MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN
Satbayev University

Institute of Architecture and Civil Engineering named after T. Basenov
Department of Civil Engineering and Building Materials

Rahimi Ahmad Samar

On the theme of “Campus with a sports complex using vacuum thermal insulation in Karagandy"

To the diploma project

EXPLANATORT NOTE

Specialty 5B072900 – Civil Engineering

Almaty 2021

MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN
Satbayev University

Institute of Architecture and Civil Engineering named after T. Basenov
Department of Civil Engineering and Building Materials

ALLOWED TO PROTECT

Head of Department
N.V. Kozyukova
Master of technical science,
lecturer
«__»_______2021 y.

EXPLANATORY NOTE
to the diploma project

On the theme of "Campus with a sports complex using vacuum thermal insulation in Karagandy"

5B072900 - "Civil Engeneering"

Prepared by Rahimi A. S.

Scientific adviser __________ Kozyukova N.V.

Master of technical science,
lecturer

« » 2021 y.

Almaty 2021

MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN
Satbayev University

Institute of Architecture and Civil Engineering named after T. Basenov
Department of Civil Engineering and Building Materials
Specialty 5B072900 – Civil Engineering

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

ASSIGNMENT
Complete a diploma project

Student Rahimi Ahmad Samar
Topic «Campus with a sports complex using vacuum thermal insulation in Karagandy»
Approved by the Order of the Rector of the University No. 2131-b dated November 24, 2020.
The deadline for the completed work is May 10, 2021.
Initial data for the diploma project: construction area in Karagandy
Structural schemes of the building - reinforced concrete frame scheme with stiffening diaphragms.
List of questions to be developed:
a) Architectural and analytical part: basic initial data, space-planning solutions, heat engineering calculation of enclosing structures (outer wall), lighting calculation, calculation of the foundation option and depth of laying, justification of energy efficiency measures;
b) Calculation and design part: calculation and design of a column;
c) Organizational and technological part: development of technological maps, construction schedule and construction plan;
d) Economic part: local estimate, object estimate, summary estimate;
List of graphic material (with exact indication of required drawings):
1. Facade, floor plans, sections 1-1 and 2-2 - 4 sheets.
2. KZh columns, specifications - 1 sheet.
3. Technical maps of earthworks and formwork, calendar plan, construction site plan - 4 sheets.
11 slides of work presentation are provided.
Recommended main literature: SP RK 2.04-01-2017 "Construction climatology", SN RK 2.04-04-2013 "Construction heat engineering", SN RK 2.03-30-2017 "Construction in seismic zones"

SCHEDULE
preparation of thesis (project)

№	Part	30%	60%	90%	100%	Note
1	**Architectural and analytical**	**11.01.2021г.-14.02.2021г.**				
2	**Calculation and design**		**15.02.2021г.-23.03.2021г.**			
3	**Organizational and technological**			**24.03.2021г.-01.05.2021г.**		
4	**Economic**				**01.05.2021г.-09.05.2021г.**	
5	**Pre-defense**	**10.05.2021г.-14.05.2021г.**				
6	**Anti-plagiarism, norm control**	**17.05.2021г.-31.05.2021г**				
7	**Quality control**	**26.05.2021г.-31.05.2021г.**				
8	**Defense**	**01.06.2021г.-11.06.2021г.**				

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

Name parts	Consultants, I.O.F. (academic degree, rank)	the date signing	Signature
Architectural and analytical			
Calculation and design			
Organizational and technological			
Economic			
Norm controller			
Quality control			

Scientific adviser ___________ N.V. Kozyukova

The task was accepted
for execution student ___________ Rahimi Ahmad Samar

Date "__" ________ 2021 y.

АҢДАТПА

Дипломдық жұмыстың тақырыбы - " Қарағанды қаласындағы вакуумдық жылу оқшаулағышты пайдаланатын спорт кешені бар кампус". Жұмыс мынадай бөлімдерден тұрады: сәулет-талдау, есептеу-конструктивтік, ұйымдастыру-технологиялық, экономикалық бөлім.

Бұл жұмысты құру кезінде бағдарламалық кешендердің келесі тізімі қолданылды:

1 AutoCAD 2020;

2 ETABS 2016.

3.MS PROJECT

АННОТАЦИЯ

Тема данной дипломной работы – «Кампус со спортивным комплексом с использованием вакуумной теплоизоляции в городе Караганды». Работа состоит из следующих разделов: архитектурно-аналитический, расчетно-конструктивный, организационо-технологическиий, экономический раздел.

При создании данной работы был использован следующий перечень программных комплексов:

1 AutoCAD 2020;

2 ETABS 2016.

3.MS PROJECT

ANNOTATION

The theme of this thesis is "Campus with a sports complex using vacuum thermal insulation in Karagandy" The work consists of the following sections: architectural and analytical, computational and constructive, organizational and technological, economic section.

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

1 AutoCAD 2020;

2 ETABS 2016.

3.MS PROJECT

CONTENT

INTRODUCTION

Undoubtedly, the construction industry plays an exceptionally significant and significant role in the development of the state as such and its economic position. Construction is not only the production of the final product - buildings or structures, but also processes: repair, maintenance, restoration, reconstruction and monitoring. This industry determines the level of development of the country, its position in the world market, pedestal and welfare.

The construction industry is one of the most important and decisive areas affecting the overall development of the country, including the economic side. Compared to underdeveloped countries, construction in Kazakhstan is, of course, at a higher level. But if you look at the global level, it is worthwhile to study quite a few innovative technologies, techniques and other things, for which it will take enough time to achieve such results as, for example, China or the United Arab Emirates. The most popular, or even one might say, leading builders in their field

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

The project "Campus with a sports complex using vacuum thermal insulation in Karagandy " is a vivid example of the effectiveness of automation of construction processes, as it uses modern software for calculating building structures, the economic part and planning the time that will be spent. This project was developed in accordance with the current technical literature, regulatory documentation, a set of rules, modern, efficient building materials were used.

Also, another absolutely positive factor of construction, which is used in this project, is the involvement of mechanization in the process, since it determines the higher speed and quality, as well as the low cost of work, compared to manual execution.

1 Architectural and analytical

1.1 Natural and climatic and engineering-geological conditions

The characteristic features of the climate of this territory are: an abundance of sunlight and heat, continentally, hot, long summers, relatively cold with alternating thaws and cold snap winters, large annual and daily amplitudes of fluctuations in air temperature, air dryness and changes in climatic characteristics with the height of the terrain.

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Год
-16,8	-16,5	-10,1	+3,0	+12,7	+18,2	+20,4	+17,8	+11,5	+2,6	-7,0	-14,0	1,8

Figure 1- Monthly and annual air temperatures

As can be seen from table 3.1, the average monthly temperature of the coldest month of the year of January is minus 16.8 degrees of frost, and the warmest of July is plus 20.4 degrees of heat.

In separate, very severe winters, the temperature can drop to 29-32 degrees (absolute minimum), but the probability of such a temperature is no more than 5percent. On hot days, the temperature can rise to 39-40 degrees Celsius. The estimated air temperature of the coldest five-day period is 25 degrees, the estimated air temperature of the hottest five-day period is 28 degrees, the average duration of the heating season is 184 days.

Atmospheric precipitation

The average amount of precipitation falling over the year is 330-370 mm.

Rainfall is unevenly distributed over the seasons of the year; the greatest amount of precipitation falls in the warm season (May-September) - 238 mm. The average annual snow depth is 22 mm; the water supply in the snow is 67 mm.

According to SP RK 2.04-01-2017 snow area by weight of snow cover - III.

Wind

The study area is characterized by frequent winds blowing mainly in the south-westerly direction. The average annual wind speed is 5.0-5.6 m / s. Wind roses are shown in Figure 2.

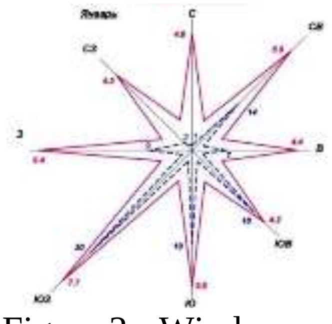


Figure 2 - Wind roses

Soil freezing depth

The standard freezing depth according to SP RK 2.04-01-2017 "Construction climatology" is 205 cm. The average depth of penetration of “0” into the soil is 234 cm (the greatest penetration is usually in March).

By analogy with data from other regions, the possible penetration of zero into the depth, with little snow, can reach 350 cm in loams [3, 4]

Air humidity

The smallest value of absolute humidity in January-February (1.6-1.7 m), the highest - in July (12.7 m).

The lowest relative humidity is in the summer months (40-45)percent, the highest in winter.

The average annual relative humidity is 86percent. The highest moisture deficit is observed in June-July (12.2-12.4 m). Low in December-February (0.3-0.4 m). The average annual humidity is 4.8 m.

The planned building has a rectangular shape with dimensions 42000x18000 mm. The height of the building is 21 m. block diagram: a building with a complete frame; The longitudinal pitch of the columns is uniform.

Climatological characteristics:

Climatic zone - III B;

Humidity zone III

Building class - II; the designated outdoor air temperature for the coldest five days (provided 0.92) - minus 20 Celsius;

- duration of the heating period - 179 days;
- the average annual air temperature is plus 9.8 Celsius;
- average temperature of the coldest month of the year - minus-5.3 Celsius;
- the average temperature of the warmest month of the year-plus-23.8 Celsius.
- area-II by weight of snow cover (0.70 kPa);
- area II for wind pressure (0.39 kPa);
- 6 points for Karaganda, taking into account seismic activity.

Geological features of the construction site are determined by engineering and geological surveys. The purpose of the search was to study the physical and mechanical properties of the soil on the basis of foundations.

A well with a depth of 16.5 m 2 will be drilled to achieve the set goals. The well was drilled in 1.5 m deep pits.

According to the geological profile, the area has a quiet relief, three geomorphological layers of one genesis. Groundwater is located at a depth of more than 10 m

The basis of the foundations is loamy soil:

- soil density ρ = 1.72-1.73 t / m^3
- specific coupling C = 25 kPa
- internal friction angle φ = 23 degrees
- Modulus of deformation E = 62 mPa
- design resistance - Ro = 600 kPa

- wind area - according to III (W = 38 $\frac{kg}{m^2}$);
- snow area - II (S = 70 $\frac{kg}{m^2}$);
- rated outdoor air temperature - 25 Celsius.
- soil category-II on seismic properties;
- Depth of soil compaction - 130 cm.
- Groundwater is at a depth of more than 5 m

The required orientation of the premises, the master plan for the development of industrial areas, taking into account landscaping and landscaping in accordance with the requirements of SN RK 3.02-07.2014 "Public buildings and structures" and SP RK 3.01-101-2013 "Urban planning. Improvement and gardening of the site provided by the project reduces the overall dust content and eliminates local sources of dust.

Table 1 - Technical and economic indicators of the master plan

Name	Unit	Quantity	Note
Area			
- plot	$м^2$	37700	
- the designed building	$м^2$	4844	
- coatings	$м^2$	20682	
- landscaping	$м^2$	9282	
Coefficient			
Building percentage	%	67.7	
Percentage of landscaping	%	33.3	
Territory utilization rate	%	1.57	

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

1.2 Architectural solutions

In the building of the institute there are balconies and loggias, a basement and a technical floor. The height of the floors is taken as 2.850 m.

The level of the finished floor is considered to be the level of 0.000.

The building is of the II degree of responsibility, which means that the building has high requirements for durability for more than 50 years.

The architectural decision was made on the basis of regulatory documents. One of the many important goals is to create aesthetic expressiveness.

This graduation project is a building with a set of blocks, with a difference in functional purpose and stores that meet the requirements of advanced concepts of architectural aesthetics. [3]

The space-planning solution of the projected building provides convenient and functional operation of the premises, good sound insulation, which is necessary for student athletes to concentrate, excellent both natural and artificial lighting, thanks to large stained-glass windows. The presence of large spatial rooms also has a beneficial effect on insolation and on the ergonomics of the rooms being operated. In addition to this, the entire building has convenient standard shapes and layouts, which will provide an aesthetic appearance and harmony with the exterior of the urban architecture of the area.

The main task is to provide construction with new technical means, as well as the correct selection of materials, which in turn is one of the important aspects in space-planning decisions.

The correct selection of materials is also beneficial for the economic fund of the building, which has a beneficial effect on its rational use.

The building consists of two block-sections, separated by an expansion joint, the first building of which has 4 floors, the second is a one-story building with a large arena, belonging to a number of unique structures, the roof slab of which is located at an elevation of 10.2 meters, as well as a spacious spatial planning and with additional annexes in the form of corridors.

