2025 г

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

NON-PROFIT JOINT STOCK COMPANY «KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY NAMED AFTER K. I. SATPAEV»

REVIEW
for a Graduation Project of
Levin Daniil Romanovich
6B07302 - Civil Engineering

On the topic: New passenger terminal of the airport with comfortable areas in Astana.
Completed:
a) graphic part on 11 sheets
b) explanatory note on 77 pages

COMMENTS ON THE WORK

- Text has inconsistent font sizes
- Calendar schedule is hard to read
- Title blocks on the drawings are inconsistent

Job evaluation

The diploma project includes 77 pages of explanatory calculations and 11 sheets of graphic material.

The graduation project represents a comprehensive architectural and structural design of a modern airport terminal, with particular attention paid to creating a comfortable environment for passengers.The architectural and planning section demonstrates confident command of the principles of functional zoning and rational use of space.The structural design section is completed at a high professional level. The use of up-to-date software such as LIRA-SAPR 2024 and SAPFIR 2024 confirms the author's technical competence, and the demonstration of manual calculation skills for structural elements reflects solid engineering training.The construction technology section shows a systematic approach. The technological chart, the justified choice of machinery, and the sequence and coordination of works all indicate a good understanding of the production process. The economic part of the project is also worthy of high praise. The use of SMETA RK software and adherence to current standards ensure the relevance and accuracy of the calculations, which is especially important in the context of a constantly changing construction market.

The work meets the requirements for graduation projects, deserves an “Excellent” grade, and its author, Levin Daniil Romanovich, is recommended for the academic degree of "Bachelor of Engineering and Technology" in the educational program 6B07302 – "Civil Engineering".

Reviewer

Master of technical sciences, Chief Engineer of
the Architectural and Construction Section
JSC "Mega Center Management"

_____Rudnyayev R.G.

(signature)

"04" 06 2025 y.

Mega Center Management (Мега Центр Менеджмент)

Ф КазНИТУ 706-17. Рецензия

НЕКОММЕРЧЕСКОЕ АКЦИОНЕРНОЕ ОБЩЕСТВО «КАЗАХСКИЙ НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ ТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ имени К.И.САТПАЕВА»

FEEDBACK OF

SCIENTIFIC SUPERVISOR

For a graduation project of
(наименование вида работ)
Levin Daniil Romanovich
(Ф.И.О. обучающегося)
6B07302 – Civil Engineering
(шифр и наименование ОП)

Topic: New passenger terminal of the airport with comfortable areas in Astana

Levin Daniil Romanovich's graduation project is completed in full and includes an explanatory note on 77 pages with appendices and 11 sheets of graphic part. All sections of the project have been developed in accordance with current regulations and design assignments.

In the course of the work, a preliminary analysis was carried out, an architectural, planning and constructive concept was worked out. Calculations of a steel truss and a columnar foundation have been performed in the computational and structural part. The economic section contains calculations of the cost, profitability and feasibility study of construction.

The tasks have been completed in full. The information sources used correspond to the regulatory and technical documentation.

In the process of working on the project, he showed a high level of independence, demonstrated analytical abilities, engineering erudition and a creative approach. His decisions are distinguished by their validity, accuracy and attentive attitude to the quality of graphic and text materials, which indicates a good command of professional skills.

The graduation project was completed at a high professional level and deserves an «excellent» grade.

Scientific supervisor
Master of Technical Sciences
(должность, уч. степень, звание)
_____ Sakhi A.K.
(подпись)
«09» 06 2025 г.

Supervisor's confirmation form on the completion of the graphic part of the thesis project

Student: Levin Daniil Romanovich
Group: CDBS-21-4er

The topic of the graduation project:
« New passenger terminal of the airport with comfortable areas in Astana »

I confirm that the graphic part of the student's thesis project (drawings) has been fully finalized in accordance with the comments given at the pre-defense.

The drawings have been checked, corrections have been made, and further control is allowed.

Date: «09» 06 2025 y.

Supervisor's signature: _____

Full name of the supervisor: Сахи А.К.

Протокол

о проверке на наличие неавторизованных заимствований (плагиата)

Автор: Левин Даниил Романович

Соавтор (если имеется):

Тип работы: Дипломная работа

Название работы: Новый пассажирский терминал аэропорта с комфортными зонами в городе Астана.

Научный руководитель:

Коэффициент Подобия 1: 3.6

Коэффициент Подобия 2: 0.3

Микропробелы: 0

Знаки из здругих алфавитов: 2

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 9.06.25

Джатписбаева А.
проверяющий эксперт

Протокол

о проверке на наличие неавторизованных заимствований (плагиата)

Автор: Левин Даниил Романович

Соавтор (если имеется):

Тип работы: Дипломная работа

Название работы: Новый пассажирский терминал аэропорта с комфортными зонами в городе Астана.

Научный руководитель:

Коэффициент Подобия 1: 3.6

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☐ Обоснование:

Дата *Заведующий кафедрой*