The explication of the premises of all floors includes: a hall, a buffet, a security room, a PUI, sanitary facilities, gyms, locker rooms, coaching rooms, showers, staircases, corridors, a heating unit, a vestibule, a porch, office and administrative premises, a cloakroom, a ventilation chamber, panel room, balcony. There are also entrance and exit corridors at the rear of the building, at floor elevation -1,200, with a total area of 558.4 m^2.

1.3 Constructive decisions

One of the most important building requirements is guaranteed stability, strength and spatial rigidity. The joint work of frames, horizontal reinforced concrete slabs provides the required stability and rigidity.

The construction area of the building is the city of Karaganda, the location of the projected building does not have exposure to seismic influences, that is, it does not belong to seism zones, the reason for this is the absence of mountains and the location of a platform, the type of which is denudation plains.

Consequently, based on the data obtained, it was agreed to adopt a mixed-type design scheme. In other words, part of the building has a frameless system, the support for the coatings of which are the outer walls, namely the corridor at the floor level of -1.2 m. The first and second blocks have a frame system, the supporting frame of which is a system of columns resting on the foundation and horizontal ties - crossbars providing the bearing capacity and spatial rigidity of the building. The sports hall (the second block) is assigned to the number of unique structures due to its large-span structures, the span of which exceeds 36 m and is 42 m.

- The dimensions of the building in the outer axes are 74.5 · 24.5, the L-shaped part is 30.0 · 15.9. The column spacing differs depending on the block.

- With regard to structural solutions, the columns are made of concrete of class B25 and with dimensions of 400·400 mm, the connection of the working reinforcement is made with an overlap, and the column spacing and spans comply with the requirements of SP RK 3.02- 107-2014 "Public buildings and structures" [1].

- Cross-sections of crossbars 500·400 mm.

- Floor slabs are 200 mm thick.

- The outer walls are 510 mm thick and are made of aerated concrete blocks, the inner walls and partitions are made of aerated concrete blocks with a thickness of 200 mm and 100 mm, respectively.

- The foundation is made of monolithic, mimed type, for columns, columnar, walls-tape, made of concrete M350 on sulfate-resistant cement with a water resistance grade W_6, frost resistance F_{75} with a water-cement ratio $\frac{w}{c}$= 0.55.

- Horizontal loads from wind, seismic and operating equipment are perceived by columns and diaphragm stiffness located in the staircase.

The outer wall is insulated. The filling of the openings is designed from a foam block.

All premises have entrances, are supported by natural light, which meets the requirements of SN RK 2.04-02-2011 "Natural and artificial lighting".

Passenger elevators and staircases provide communication between floors and are deployed in each block in several places. The maximum lifting capacity of the elevator is 500 kg. All elevator equipment and machinery are located in the underground part of the building and on the roof, which, in turn, allows you to save on components.

All doors open from the premises towards the stairwells, exits from the building, which meets the fire safety requirements of SN RK 2.02-01-2014 "Fire safety of buildings and structures."

1.4 Measures to improve the energy efficiency of the building

According to the theme of the thesis, as a measure to improve efficiency, the project uses a vacuum insulation panel for the sports building [17]

The thermal insulation characteristics and lifespan of a vacuum insulation panel are determined by a large number of reasons: the qualities of the filler; the initial level of vacuum in the panel; permeability of the shell; the number and efficiency of the gas residue absorber; the size and width of the panel; criteria of her work.

The vacuum insulation panel consists of a porous filler material enclosed in an impermeable structure. The air in the panel is evacuated to a pressure of 0.1 to 100 Pa, then the casing is sealed.

The role of the filler is threefold:

1) the filler holds the walls of the panel. An external influence of 105 Pa means that an atmospheric column weighing almost 1 tonne presses on the skin of a 30 cm2 panel;

2) the filler restricts the movement of gas molecules. The smaller the pore size of the filler, the more likely it is that the molecules will collide with its particles, and not with each other. This reduces the requests for the initial level of rarefaction in the packet;

3) the radiative mechanism of heat transfer must be excluded through the filler. To do this, substances (for example, titanium dioxide) are often introduced into its composition, which spray and absorb infrared electromagnetic waves [17]

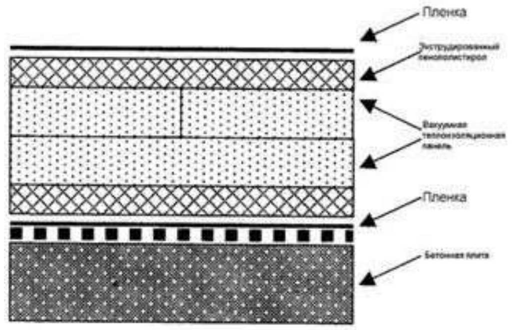


Figure 3 - The structure of the vacuum insulation panel.

The phenomenally low coefficient of thermal conductivity of vacuum insulation panels is 0.004-0.006 W / m * K. For comparison: polyurethane foam - 0.024 W / m * K; penoplex - 0.03 W / m * K; foam plastic - 0.041 W / m * K; mineral wool - 0.05W / m * K. The introduction of the latest insulation makes it possible to reduce the thickness of the insulating layer by 6-10 times. For example, 4.6 cm of a vacuum panel to resist heat transfer corresponds to 4.6 m of brickwork.

Among the main parameters of the material:

• Fire safety, its fire resistance class A.

• Panel thickness is 20 mm.

• Lack of smell and poisonous discharge.

• Long service life - 50-80 years.

• Absolute vapor tightness.

• No shape restrictions, panels are made of round, spherical, cylindrical shape, with a 3D surface, with pre-drilled holes.

• The likelihood of reuse.

• Safety of life of people.

The service life of vacuum panels is influenced by several reasons:

• degree of initial vacuum,

• the shape of the product,

• filler characteristics,

• quality of the shell material,

Temperature dependence of the thermal conductivity coefficient for different thermal insulation materials (see figure 4).

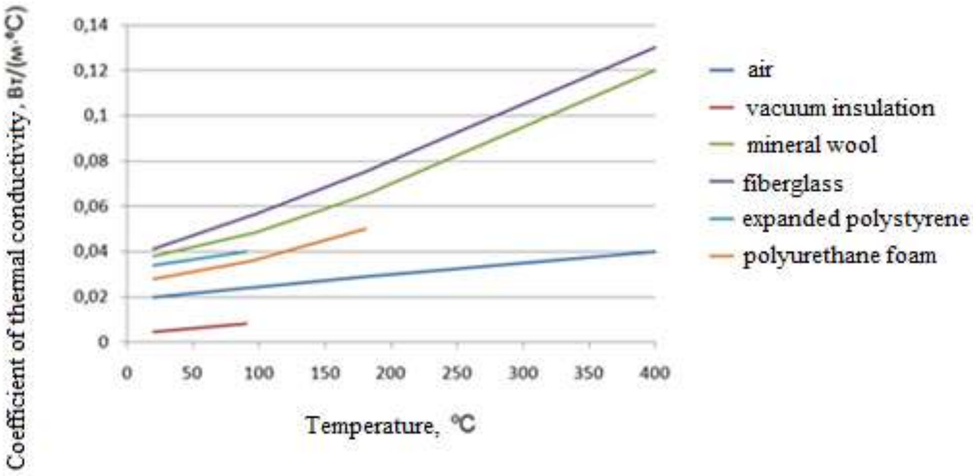


Figure 4 - Thermal conductivity coefficient graph.

To ensure the same thermal resistance to heat transfer R0, the use of vacuum insulation makes it possible to reduce the thickness of the insulating layer by a factor of 6 - 10 in comparison with other materials (see Figure 5).[17]

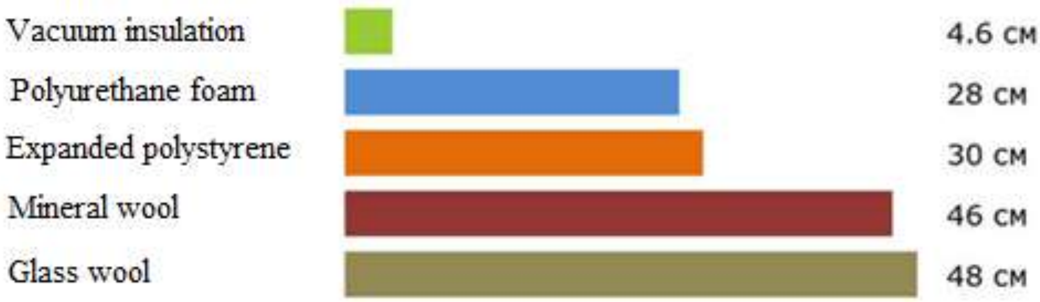


Figure 5 - Comparison of the thermal performance of vacuum insulation with other thermal insulation materials.

The principle behind vacuum panels is similar to a thermos, where heat transfer is reduced by removing air between the inner walls of the bottle. In a flat vacuum panel, there can be no empty space inside the panel, as this can lead to collapse. Therefore, the material is used inside the core of the panel, which withstands atmospheric pressure on the shell when the inside is evacuated. Figure 6 shows two vacuum panels used, showing a shell surrounding the base material and an open vacuum panel with core material and laminate.

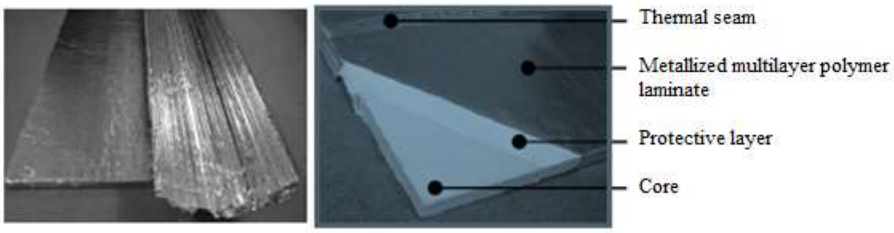


Figure 6 - Left: flat and concave vacuum panel for use as pipe insulation. Right: Fine powder core wrapped in thermally insulated metallized multilayer polymer laminate.

1.5 Thermomechanical calculation of the outer wall

Thermal calculations of the outer wall are performed in accordance with the current SP RK 2.04-01-2017 "Construction climatology" [1], as well as SN RK 2.04-04-2013 "Construction heat engineering" [2]. The purpose of the above calculation is to determine the thickness of the outer wall insulation material.

The required resistance to heat transfer of external wall structures, which meets sanitary and hygienic and comfortable conditions, is determined from the table:

Table 2 - Properties and materials of the outer wall

Layer distribution naming	Layer thickness	λ ,Вт/м·С
Facing decoration layer	δ_1 = 0,004	λ_1 = 0,93
Mineral wool insulation	δ_2	λ_2 = 0,048
Aerated concrete	δ_3 = 0,4	λ_3 = 0,183
Plaster layer	δ_4 = 002	λ_4 = 0,87
Water-based paint	δ_5 = 0,01	λ_5 = 0,93

Determine the value of the degree days of the heating period:

$$\Gamma_{\text{СОП}} = (t\text{в} - \text{ton}) \cdot zz\text{ор}, \quad (1)$$

where tв = 20 ℃ is the optimal air temperature during the cold season;

tор = 4.9 ℃ - average temp. with an average daily temperature of the atmosphere below or equal to 8 Celsius;

zор = 214 days - the duration of the period with an average daily air temperature below or equal to 8 degrees C.

$$\Gamma_{\text{СОП}} = (20+4,9) \cdot 214 = 5328,6 \text{ ℃} \cdot \text{сут}$$

For a given value of GSPN according to table 1 * [4, p. 32], we determine R_{tr}^{0}

The required resistance to heat transfer of external structures corresponding to sanitary, hygienic and comfortable conditions is equal to:

$$R_{tr}^{0} = \frac{n(t_b t_{n)}}{\Delta t^n \cdot a_b} = \frac{1(20-(-37))}{4 \cdot 8.87} = 1.469(\frac{M^2 \cdot C^{\circ}}{VT}$$

where t_V = 20 Celsius is the optimal air temperature during the cold season;

$t_н$ = −37 Celsius - design temp. outdoor air, determined by the temp. the coldest five-day period with a security of 0.92.

nn = 1 - coefficient adopted according to table 3 * [SN RK 2.04.21. 2004 ·] for an external wall

$\Delta_{t_н}$ = 4Celsius - normalized temperature difference between the temperature of the internal air and the temperature of the internal surface of the external structure.

α_w = 8.7 W / (m_2 · °C) is the heat transfer coefficient of the inner plane of external structures.

From the above calculations for the required resistance, we choose $R_{tr}^{0}$from the circumstances of energy saving and denote it R_{tr}^{0} = 3.265 (m_2 · °C) / W, which was found by the interpolation method based on table 1 · [SN RK 2.04-03-2002].

The heat transfer resistance of the enclosing structure is determined by

$$R_0 = \frac{1}{a_b} + \frac{\delta_1}{\lambda_1} + \frac{\delta_2}{\lambda_2} + \frac{\delta_3}{\lambda_3} + \frac{\delta_4}{\lambda_4} + \frac{\delta_5}{\lambda_5} + \frac{1}{a_n} \tag{2}$$

$$\delta_2 = \lambda_2 \cdot \left(\frac{R_{tr}^{o}}{r} - \frac{\delta_1}{\lambda_1} - \frac{\delta_2}{\lambda_2} - \frac{\delta_3}{\lambda_3} - \frac{\delta_4}{\lambda_4} - \frac{\delta_5}{\lambda_5} - \frac{1}{a_n}\right)$$
$$= 0.048 \cdot \left(\frac{3.265}{0.95} - \frac{0.4}{0.183} - \frac{0.02}{0.87} - \frac{0.004}{0.93} - \frac{0.01}{0.93} - \frac{1}{8.7} - \frac{1}{23}\right)$$
$$= 0.050m$$

We preliminarily accept the thickness of the insulation equal to 0.05 m.

Checking the condition:

$$R_0 \geq R_0^{tr} \tag{3}$$

$$R_0 = 2.3716m^2 \cdot \frac{C^{\circ}}{B_t} \geq R_0^{tr} = 1.469m^2 \cdot \frac{C^{\circ}}{B_t}$$

Condition 3 is satisfied. The required value of the heat transfer resistance is less than the calculated one. The thickness of polyurethane foam can be taken equal to 50 mm. The total thickness of the outer wall is 450 mm.

The calculated wall structure meets the climatic conditions of the city of Karaganda.

2 Calculation and design

2.1 Initial Data

For the initial drawing up of options for flooring, spans of reinforced concrete beam slabs should be taken within $\frac{1.5}{2.7}$ m and, rarely, more. Spans of secondary beams are accepted within 5–7 m and spans of main beams are 6–9 m.

According to design requirements from rigidity conditions:

$$h_{mb} = (\frac{1}{8} / \frac{1}{15}) l_{mb} \quad (4)$$

$$hmb = (\frac{1}{8} \div \frac{1}{15}) 6500 = (825\text{-}410) mm$$

We accept h_{mb} = 400 mm

Width of main beam:

$$b_{mb} = (0.3 \div 0.5)\ h_{mb} \quad (5)$$

$$b_{mb} = (165 – 275) mm$$

We accept b_{mb} = 400 mm.

According to design requirements from rigidity conditions:

$$h_{sb} = (\frac{1}{12} \div \frac{1}{20}) l_{sb} \quad (6)$$

$$h_{sb} = (\frac{1}{12} \div \frac{1}{20}) 6400 = (533.33 – 320) mm$$

Taking into account the requirements for gradation of beam sizes, the end-
we accept h_{sb} = 500 mm

Beam width: ·

$$b_{sb} = (0.3 \div 0.5)\ hsb = (0.3 \div 0.5) \cdot 500 = (150 \div 250)\ mm.$$

We accept a bit more b_{sb} = 200 mm

According to standards seismic zone we have 6 points with second type of soil, in this case our building dimensions are ok.

Table 3 - Maximum dimensions of buildings in plan

Seismic rate	Earth according to seismic in each category		
	IA and IB	II	III
7	150/80	150/80	96/80
8	96/80	96/80	72/60
9	96/60	72/60	60/60
10	60/45	60/45	45/36

As well requirement for the height of the building that we have monolith reinforcement structure. According to below table the height of the building doesn't exceed from limited value: the height our structure is 57.25 m.

We have monolithic slab in this case according to seismic points the thickness of slam shouldn't be less than 200mm [5]

Table 4- Limiting dimension of building according to height of it.

No	Supporting structure job	Hight,M(building number)for seismic area pint			
		7	8	9	10
1	Metal frame a) frame link b) fram	66(20) 54(16)	54(16) 42(12)	42(12) 32(9)	16(4) 16(4)
2	Reinforcement frame a) frame link b)frame c) without reign	66(20) 32(9) 19(5)	54(16) 25(7) 16(4)	42(12) 19(5) 8(2)	16(4) 16(4) -------
3	Reinforcement wall a) monolotich b) prefabricated	66(20) 54(16)	54(16) 42(12)	42(12) 32(9)	16(4) 16(4)
4	Wall complex construction	21(6)	19(5)	16(4)	12(3)
5	Curtain wall	16(4)	13(3)	8(2)	4(1)
6	Panel board	13(3)	8(2)	8(2)	4(1)

For collection of loads and calculation results in ETABS see Appendix A.

Table 5- Determination of mechanical and deformation properties of soils

Name of soil	Layer thickness	Specific gravity Kn / m^3		Specific adhesion kPa		Internal friction angle, degree		Deformation modulus MPa	Design resistance MPa
		γ	γ_2	C	C_2	ϕ	ϕ_2	E	R
1 Plant layer									
2 Medium sand	1,0 6	26, 06	0,3	2	-	38	-	40	
3 Plastic sandy loam	1,0 6	26, 65	0,3	13	0,45	24	0,84	16	
4 Hard loam	2,7 6	26, 26	0,3	31	1,39	24	1,21	27	
5 Clay semi-hard	4,3 6	27, 34	0,3	47	2,58	18	0,99	18	
6 Medium sand	4,6	26, 16	0,3	2	-	38	-	40	

2.2 Foundation design

For the soil under the foot of the foundation (dense sand of medium size) $R0$ = 500 kPa = 500 kN / m^2 d = 3 m (depth of the foundation) Concrete class: C_{16} / 20 (B_{20}) Reinforcement class (A400) Design tensile strength of concrete, R_{bt} = 0 , 9 MPa = 900 kN / m^2 Design tensile strength of reinforcement, Rs = 3600 kgf / cm2 = 35.5 kN / cm^2 $h_c = b_c$ = 40 cm = 0.4 m (Column section) Number of floors: 13

Foundation foot area:

$$A_f = \frac{\Sigma N}{(R_0 - \Sigma\gamma_i \cdot h_i)} = 1743{,}6(500-0.9)=1743{,}6499.1=3{,}5\ м^2$$

$$\Sigma N = NII \cdot \gamma f$$

$$\Sigma N = (1250+60+139+4)\cdot 1{,}2 = 1743{,}6\ кН$$

where γf is the load safety factor = 1,2

$$\Sigma\gamma_i \cdot h_i = \gamma_i \cdot h_i + \gamma_2 \cdot h_2 \quad (7)$$

$$\Sigma\gamma_i \cdot h_i = = 2.7 \cdot 0.3 + 0.3 \cdot 0.3 = 0.81+0.09 = 0{,}9\ kn/м^2$$

Foundation sole width:

$$bf = \sqrt{Af} = \sqrt{3{,}8} = 1{,}87 \approx 2\ м$$

$$h_0pl = -h_c + b_c/4 + 1/2\ \sqrt{\Sigma N_a \cdot \gamma b_2 \cdot \gamma b_9 \cdot Rb_t + pгр.}$$

$$h_0pl = -0{,}4+0{,}44+12\ 1743{,}6\ 0{,}85\cdot 1\cdot 0{,}9\cdot 900+435{,}9 = -0{,}2+0{,}61=0{,}41\ м \approx 0{,}5\ м$$

$$pгр. = \Sigma N/b_f l_f = 1743{,}6\ 2\cdot 2 = 435{,}9\ кН/м^2$$

Full height of the slab part of the foundation:

$$hpl = h_0pl + a_s \quad (8)$$

$$hpl = 0{,}5 + 0{,}03 = 0{,}53\ м$$

where as is the thickness of the concrete cover for foundations = 30 mm = 0.03 m

Total design height of the foundation:

$$H_f = hpl + hc_f \quad (9)$$

$$H_f = 0{,}53 + 0{,}22 = 0{,}75\ м \approx 1 м$$

where hc_f- (basement floor structure thickness) = 0.22 m

h_f (foundation height) is rounded in multiples of 0.3 m, and the height of steps - in multiples of 0.15 m.

Next, the design of the steps is carried out.

If $h_0pl \leq 450$mm., It is recommended to design the foundation as one-stage, at 450 mm. <Hpl <900mm-two-stage, at h_{pl}> 900mm-three-stage.

The accepted dimensions of the step consoles should be within the following limits

$c_i=(1\div2.5)\cdot h_i=0.4\cdot0.7=0,28$

where hi is the height of the steps.

$h_i=2,1:3=0.7$

We accept:

Step height h1 = 0.4 m

Column embedment depth = 45 cm = 0.45 m

Checking the angle 33-37˚:

tgα = bc = 0,520.73 = 0,69 => α = 35˚ □□

b = 1– 0,45 – 0,03 = 0,52 м

c = 1 – 0,22 + 0,05 = 0.73 м

Checking the bottom of the foundation:

$$P \leq R \quad (10)$$

P=N+Gf+Gгр на уст.фунд./Af

P=1743,6+20·1,6+ 0,3·2,7+0,3·0,3/3,5=508 кН/м^2

$$R=\gamma c1\cdot\gamma c2/k\ [M\gamma kzb\gamma II+Mqd1\gamma II'+ Mq-1\ db\gamma II'] \quad (11)$$

R=1,4·1,41,1 2,11·1·2·0,3+9,44·3,2·0,3+ 9,44−1 2·0,3 =2800 кН/м2

508 kn/м^2 ≤ 2800кп/м^2

The check is satisfied

Reinforcement design: Bending moments:

$$MI-I=0,125\cdot \text{ргр.}\cdot(\text{a}f-\text{h}k\ )^2\cdot b_f \quad (12)$$

$MI-I$=0,125·435.9·(3.5–0,4)^2·2=1047кп·м=104724 кп·см

$$MII-II=0,125\cdot \text{ргр.}\cdot(\text{a}_f-\text{a}_1\ )^2\cdot b_f \quad (13)$$

$MII-II$=0,125·435.9·(3.5−1,25)^2·2=556 кп·м=55624 кп·см

Sectional area of tensile reinforcement:

AsI−I=MI−I/0,9·Rs·h_0=1047240,9·35,5·(100−7,5)=35.4 см^2=3543 мм^2

AsII−II=MII−II/0,9·Rs·h_0=556240,9·35,5·(40−7,5)=53.5 см^2=5356 мм^2

The cross-sectional area of the stretched mesh reinforcement in the lower foundation slab is taken to be the largest value, that is A_s = 5356 мм^2

According to the assortment, we select reinforcement of 28 diameters with a step of 200·200 (5542 mm^2)

Settlement calculation (layer-by-layer summation method)

Calculation and plotting of the distribution of vertical stresses σzq:

Table 6-Table of soils

Layer	Layer thickness	Specific weight of soil, kn / m^3

1Sandy loam	1,06	26,65
2 Sand	2,7	26,06
3 Loam	1,76	26,26
4 Sand	4,6	26,16
5 Clay	4,36	27,34

$\sigma zq0=0$
$0{,}2\sigma zq0=0$
$\sigma zq1=26{,}65\cdot 1=26{,}65$ кPa
$0{,}2\sigma zq1=0{,}2\cdot 26{,}65=5{,}33$ кPa
$\sigma zq2=26{,}65+26{,}06\cdot 2{,}2=83{,}98$ кPa (foundation sole level)
$0{,}2\sigma zq2=0{,}2\cdot 83{,}98=16{,}796$ кPa
$\sigma zq3=83{,}98+26{,}06\cdot 0{,}5=97{,}01$ кPa (ground water level)
$0{,}2\sigma zq3=0{,}2\cdot 97{,}01=19{,}402$ кPa
$\sigma zq4=97{,}01+26{,}26\cdot 1{,}76=143{,}22$ кpa(hard loam)
$0{,}2\sigma zq4=0{,}2\cdot 143{,}22=28{,}6$ кpa
$\sigma zq5=143{,}22+26{,}16\cdot 4{,}6=263{,}55$ кpa
$0{,}2\sigma zq5=0{,}2\cdot 263{,}55=52{,}71$ кPa
$\sigma zq6=263{,}55+27{,}34\cdot 4{,}36=382{,}75$ кpa
$0{,}2\sigma zq6=0{,}2\cdot 382{,}75 =76{,}55$ кpa

Calculation and construction of a diagram of the distribution of vertical stresses σzp:

$$P_0 = P - \Sigma\gamma_i\cdot h_i \quad (14)$$

$P_0= 508 - (26{,}65\cdot 1{,}06 + 26{,}06\cdot 2{,}2) = 508 - 85{,}58 = 422{,}42$ кpa

We divide the soil thickness under the base of the foundation into elementary layers with a thickness:

$\Delta_i=0{,}4\cdot 2=0{,}8$ м

$\sigma zp=\alpha\cdot P0$ (3.2) $\sigma z\gamma,i=\sigma zq^2$

At the level of the base of the foundation = 84.1 kpa

Table 7- Soil settlement

Soil type	zi, м	Δi, м	ξi = 2z/b	αi	σzp, i, кPa	$\sigma zp,ic$p, кPa	σzγ,i, кPa	$\sigma z\gamma,ic$p, кPa	$\sigma zp,ic$p$-\sigma z\gamma,ic$p	E0i, MPa
Sand	0,0 0,5	0,5	0,0 0,5	1,000 0,920	432,0 397,4	414,7	84,1 77,4	80,8	333,9	40
Loam	0,8 1,6 2,2	0,3 0,8 0,6	0,8 1,6 2,2	0,800 0,449 0,297	345,6 194,0 128,3	371,5 269,8 161,2	67,3 37,8 25,0	72,4 52,6 31,4	299,1 217,2 129,8	27
Sand	2,4 3,2 4,0 4,8	0,2 0,8 0,8 0,8	2,4 3,2 4,0 4,8	0,257 0,160 0,108 0,077	111,0 69,1 46,7 33,3	119,7 90,1 57,9 40,0	21,6 13,5 9,1 6,5	23,3 17,6 11,3 7,8	96,4 72,5 46,6 32,2	40

	5,6	0,8	5,6	0,058	25,1	29,2	4,9	5,7	23,5	
	6,4	0,8	6,4	0,045	19,4	22,3	3,8	4,4	17,9	
	6,6	0,2	6,6	0,043	18,6	19,0	3,6	3,7	15,3	
Clay	7,2	0,6	7,2	0,036	15,6	17,1	3,0	3,3	13,8	18
	8,0	0,8	8,0	0,029	12,5	14,1	2,4	2,7	11,4	
	8,8	0,8	8,8	0,024	10,4	11,5	2,0	2,2	9,3	
	9,6	0,8	9,6	0,020	8,6	9,5 8	1,7	1,9	7,6	
	10,4	0,8	10,4	0,017	7,3	6,9	1,4	1,6	6,4	
	11,2	0,8	11,2	0,015	6,5	6,4	1,3	1,4	5,5	
	11,4	0,2	11,4	0,015	6,3		1,2	1,3	5,1	

3 Organizational and technological

3.1 The construction of temporary fencing

Prior to the construction work necessary to perform the construction temporary fencing, fencing perimeter determined by the formula (for the pit and the trench):

$$P_{fen} = (20 + l1) \cdot 2 + (20 + l2) \cdot 2, (m) \quad (15)$$

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

$$P_{fen} = (20 + 97) \cdot 2 + (20 + 37) \cdot 2, (m) = 348m$$

3.2. Removal of top soil

Distance from the a·is of the building in each direction is 20 m

During trench excavation, removal of the top soil to be implemented at the area (only for the pit):)

$$S_1 = (10 + l_1 s.t + 10) \cdot (10 + l_2 s.t + 10), (m^2) \quad (16)$$

where l_{1st}– the trench length at the top, m (determined per the scheme);

l_{2st}– the trench width at the top, m. (determined per the scheme);

$$l_{1s}.t = l_{1s}.b + 2mh \quad (17)$$

$$l_{2s}.t = l_{2s}.b + 2mh \quad (18)$$

$$l_{1s}.t = 99.6 + 2 \cdot 1.06 \, x \, 6.9 = 114.23$$

$$l_{2s}.t = 39.6 + 2 \cdot 1.06 \, x \, 6.9 = 54.23$$

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

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

$$l_{1s}.b = l_1 + (1,3x2), \text{ m} \quad (19)$$

$$l_{2s}.b = l_2 + (1,3x2), \text{ m} \quad (20)$$

$$l_{1s}.b = 97 + (1,3 \cdot 2) = 99.6$$

$$l_{2s}.b = 37 + (1,3 \cdot 2) = 39.6$$

Where m– slope steepness factor;

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

1,3m– distance between the axis and slope bottom, destined for a person access to the structure;

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

$$S_1 = (10 + 114.23 + 10) \cdot (10 + 54.23 + 10) = 7681.98\, m^2$$

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

Pit volume determination.

$$Vp = \frac{h}{6} \cdot [(2l_{1s}.b + l2s.t)l_{2s}.b. + (2l_{1s}.t. + l_{1s}.b) \cdot l_{2s}.t] \qquad (21)$$

$$Vp = \frac{6.9}{6} \cdot [(2 \cdot 99.6 + 39.6) \cdot 39.6 + (2 \cdot 114.23 + 99.6) \cdot 54.23] = 19810.3$$

where h– depth of pit, m.

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

Earthworks quantity of the trench access to the pit is calculated by the formula (only for pit):

$$V_{tr.a}. = \beta(\frac{(bh^2}{2} + \frac{h^3.m}{3}) \qquad (22)$$

$$V_{tr.a} = 10(\frac{6 \cdot 6.9^2}{2} + \frac{1.06 \cdot 6.9^3}{3}) = 2589.03\, m^3$$

All soils for backfilling, forming further the foundation basis for the equipment, floors, a perimeter walk, access roads to be compacted.

During determination of filled and compacted layers’ thickness, number of passes of soil compacting machines it is reasonable to implement it per the ENiR.

3.5 Excavation of soil shortage

Calculation of the trench volume (V_{tr}) is carried out on the basis of longitudinal profiles and cross–sections of the separate sections. The volume of each trench section can be determined by the formula:

$$V_{tr} = \sum L_1 \cdot F_a \qquad (23)$$

where L_1 – full length of the trench per the scheme, m;

F_a– the average cross–sectional area of the trench,m^2;

$$F_a = \frac{(L_{2s.b}+L_{2s.t})h_{tr}}{2} \quad (24)$$

where m–slope factor [7, annex №1 table.2]

h_{tr}–depth of trench, per the task, m;

$$L_{2s.b} = L_2 + (0.8 \cdot 2)m \quad (25)$$

where L_2–width of the base is equal 1,6 m;

1,3 m– distance between the structure edge and slope bottom, destined for a person access to the structure (0,3÷1 m).

$$L_{2s.t}=L_{2s.b}+2mh_{tr} \quad (26)$$

$$L_{2s.b} = L_2 + (0.8 \cdot 2)m = 3.2m$$
$$L_{2s.t} = 5.88$$
$$F_a = \frac{(3.2 + 5.88)2}{2} = 41{,}22$$
$$V_{tr} = 288 \cdot 41.22 = 11871{,}36$$

The volume of soil shortage is calculated by the formula*:*

$$V\text{shortage}=Fp \cdot \Delta hsh,\ (m^3) \quad (27)$$

$$V\text{shortage}= 3944{,}16 \cdot 0.2=788.83\ m^3)$$

where $Fp(tr)$ – area of the pit (trench) bottom:

Δhsh – 0,05÷0,2 – quantity of soil shortage level during excavation, m.

$$Fp = l_{1s}.b. \cdot l_{2s}.b.=99.6 \cdot 39.6=3944{,}16$$

3.6 Backfilling

The volume of soil to be backfilled in the trench gaps, in structures without basement, is calculated by the formula (for trench):

$$Vb.f.=Vp–Vs/f–Vcellar/1+Krl\ , \quad (28)$$

$$Vb.f.= 19810.3\text{-}9564.2\text{—}7764.1/1+1.24=1108{,}04,$$

where Vs/f– volume of strip foundation, m^3;

$Vcellar$– volume of cellar:

$$Vcellar = l_1 \cdot l_2 \cdot hf\ (b),\ m3 \tag{29}$$

$$Vcellar = 97 \cdot 37 \cdot 6.9 = 7764.1\ m^3$$

where Krl – Index of residual soil loosening,

$hf\ (s)$– the height of the structure basement, ref. monolithic strip foundation section

3.7 Soil compaction

Compaction volume is measured mainly by the area of compaction that can be found, given by the average value of the compacted layer thickness (for the pit and the trench)

$$\mathrm{V_{comp}} = \frac{\mathrm{V_{bf}}}{\mathrm{h_c}}, \mathrm{m^2} \tag{30}$$

$\mathrm{V_{bf}}$ – backfilling volume, $\mathrm{m^3}$; $\mathrm{h_c}$– compacted layer thickness, 0,2 ÷ 0,4 m.

$$\mathrm{V_{comp}} = \frac{\mathrm{V_{bf}}}{\mathrm{h_c}}, \mathrm{m^2} \rightarrow = \frac{1108{,}04\mathrm{m^3}}{0.3\mathrm{m}} = 3693.45\mathrm{m^2}$$

3.8 Final land planning

The final planning is made after the completion of all excavations and communication devices (for the pit and the trench):

$$S_{planning} = S_{1(a)} - S_{building}, \mathrm{m^2} \tag{31}$$

where l_1,l_2– length and width of the structure in plan, respectively (per the task), m

$$S_{planning} = (97 \cdot 37) - 5184, \mathrm{m^2} \rightarrow= 1540\mathrm{m^2}$$

3.9 Removal of temporary fencing

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

$$\mathrm{P}_{fen} = (20 + l1) \cdot 2 + (20 + l2) \cdot 2, (m) \tag{32}$$

where l_1,l_2– length and width of the structure in plan, respectively (per the task), m.

$$\text{P}_{fen} = (20 + 97) \cdot 2 + (20 + 37) \cdot \ 2, (m) = 348m$$

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

3.10 Method choice of complex mechanized earthworks process

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

When choosing methods of production work to be considered: the type of soil, the size of earth construction, the groundwater level, the range of soil haulage and the season of the work.

Excavation and haulage of soil during pits and trenches excavation can be carried out by bulldozers, excavators, in set with dump trucks.

The choice of a complex– mechanized production process of excavation is carried out on the basis of technical and economic comparison of options of different sets of machines. For comparison to be chosen 2–3 cars of one or different types.

In the Course Project it is necessary to implement options comparison per the leading earthmoving machine. Top soil removal is carried out by bulldozers or scrapers. When choosing types of machines must be taken into account that the process actually involves topsoil removal and soil transportation. Bulldozers to be used preferably to move the soil at a distance of 50–150 meters (depending on the power of a bulldozer). Maximum efficiency is achieved when moving soil at the following distances: for bulldozer on the basis of tractors DT–74, DT–75, T–4AP1 – 30–50 m; on the basis of tractors T–100, T–130 – 50–70 m; on the basis of tractors T– 180, DET250, T–330 – up to 150 m.

During design of top soil removal by earthmovers, to be set the haulage distance of topsoil and in accordance with this distance to select the brand of bulldozer or scraper, using the recommendations trough the construction practice and machine specifications [7, annex №1 tables 7,8]

Shift operating of the bulldozer is calculated per the formula

$$P_{sh.o} = \frac{60 \cdot \text{T} \cdot q \cdot \alpha \cdot Ctime}{\text{T}_l + \text{T}_s + \frac{l_r}{V_r} + \frac{l_n}{V_n}} \qquad (19)$$

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

q – the soil volume moved with a dump, m^3. [7, annex. No. 1 of tab. 7]

α – factor, including the loss of soil in the process of haulage,

$$\alpha = 1 + 0{,}005 \cdot l_r;$$

C_{time}– factor of the equipment usage in time (during haulage of loosened rock material 0,75; in other cases – 0,8);

T_l – time for a set of soil category, min [7, annex. No. 1 of tab. 7];

T_s – time spent on switching speeds, min. [7, annex. No. 1 of tab. 7];

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

V_r, V_n –bulldozer speed during soil transportation (charged) and forward drive (empty), m / min, [7, annex. No. 1 of tab. 7]

$$P_{sh.o} = \frac{60 \cdot 8 \cdot 60 \cdot 7.5 \cdot (1 + 0.5 \cdot 72) \cdot 0.75}{0.15 + 0.17 + \frac{72}{38.33} + \frac{72}{96.6}} = 10.1014$$

DZ-4 bulldozer with the following characteristics was selected:
Power, kW: 40
Mass, t: 3,1
Dump: length x hight, m: 2,8x0,8
Depth of development, m: 0,15
Dimensions: length x width x hight, m: 4,3x2,8x2,3
Productivity, m3/h: 200

3.11 Selection of the excavator

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

$$c_{(1,2)} = \frac{1.08 c_{eqp-shift}}{p_{shf.pr}} \qquad (20)$$

where 1,08– factor including overheads C$eqp.-shift$ – cost of equipment–shift of excavator (annex. №1. tab.3);

$Pshf.\ pr.$ – excavator shift production, including soil excavation for dump and with loading in vehicles. =16.68

$$c_{(1,2)} = \frac{1.08(500 - 16.6\ \ )}{10.1014} = 51.68$$

Kind of excavator SHE–1514
Shift production can be calculated by the following formula:

$$Pshf.\ pr.\ (1,2) = V\text{к}(tr) \sum Nqp.-shift \qquad (21)$$

where $\sum Nqp.-shift$– total number of equipment–shifts of excavator, For the trench:

$$\sum N_{qp-shift} = \frac{V_{tr}}{100} H_{sd} \qquad (22)$$

where Hsd– standard duration of the excavation cycle [7, annex. № 1. table.2];

(tr)–soil quantity of the pit (trench);

$Vtr.a.$ –access trench quantity.

$$\sum N_{qp-shift} = \frac{4}{100} 45.1 = 1.804$$

To be determined the specific capital investments for the development of 1m3 of soil in the pit (trench) for each type of excavators:

$$c_{sp(1,2)} = \frac{1.07 c_{i.e}}{p_{shf.}} c_{sp(1,2)} \tag{23}$$

where C$i.e.$ – inventory–estimated cost of excavator, [7, annex. №1. tab.3];

P$shf.$ – number of excavator work shifts in a year. Approximately it can be accepted as 350 shifts for machines with bucket capacity of up to 0,65m3 inclusive and 300 –for the bucket more than 0,65m3.

$$c_{sp(1,2)} = \frac{1.07 \cdot 37.34}{1.804} = 22.14$$

The final selection of the excavator is produced on the basis of comparison of specific reduced development costs of 1m3 of soil:

$$P_{sp(1,2)} = c_{(1,2)} + E_n . C_{(1,2)} \tag{24}$$

here, En – normative factor of effectiveness of capital investments, equal to 0,15.

$$P_{sp(1,2)} = 22.14 + 0.15 \cdot 22.14 = 25.461$$

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

$$P_{sh.o} = T. 60. g. n. K_1 . K_b \tag{25}$$

$$P_{sh.o} = 8 \cdot 60 \cdot 1 \cdot 60 \cdot 0.8 \cdot 0.81 = 18662.4$$

3.12 Selection of mechanisms for soil compaction

Soil compaction work in the pits are implemented in two steps: I – soil compaction between the columns foundations; II – over the columns foundations. Depending on the lack of space of works performance conditions, can be used: -motor rollers with smooth rolls – for cohesive soil; -vibrio roller– for non–cohesive soils;

-hydraulic–mechanical vibratory compactors – for all soils;

-electrical self–moving vibrating rammer – for non–cohesive and lowly cohesive soils; -electrical rammer – for cohesive and non–cohesive soils.

Shift operating performance of rollers is calculated by the formula:

$$P_{sh.o} = \frac{(B-b)\cdot V\cdot 1000\cdot h\cdot T}{m} 0.85 \quad (26)$$

where *B*– width of compaction line [7, annex. №1. table. 4];

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

v – average speed (4–6 km / h);

h – width of the condensed layer, m {7, annex. №1. table. 4];

m– required number of blows or passes (8…10).

The composition of the machines included in the set to be determined by estimated (operational performance) and selected on the basis of the requirement for mechanization of all processes in the volume of works, the usage of a minimum number of machines in the set, compliance with the specified flows of excavation in shift.

$$P_{sh.o} \frac{(5.20 - 0.18)\cdot 5\cdot \frac{1000}{3600}\cdot 1000\cdot 520\cdot 1}{9} 0.85 = 51362$$

Rammer D-471V selected with the following characteristics:
Tractor carrier: T–130
Power, kW: 118
Mass, t: 6,5
Depth of the condensed layer, m: 1,2
Width of the condensed layer, m: 2,5
Dimensions: length x width x height, m: 5,0·2,5·3,0
Productivity, m^3/h: 115

3.13 Measures for water drainage and artificial lowering of groundwater

During implementation of zero cycle construction works it is necessary that the bottom of the pit (trench) was cleaned from groundwater. For this purpose, is used an open drainage, artificial lowering of groundwater levels and other ways. The choice of method for groundwater control depends on the nature of the soil and excavation depth. Recommendations for choose of drainage and dewatering systems depends on the soil type that can be accepted from [2]. Open drainage is produced by pumping units, while entering the pit (trench) water is collected in areaway (shaft bottom sump), from there it is swap out by pump in the open or underground drains.

With an open dewatering can be assumed that 1 m^2 of pit (trench) surface and vertical projections of the walls, locations below the static groundwater level, the water flow is:

with fine–grained sands 0,16;
with medium–grained sands 0,24;
with coarse sands 0,3–3,0;
with fracture rock material 0,15– 0,5m^3/h.

Water inflow into the pit (trench) in m3/h can be calculated by the formula:

$$Q = (F_{a.b(tr)} + F_{sl}) \cdot \alpha \tag{27}$$

where ($F_{a.b(tr)}$)area of a bottom, pit (trench), $m3$

$Fsl.$ – slope area, located below the groundwater level, $m2$

α – water inflow from 1m2, 0,16 – 0,5m3/h.;

$$F_{a.b(tr)} = L \cdot l_{2s}.b \tag{28}$$

$$F_{sl}. = (h_{tr} - h_{gwl}) \cdot L \tag{29}$$

where,hp,htr– pit or trench depth (per the task);

$hgwl$ – level of underground water, m (per the task);

L– trench length;

$$F_{a.b(tr)} = 70 \cdot 73.6 \cdot 1.45 = 7470.4$$

$$F_{sl}. = (2 - 1) = 1$$

$$\text{P}p \;\; - \; perimeter\ of\ the\ pit\ (l1 + l2) \cdot 2\ ; = 140 \cdot 2 = 280$$

$$Q = (7470.4 + 1)2 = 14940.8$$

The number of pumps required for water pumping:

$$N = \frac{Q \cdot Sf}{Pn} \tag{30}$$

where Sf– assurance coefficient, to be taken to be equal to 1,1–1,2;

Pn– hour pump capacity, (annex. №1. tab.8) m^3/h.

$$N = \frac{14940.8 \cdot 1.1}{52.6} = 284.045$$

With a significant inflow of groundwater (in soils with a filtration ratio of 2 to 40 m /day.), it is recommended to use a method of artificial lowering of groundwater using well point systems, which are located along the outer perimeter of the earthworks at a distance from the pit (trench) slope edge 0,5–1m.

Water inflow to the closed installations for pits is calculated by the formula:

$$Q = \alpha \cdot C \cdot S, = 1 \cdot 12 \cdot 2 = 24 \tag{31}$$

where Q – water inflow, $\frac{m^3}{h}$;

α– factor varying from 1 to 3m;

C– filtration coefficient (for clay – 0,005; loam – 0,005–0,4; sandy loams – 0,2–0,7; sand small – 1–10; average sand – 10–25; coarse sand – 25–75; gravel – 75–1000 m/days);

S– depth of required lowering of the water level (per the task);

$$Q = 1 \cdot 12 \cdot 2 = 24$$

The water–removing self–soaking–up pumps: S–203 with the following characteristics:

Productivity, m3/h: 24

The pressure created by the pump KPa: 90

Absorption height (greatest), m: 9

Diameter of absorption of a hose, mm: 50

Diameter of absorption of a hose, mm: 50

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

During the development of the technological works scheme it is required to pay special attention to workplace organization for earthmoving machines, i.e. machines working place illustrated for all specific areas of the pit (trench). The graphical part of the project draws the mine face plan, longitudinal and cross sections, which indicate the excavator position (cutting radius, the height or depth of cut, the angle of the excavator rotation, unloading range, loading height), the location of vehicles, traffic ways and other required data (Annex № 4).

Depending on the excavator parameters and pit size, the excavation if carried out in one or several passes at a width and in one or several layers at a bottom.

During pit excavation, the first pass to be carried out by frontal mine face, the other – by the side face, and trench excavation – by the frontal face.

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

$$\mathrm{B}_l = 2 \cdot 0{,}9 R_{dl} \tag{34}$$

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

$$\mathrm{B}_l = 2 \cdot 0.9 \cdot 9 = 16.2$$

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

$$\mathrm{B}p = 2\sqrt{(0{,}9R_{max})^2 - ln^{\,2}}, \tag{35}$$

$$\text{B}p = 2\sqrt{(0.9 \cdot 9)^2 - 2.3^2} = 15.53$$

Maximum width of the second (side) excavator pass:

$$B = b_1 + b_2, \tag{36}$$

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

$$b_1 = 0{,}9Rdl = 0.9 \cdot 9 = 8.1$$

$$b_2 = 0{,}7Rdl = 0.7 \cdot 9 = 6.3$$

$$B = 8.1 + 6.3 = 14.4$$

In order to reduce the average work cycle duration, the rotation angle of the excavator front sinking should take no more than 70–900. When excavation the trench by side passes with unloading to the dump or in vehicles, the optimum width of the pass at the top is assumed to be 1,2– 1,3R (R – the maximum digging area at the level of the excavator datum level). When working for the dump, the width of the front pass is linked to the size of earth deposit and practically is assumed to be 0,5–0,8R/

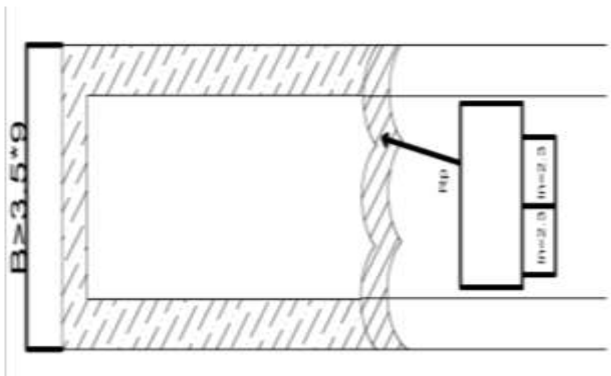


Figure 7 - Diagram of excavator pass "backhoe" during pit or trench excavation: across the pit or trench.

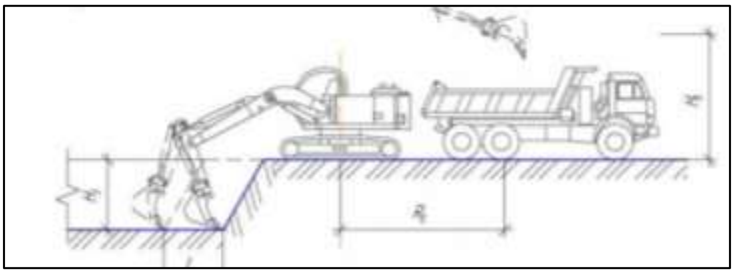


Figure 8 - The scheme of front face of excavator – backhoe: longitudinal section

Excavation of the trench to be provided with the excavator movement along the trench axis (along the longitudinal axis of the structure) with the front face. Excavation of the separate pits for each foundation by excavator – backhoe is implemented with the front face with the excavator movement along the structure axis. Excavation of a separate pit is possible with one or several excavator datum level – backhoe. Starting excavator datum level has the maximum distance L from the top edge of the first excavated slope:

$$L = \sqrt{R_{dl}^2 (\frac{a}{2})^2} \tag{37}$$

where Rdl – the largest radius of digging at the levels of excavator datum level

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

$$\text{a} = 1.25\ R_{dl} = 1.25 \cdot 9 = 11.25$$

$$L = \sqrt{9^2 (\frac{11.25}{2})^2} = 50.625$$

The pit is excavated from one datum level, if all in section along the axis of excavator movement is located within L to rdl – the smallest radius of excavator digging at the datum level.

The quantity rdl it is possible to accept:

$$R_{dl} = \frac{c}{2} + 1 \tag{38}$$

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

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

$$R_{dl} = \frac{2.9}{2} + 1 = 2.45$$

The first datum level is determined by the formula:

$$b\ =\ B\ - 2mh \tag{39}$$

where m – slope laying coefficient [7, annex. №. 1. tab. 2]

h – depth of a pit (trench), m

$$b\ = 14.4 - 2 \cdot .47 \cdot -2 = 16.28$$

Rdl – the digging radius at the levels of excavator datum level [7, annex. 1. tab. 9.1].

Then to be decided movement of excavator by step ln (tab.5).

Excavator movement step depends on the size of working equipment and excavation depth.

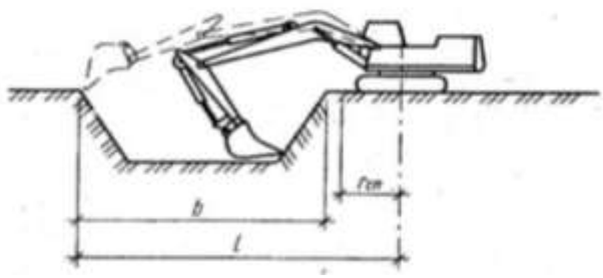


Figure 9 - Scheme of the pit excavation for one foundation by excavator – backhoe from several datum levels

In the Course Project may be adopted a step of excavator movement – backhoe with excavation depth of 4,5 ÷ 2,0 m within the limits specified in table 6.

3.15 Selection of vehicles for the construction of excavations and trenches

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

The solid soil volume in excavator bucket is determined:

$$V_{soil} = \frac{V_{buck} \cdot c_f}{C_{fr}} \quad (40)$$

where V_{buck}–accepted volume of excavator bucket, m3;

c_f–bucket filling factor: for front shovel from 1 to 1,25; the backhoe – from 0,8 to 1;

C_{fr}– Initial increase soil volume later developments

$$V_{soil} = \frac{0.4 \cdot 1.21}{0.8} = 0.605$$

The soil volume in excavator bucket is determined:

$$Q = Vsoil \cdot \mathcal{V} \quad (41)$$

where $\mathcal{V}$–average soil density (on ENIR), kg/m3

$$Q = 2300*0.605=1391.5$$

Number of soil buckets, loaded into dump truck body:

$$n = \frac{P}{Q} \quad (42)$$

where P– truck carrying capacity [7, annex. №1. tab.12,14].

$$n = \frac{40}{1391.5} = maz = 0.02874$$

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

$$V = V_{soil} \cdot n. = 2300 \cdot 1 = 2300$$

The duration of one work cycle of the truck is calculated

$$T_c = t_1 + \frac{60L}{v_r} + t_p + \frac{60L}{V_n} + t_m \quad (43)$$

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

$$t_1 = \frac{v \cdot N_{tm} \cdot 60}{100} = \frac{2300 \cdot 23.3 \cdot 60}{100} = 32154$$

where N_{tm} – standard of machine time per the ENiR [7, annex. №1 tab.22];

L– distance of ground transportation, (km);

$V\ r$– average speed of loaded truck [7, annex. №1 tab.16.1];

$V\ n$– average speed of empty truck [7, annex. №1 tab.16.1];

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

tm– duration of auxiliary operations (installation time for loading, unloading, expectation at the excavator, admission of the oncoming dump truck), min, [7, annex №1. table 16].

$$T_c = 32154 + \frac{60 \cdot 2000}{25} + 1.83 + \frac{60 \cdot 2000}{6.3} = 56003.44$$

Required number of trucks:

$$N = \frac{T_c}{t_1} = \frac{56003.44}{32154} = 1.74$$

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

The dump truck GAZ — 52 was selected with the following characteristics:

Characteristic: Dump truck Onboard

Loading capacity, t: 2,5

3.16 Selection of the assembly crane

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

In the cranes selection for installation of column foundations need to be used self–propelled jib cranes.

Cranes selected by the technical parameters: load capacity, hook lifting height, working radius and the largest load moment.

When taking into account the basic parameters of cranes (lifting capacity, working radius, lifting height) is also to be considered modifications of crane base models with interchangeable equipment: jib and tower–jib, various jibs, platforms, etc.

Crane hook radius Lcr, m, is calculated by the formula:

$$L_{cr}=l_1+l_2+l_3, \quad (44)$$

where L_{cr}– mounting radius

l_1 – the distance from the pivot axis to the mount joint of crane boom (3÷3.5), m;

l_2 – the smallest admissible distance from the slope basis to the closest support of the crane (portable, wheel, caterpillar), for tower cranes – to a sleeper design at not bulk soil [7, annex.1, tab. 17];

l_3 – the distance the structure outer surface or its protruding part crane hook axis, to be taken as equal to the half of the structure width $l2/2$.

$$L_{cr}=l_1+l_2+l_3=3+3+24=30$$

The required lifting capacity G is determined the same as for column–jib and rail jib cranes.

Required working radius is determined graphically. For cranes without jib (figure 9) boom axis is lined through two points: A_1– located at the height Hп+1,5 m (where 1.5 m – minimum height from the hook to the boom head), and B providing a safe gap between the boom and the closest to the boom point D a part of the building (taken from 0.5 to 1.5 m, depending on the length of the boom). The axis of the boom is drawn by line N – N, located at the level of its mounting joint (for jib cranes can be taken 1.5 m from the crane datum level – CDL – with subsequent adjustment). At the same time, seeking to provide the minimum radius and boom length, to be implemented lineup through the point B and the vertical axis of the load.

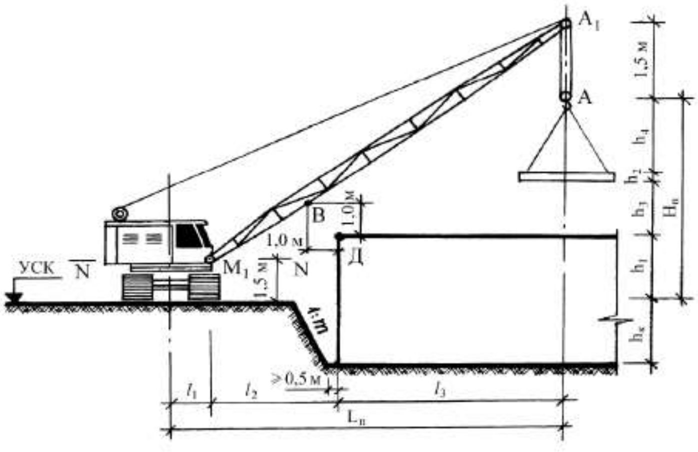


Figure 10 - The scheme for determination of the mount characteristics of self–propelled jib cranes

Position of the boom A1M1 is as desired. Then, lineup to the left from the point M1 distance $l1$, can be received the position of the crane rotation axis.

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

Location of jib cranes on the edge of the pit or trench slope is determined by taking into account the type of soil and the depth of the pit (trench). This should take into account features of the crane support.

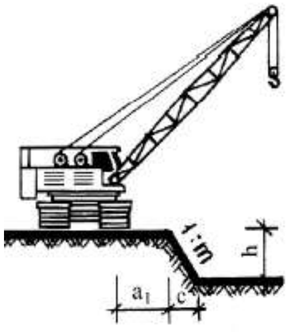


Figure 11 - Jib cranes dimensioning to the size of open pits or trenches: caterpillar–tracked cranes

The DEK – 50 crane with the following characteristics was selected:
Loading capacity, t: 50
Departure, m: 6…34
Height of rise, m: 30
Inventory settlement cost of K_1, thousand u: 69,7
Cost value machine change C (mach–change.u.e.): 53,4

3.17 Selection and estimate of freight–catching devices

Selection of slings and other gripping equipment is implemented for each structural element of the building. One kind of the sling should be used for different types, but similar in size constructions of different weight characteristics.

Calculation of the selected sling length and selection of ropes diameter to be carried out for the greatest structural element of the group per the weight and dimensions for the of which will be used lifting slings.

Calculation of the slings is based on the breaking load and the selection of cable diameter according to the current GOST.

To be find the force (in kg) that occurs in one branch of sling:

$$S=(Q/\cos\alpha)K \quad (45)$$

where α – vertical deviation angle of the sling, no more than 45degrees;
Q– weight of lifted structures (3÷5 t);

m – number of sling branches (2 or 4);

K – factor of load unevenness to the sling branches (m<4 is taken, K = 1, with m≥4 K= 1,33)

$$S=(5/\cos 45)1.33=9.405$$

Breaking strength in the sling branches is determined:

$$P=S.S_f \quad (46)$$

where Sf– safety factor, taken as S_f = 6 – for slings with inventory lifters, Sf =8 – for slings with fastening of cargo by strapping.

Using tables of SES 3079–80, for steel ropes is selected cable diameter of the breaking load.

$$P=9.405\cdot 8=75,24$$

3.18 Set of machines and equipment for concrete works

The number of machines and vehicles included in the set must provide the required intensity of the concrete work. Hours or shift intensity of concrete mix laying can be given by the head of the Course Project. If neither the intensity nor the duration of the concrete works are not set, then as the intensity of the concrete should be accepted a performance of leading concrete paver. The operational performance of the crane for the supply of concrete in bins is determined from the condition of performing by the crane an 8 – 10 cycles per hour.

To installation of the formwork and reinforcement, feeding of concrete mix into the bins to be used self–propelled jib cranes – automobile, at a special chassis of motor type, pneumatic and caterpillar–mounted. When choosing a brand, it is necessary to state the required crane cargo characteristics – capacity, radius and hook height.

The required load capacity of the crane is the heaviest weight of the lifted load (formwork block–form, reinforcing mesh or frame, bin with concrete mix). Weight of bin with concrete mix M:

$$M=M_e+E\cdot\gamma_{dc},t, \quad (47)$$

where Me – mass of the empty bunker, (annex.1 , tab. 18) t;

E – hopper capacity, (annex.1 , tab. 18) $m3$;

γ_{dc} – 2,4 t/m^3 – density of concrete mix.

$$M=380+2.5\cdot 2.4=2280$$

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

The required radius and height of crane hook lifting is determined graphically through the drawn works schemes on a scale.

Selection of crane brand is made by comparing the required parameters of the crane with cargo characteristics of self–propelled jib cranes. Generally, to perform formwork and reinforcement works, supply concrete mix is used one crane.

Choosing a concrete pump as a paving machine, should take into account the relative placement of the concrete pump and concreted foundations – the desired range. Specifications for the concrete truck are given in (annex №1 tab. 19). The RVM 42 concrete pump with the following characteristics was selected:

Technical productivity, m^3/h: 90

Quantity of sections of an arrow, piece: 4

Inner diameter of a concrete delivery, mm: 125

The greatest range of giving of a concrete mixture: 38,05

(Basic car: MV 3328)

The car sizes in transport situation, m

Length: 12,9

Width: 2,48

Heigh: 3,93

For transportation of concrete mix should select the brand of mixer truck (annex №1 tab. 20). The amount of concrete mix, hauled in mixer trucks must comply with concreting intensity.

With a relatively low intensity of concreting by the crane to be adopted a mixer truck 4÷5, m during the concreting by concrete pump – 5÷7, m.

3.19 Determination of work labour input and crew composition

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

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

Data of columns 10 and 11 to be calculated. Labor costs of processes in man–hours are determined by the formula:

$$Q_m{-}hour.=V \cdot \mathrm{N_{tr}}. \qquad (48)$$

The construction of temporary fencing

$$Q_m{-}hour.=368 \cdot 1.2=441.6$$

Removal of top soil

$$Q_m{-}hour.=1008.6 \cdot 0.56=564.82$$

Soil excavation in the trench and trench access to the pit

$Q_m\text{–}hour$.=87.86·2.8=246.01(workers)

$Q_m\text{–}hour$.=87.86·3.56 =312.78(drivers)

Excavation of soil underrun

$Q_m\text{–}hour$.=11871.36·1.64=19469.03

Backfilling

$Q_m\text{–}hour$.=2179.68·0.39=850.0

Soil compaction

$Q_m\text{–}hour$.=7265·0.92=6683.8

Final land planning

$Q_m\text{–}hour$.=1540·0.33=508.2

$Q_m\text{–}hour$.=1540·0.49=754.6

Removal of temporary fencing

$Qm\text{–}hour$.=368·0.9=331.2

and in man–days defined as:

$$Q_m\text{–}day = Qm\text{–}hour.\cdot 8{,}2 \qquad (49)$$

The construction of temporary fencing

$Q_m\text{–}day$=441.6·8.2= 3621,12

Removal of top soil

$Q_m\text{–}day$=564.82·8.2= 4631,524

Soil excavation in the trench and trench access to the pit

$Q_m\text{–}day$=246.01·8.2= 2017,282 (workers)

$Qm\text{–}day$=312.78·8.2= 2564,796 (drivers)

Excavation of soil underrun

$Q_m\text{–}day$=19469.03·8.2= 159646,046

Backfilling

$Q_m\text{–}day$=850.0·8.2= 6970

Soil compaction

$Q_m\text{–}day$=6683.8·8.2= 54807,16

Final land planning

$Q_m\text{–}day$=508.2·8.2= 4167,24

$Q_m\text{–}day$=754.6·8.2= 6187,72

Removal of temporary fencing

$Q_m\text{–}day$=331.2·8.2= 2715,84

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

3.20 Preparation of work schedule

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

The duration of the mechanized processes is determined by:

$$P_m = N_m.s_h / n \cdot A, \qquad (50)$$

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

n – number of machines;

A – number of shifts per day.

Determination of the required number of machine shifts

$$N_{Mc} = \frac{Q}{P_{cm}} = 0, \qquad (51)$$

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

P_{cm}– changeable productivity of the unit, ha / shift.

Removal of top soil

P_m=368/1·2·18662.4=1 day

Soil excavation in the trench and trench access to the pit

P_m=87.86/1·2·200=2 days

Backfilling

P_m=2179.68/2·2·200=3 days

Soil compaction

P_m=7265/2·2·115=5 days

Final land planning

P_m=1540/2·2·200=2 days

Duration of manual processes is determined by:

$$P_p = \frac{Q}{n.A} \qquad (51)$$

where Q–labor costs (table 10), (human –day);

n– number of workers per shift.

The construction of temporary fencing

P_p=441.6/2·10=2 days

Soil excavation in the trench and trench access to the pit

P_p=246.01/2·5=2 days

Excavation of soil underrun

P_p=19469.03/2·20=15 days

Final land planning

P_p=508.2/2·10=3 days

Removal of temporary fencing

P_p=331.2/2·10=2 days

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

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

$$K_u = n_{max}/n_{av}, \quad (52)$$

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

n_{av} – the average number of workers:

$$n_{av} = \Sigma Q/ , \quad (53)$$

where Q – total labor input (labor costs);

Ptotal– total duration determined by the schedule of work.

$$n_{av} = \Sigma Q/P_{tota}$$

$$K_u = n_{max}/n_{av},$$

Ratio Кu should not exceed 1.5, and if it is large, the schedule should be adjusted due to a more uniform distribution of the individual processes. Sometimes it is possible to lengthen the periods of time–consuming work, reducing the number of workers, as well as move the timing of these works without changing the number of workers.

3.21 Reinforcement works

Prior to the start of normal and reinforcement works on the construction of concrete structures, it is necessary to complete the geodetic survey work, fixing the axes of concrete structures in place. Particular attention should be paid to geodetic work, when installing reinforcement and reinforcement frames.

During the work, special attention should be paid to ensuring the rigidity of the installed formwork and preventing its deformation and pressure separation of the concrete mix column, as well as determining the rate of construction of all elements of the supports, taking into account the installation time of the concrete mix.

Prior to reinforcement work, the base must be cleaned of debris and dirt.

When preparing concrete foundations and working seams for the removal of cement film, surface treatment is carried out with water and air flow, metal brushes or sand flow units.

Prior to concreting the structure, it is necessary to create and install reinforcing frames and install the formwork and embedded parts required by the project in the area of concreting.

Reinforcement works are performed in accordance with the working drawings of structural reinforcement.

For reinforcement 32 mm, 22 mm, 20 mm, 16 mm, 14 mm, 12 mm diameter class reinforcement, steel grade 25G2S, diameter 10 mm, 8 mm diameter grade reinforcement St5 sp steel grade are used. GOST 5781-82.

Procedure for storage of fittings and angles.

Steel fittings are assembled in a specially designated area. Reinforcement packages are placed on wooden floors and covered with waterproof material. Rough use of the fittings, their falling from heights, exposure to impact loads, mechanical damage are not allowed.

Inspection.

Reinforcement rolls shall be inspected for defects such as cracks, local thinning, holes, exfoliation, bending, bending, corrosion, local or general bending, deviations from the specified section length of the roll.

- Cleanliness of fittings.
- When assembling the reinforcement frame, the reinforcement must be clean, free of dirt, grease, oil, paint, rust, secondary scale and similar materials.
- The reinforcement is connected to the spatial frames using a braided wire d = 1.6 mm. The reinforcement is stacked using braided wire, the stacking of the reinforcement cores is at least 30 diameters. In one section should not exceed 50percent of the joints of the rods.

Prior to the start of concreting of structures, it is necessary to prepare the required number of spaces - "dried wood", which provides the required thickness of the protective layer and the design location of reinforcing frames in all sections of the concrete elements of structures. The quality of "cracker" concrete pavements for the decoration of the protective layer of concrete should not be inferior to the quality of concrete structures.

It is allowed to use factory-made plastic spacers - "dried wood".

Remote pavements should be made of fine-grained concrete with the addition of crushed sieves. The dimensions and configuration of concrete slabs - "dryers" must correspond to the design of the reinforcing frame and the design dimensions of the protective layer of concrete, to ensure their sT placement in the formwork and reinforcing bars.

The outer (supporting) surface of the fine-grained concrete pavement in contact with the formwork should have a curved shape (radius of rounding 30 - 50 m) in order to prevent the formation of stains and subsequent damage to the surface of the concrete in the location of "dried bread" pavements.

When performing reinforcement work, it is necessary to install the embedded parts in accordance with the design.

Preparation of reinforcing frames (individual positions) and prefabricated parts, their installation and mounting in the formwork and other work related to the design features of reinforcement of concrete elements are performed in accordance with the working drawings.

Reinforcing rods in the shape of the frame elements are attached to the required distance linings - "crackers", which reliably ensures the design location of the reinforcing frame in the structure and the size of the protective layer of concrete in all sections.

Reinforcement with all embedded elements (parts) must have a rigid frame that does not break during concreting.

Plastic or metal pipes should be attached to the reinforcement frames in the upper and central areas in order to form wells for measuring the temperature of the concrete in the process of maintenance.

Installation of standard panels is carried out in accordance with the project. For concreting, an inventory mold made in accordance with the TS is used. Additional sections of the template are made on site. A wooden frame is used for additional processing. It is necessary to ensure good tightness of the joints of the edges of the shields. When defects are identified that can lead to leakage of cement mortar during concreting, all identified areas should be covered with 30-40 mm wide adhesive tape (construction patch) or sealant before application. The joints of the shields are sealed with silicone or other sealant. The shields of the mold are solid, geometric must be fixed and secured (with supports, supports, supports, wires, etc.) to form a fixed structure.

Prior to mounting, the forming surfaces of the formwork panels must be wiped with a screw impregnated with solidly or other grease. Lubrication must be applied with a very thin layer to prevent oil from entering the fittings during the installation of the standard shields.

After instrumental inspection of the condition of reinforcement frames, installed formwork panels, reinforcement frames and installed formwork shall be certified and an act of covert work shall be drawn up in the presence of the Customer, the general contractor and representatives of supervisory services.

3.22 Calculation of electrical supply

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

$$P_C= 1,05\cdot (\lambda_1\Sigma P_H/\cos\varphi + \Sigma P_\Pi + \lambda_2\Sigma P_{OB} + \lambda_3\Sigma P_{OH} + \lambda_4\Sigma P_{CB}) \qquad (54)$$

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

ΣPH - the sum of the rated powers of all installed electric motors, kW;

ΣPΠ - power consumption for production needs (soil thawing, concrete electric heating, etc.), kW;

ΣROV - total power of indoor lighting fixtures, kW;

ΣRON - the same for outdoor lighting, kW;

ΣPCB - the sum of the rated powers of all installed welding transformers, kW;

cosφ - power factor equal to 0.8;

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

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

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

λ_4 - coefficient of simultaneous operation of welding transformers with numbers:

3 = 0.8; 3 ÷ 5 = 0.6; 5 ÷ 8 = 0.5 and over 8 = 0.4.

Table 8- Power consumption of electricity consumers

Electricity consumers	Power consumption, kW
Welding machines T-22 - 4 pcs.	130,8
Lifts - 4 pcs.	28,0
Lifts T-37 - 4 pcs.	18,0
Plastering station	7,0
Painting station	7,0
Compressors - 5 pcs.	22,0
Bitumen cooker - 1pc.	7,5
Installation for heating concrete - 1pc.	40,0
Electric heater - 1pc.	7,5
Outdoor lighting devices	40,0
Lighting devices for permanent and auxiliary buildings	50,0
Other consumers	32,0 (10percent)
Total:	386,0

$$P_0 = 1{,}05\left(\frac{0{,}4\cdot 82}{0{,}8} + 55 + 0{,}8\cdot 2 + 0{,}9\cdot 40 + 0{,}6\cdot 130{,}8\right) = 289{,}8 \text{ кВт}$$

The required transformer substation can be determined from the table. one.

It is advisable to locate transformer stations in the center of loads with a service radius within 400-500 m.

Table 9-Recommended transformer substations

Type, brand of substation	power, kWt	Voltage, kV		Total weight, t
		ВН	ПН	
Complete transformer KTPM - 100	100	10	0,4/0,23	2,3
Typical mobile transformer KPTP - 320	320	35	0,4	7,0
Typical mobile transformer PTIP -	750	10	0,4/0,23	8,1

750				

3.23 Binding the erection crane and determining the area of its action

The zones of the crane are determined in order to create conditions for the safe production of work.

The following areas should be considered: - crane service area

max slave R = 34 m; - dangerous area:

R_{op} = max slave R + 0.5l_{min} + l_{max} + lotl = 34 + 0.5. 0.22 + 8.98 + 4.2 = 47.29 m,

where l_{min} = 0.22 m is the minimum volume of the transported cargo; l_{max} = 8.98 m - the maximum volume of transported cargo;

l_{dev} = 4.2 m - minimum distance of departure of the load when falling from the hook of the crane - installation area:

amont = l_{max} + lotl = 8.98 + 3.86 = 12.84 m, where lotl = 3.86 m is the minimum distance of departure of the load when falling from the building

3.24 Temporary buildings on a construction site

The total number of personnel employed in a shift in construction:

R = (R_{CM} + R_{ITR} + R_{MOS}) / 1.06 = (46+ 5+ 3) / 1.06 = 51 people,

where R_{CM} = 46 people is the maximum number of employees in the shift is determined according to the schedule of movement of labor;

R_{ITR} - the number of engineering and technical personnel equal to 0.06 · R_{MAX} = 5 people;

R_{MOS} - the number of K_{SK} and security, equal to 0.03 R · MAX = 3 people;

R_{MAX} = 71 people - the maximum number of employees is determined according to the timetable for the movement of the labor force; 1.06 is a coefficient that takes into account not going to work.

3.25 Calculation of warehouses

Determination of stocks of materials:

The number of materials to be stored in the warehouse:

$$P_{zi} = (Q_i / T_i) \cdot n \cdot k_1 \cdot k_2, \quad (55)$$

where Qi - i is the total demand of the material;

Ti - time of execution of works on scheduling; n - regulatory fund, cf. k1 - non-uniform coefficient of material consumption k2 - coefficient of uniform receipt of materials at the warehouse

Determination of the warehouse area: Useful warehouse area (no driveways and driveways)):

$$F_i = P_{zi} / r_i, \quad (56)$$

where ri is the rate of collection of materials per 1 m2 of warehouse area. The total area of the warehouse:

$$S_i = F_i / \beta, \quad (57)$$

where β is the utilization factor of the warehouse area: for an open warehouse 0.5..0.6; for closed heating 0.6..0.7; for closed unheated 0.5..0.6.

3.26 Construction site power supply

Estimated transformer capacity with simultaneous consumption of electrical energy by all consumers:

$$P = K \cdot (\Sigma n + \Sigma P_{OB} \cdot K + \Sigma P_{OH} \cdot K) \quad (58)$$

where K = 1,1 - coefficient, taking into account PC - power capacity of a machine or installation, kW;

P_T is the power required for technological needs, kW;

P_{OV} is the required power for indoor lighting, kW; P_{ON} - required power for outdoor lighting, kW;

K_1, K_2, K_3, K_4 - demand coefficients depending on the number of consumers.

The required number of spotlights:

$$n = P \cdot S / PL, \quad (59)$$

where S is the area of the illuminated area, m2;

P is the specific power,

W / m^2; PL = 1000 - power of the searchlight lamp, W;

Specific power:

$$P = 0.25 \cdot E \cdot k, \quad (60)$$

where E = 2 is the minimum calculated horizontal illumination, lux;

k = 1.3..1.5 - safety factor;

$$P = 0.25 \cdot 2 \cdot 1.3 = 0.65 \text{ W},$$

$$n = 0.65 \cdot 8296/1000 = 6$$

Projector type PSM-50 (with DRL lamps) we accept; the number is 6 pieces. Calculation of the need for temporary power supply:

P = 1.1 · 458.73 = 504.6 kW SKTP-560 closed structure, power 560 kW, intermediate 2.27 mx 3.4 complete set of transformer station is taken by volume.

3.27 Calculation of temporary office and household buildings.

During the design of temporary office buildings, more often made of modular prefabricated containers, one should proceed from the need per day in the number of workers according to [17]:

$$Ntot = 1.05\ (N_{vp} + N_{itr} + N_{op} + N_{mop} + N_{sl}) \qquad (61)$$

where N_{op} is the need for workers according to the calendar plan, namely the schedule of movement of workers, Nop = 87 people.

N_{vp} - the number of additional work, assign 20percent of Np, Nvp = 87 0.2 = 17 people.

Niter - the number of workers of engineering and technical personnel, Niter = 10percent (N_{op} + N_{vp})

Niter = 0.1 (87 +17) = 10 people.

N_{sl} - the number of employees,

N_{sl} = 5% (N_{op} + N_{vp}) = 0.05 (87 +17) = 5 people.

N_{mop} - the number of technical service workers,

N_{mop} = 3% (N_{op} + N_{vp}) = 0.03 (87 +17) = 3 people.

N_{tot} = 1.05 (87 +17+ 10 + 5 + 3) = 122 people.

The total amount of workers in one shift is assigned - Ncm = Ntotal, and with two shifts:

N_1 = 0.7 N_{tot} = 0.7 122 = 85 people.

N_2 = 0.3 N_{total} = 0.3 122 = 36 people.

Based on the number of employees, the number of temporary buildings for the headquarters is calculated, which is equal to (Nsl + Nitr) = 15 people. per shift, also the number of showers - depending on the maximum number of workers per shift, multiplied by 30 – 40 percent by (N_{op} + N_{vp}) = 0.3 □ (87 +17) = 31 people.

As a result, we calculate the number and area of all temporary buildings and structures required for maintenance during construction production, calculated in accordance with the norms established by state organizations.

Lighting design on a construction site:

Considering that the construction site has dimensions of 87x85m. Taking into account the fact that the dimensions of 87m are less than 100m, then as lighting elements we take PZS-40 floodlights and DRL-700 lamps.

We calculate the required number of searchlights n according to [17]:

$$n = m \cdot E_p \cdot S_P \quad (3.18)$$

$$n = 0.25 \cdot 1.7 \cdot 2 \cdot 98 \cdot 78700 = 8$$

4. Economic part

4.1 Calculation of the estimated cost of construction

The estimated cost of construction is the amount of money required for the implementation of construction, determined on the basis of the estimate documentation.

The estimated cost serves as a guideline for customers when buying and concluding a contract, payments for work performed by the contractor in accordance with the current regulatory documents. Also, the estimated cost is necessary to determine the investment indicator for the implementation of the construction of the facility.

In this section, construction costs will be calculated, that is, the required capital for the project.

The cost of construction will be calculated on the basis of SN RK 8.02-01-2002 "Procedure for determining the estimated cost of construction at the stage of feasibility study."

4.2 Technical and economic indicators

When implementing the project, it is planned to use investment funds, while, according to the legislation of the Republic of Kazakhstan, 15percent of the total investment should be financed from its own funds.

The required capital investments for the implementation of the project amount to 59.008 million tenge.

At the same time, own funds amount to 8.85 million tenge.

See the full estimated cost in the "Estimated calculation of the cost of construction".

Note: see the local estimate, resource estimate, object estimate, construction cost estimate in Appendices A, B, C, D, respectively.

CONCLUSION

The purpose of this diploma project is to describe the building architecture of the designed object, calculate the structural component of the building, plan the processes and duration of construction, feasibility study of the selected methods, mechanisms and methods of automated calculations.

The educational building in Taraz is a building that will represent the aesthetic beauty and expressiveness of modern architecture, the greatness and strength of engineering, as well as the progressiveness and efficiency of software systems used in the construction industry. Modern materials were selected for the architectural - constructive solution, foundation, walls and floor structures. The master plan has been developed taking into account the amenities and all safety measures.

Each section of the work has its own solution.

As a result of this work, architectural and planning decisions were adopted and substantiated, plans, sections, nodes were developed, the main anti-seismic measures were indicated.

In the design and construction section, the design model of the building was determined, the collection of loads was compiled and the forces in the supporting structures were determined using ETABS.

In other sections, flow charts were designed for the production of earthworks and reinforcement, as well as concrete work, the process of construction production as a whole and its duration were planned, the main work was described and an estimate was made for the construction of the facility being erected, a construction master plan was designed showing the general situation and the location of all structures and buildings on the site and the operation of all mechanisms involved in the construction of the building.

LIST OF USED LITERATURE

1 SP RK 3.02-107-2014 "Public buildings and structures".

2 SN RK 2.02-01-2014 "Fire safety of buildings and structures."

3 SP RK 2.04-01-2017 "Construction climatology".

4 SN RK 2.04-04-2013 "Construction heat engineering".

5. NTP RK 02-01-1.1-2011 (for SN RK EN 1992-1-1:2004). Design of concrete and reinforced concrete structures of buildings and structures made of heavy (normal) concrete, performed without prestressing reinforcement. Astana 2015.

6. Guidelines for the design of concrete and reinforced concrete structures in heavy concrete (no prestressing). Moscow, 2011.

7. Study guide to course and diploma design of building processes during construction of substructure: Textbook for universities / Ed. ed. m. t. n A.A. Bryantsev - Almaty: KazGASA, 2017 -182 p.

8. ЕНиР Collection E2. Mechanized and manual earthworks.

9. ЕНиР Collection E4. Installation of prefabricated and installation of monolithic reinforced concrete structures.

10. ЕНиР Collection E9. Constructions of heat supply, water supply, gas supply and sewerage systems.

11. ЕНиР Collection E5. Installation of metal structures.

12. "Construction production technology",Khamzin S.K., Karasev A.K.,Moscow, 2006.

13. Methodological guidelines for the development of a construction organization project as part of course and diploma projects for full-time and part-time students of construction specialties. Brest, 2002.

14. SN RK 2.04-01-2011 "Natural and artificial lighting".

15. SN RK 1.03-05-2011 "Labor protection and safety in construction".

16. Designing the installation of assembly cranes at the construction site: study guide. allowance / S.V. Kaloshin, A.B. Ponomarev, A.V. Zakharov, D.G. Goldtooth. - Perm: Publishing house of Perm. nat. issled. polytechnic University, 2016. - 114 p.

17. Master's dissertation on the topic: "Development of recommendations for the use of energy-efficient materials based on experimental research", Kozyukova N.V., 2017

Appendix A

A.1 Own weight

For own weight in lira we have the option of dead weight and open it. For the factor=1 of own weight we select from national appendix eurocode 1990 4.1.2.

A.2 Accumulation of floor loads

Load on the foundation:

It is recommended to determine the load per 1 m2 of foundation. The following load is taken to calculate the bearing capacity

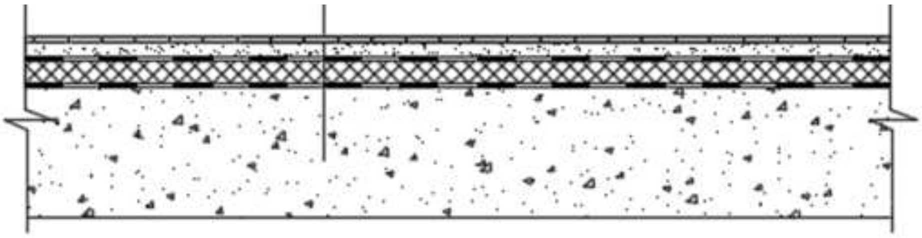


Figure A1 - The structure of the foundation

Load on the ceiling

It is recommended to determine the load per 1 m2 of the ceiling. The following load is taken to calculate the bearing capacity

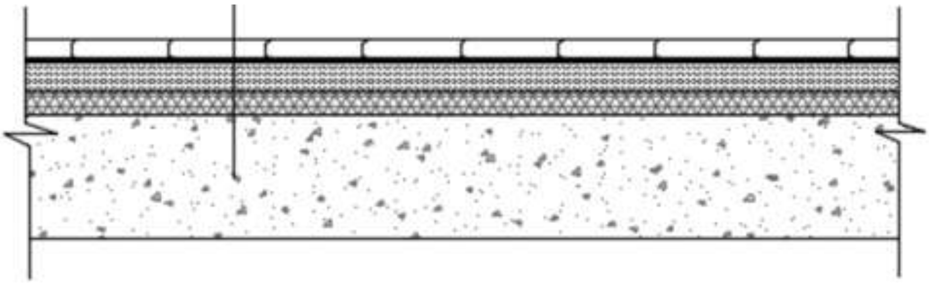


Figure A2 - The structure of the ceiling

Load on the roof

It is recommended to determine the load per 1 m2 of pavement. The following load is taken to calculate the bearing capacity

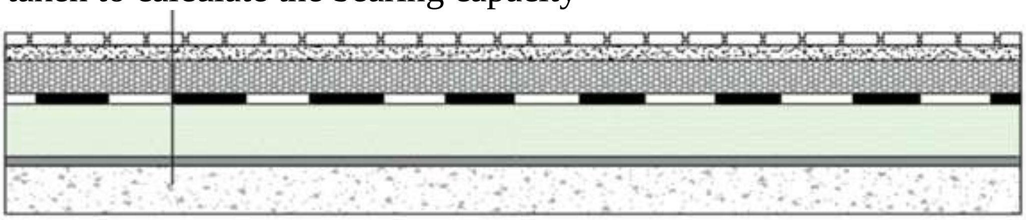


Figure A3 The structure of the roof

A.3 Determination of loads on external and internal walls

Exterior wall

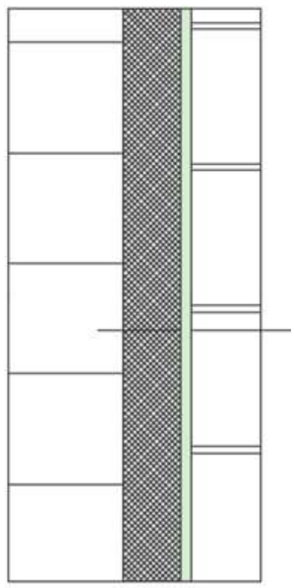


Figure A4- Exterior wall structure

Internal wall

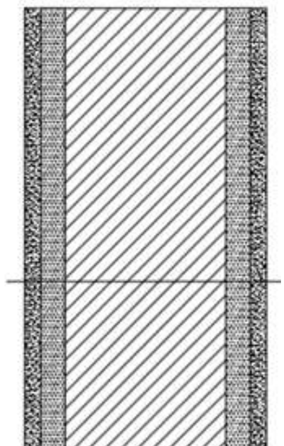


Figure A5 - Internal wall structure

A.4 Determination of soil pressure

The main soil type is loamy soil. Physical and mechanical characteristics of clay soils in Table 1.

We determine the intensity of the horizontal active pressure of the soil from its own weight at depth by the following formula:

$$P_{\gamma} = [\gamma \cdot h \cdot \lambda - c \cdot (k_1 + k_2)] \cdot \frac{y}{h} = 27 \cdot 491 \cdot 0.48 - 0] \frac{4,9}{4,9} = 53.1 кПа$$

The intensity of the transverse pressure of the soil from the evenly distributed load is determined by the following formula

$$Pq = 9.81 \cdot 0.48 = 4.7 кПа.$$

Table A1 Materials own weight according to the EN1990, 4.1.2

	Down loads		
	1 Dead weight		Auto.
	Floor construction	Layer thickness, m density, kg / m3	Characteristic load, kg / m2
	For foundation floor		
	Waterproofing TechnoNicole Uniflex Vent EKV	0.035 5,5	0,02
	Thermal insulation mineral wool	0,12 250	30
	Waterproofing TechnoNicole Uniflex Vent EKV	0.035 5,5	0,02
	Cement-sand binder	0.05 1500	75
	Ceramic tile	0.025 2750	68,75
		Basement total:	173,79

	Penopolïstrol	0.03 80	2,4
	Cement-sand binder	0.04 1500	60
	Solid fiberboard	0.005 700	11
	Parquet board	0.02 550	11
	Total for a typical floor		73,43
	For flat roofs:		
	Sealant	0.004 1020	4,1
	Penopolïstrol	0.12 50	6
	Waterproofing TechnoNicole Uniflex Vent EKV	0.0035 5,5	0,02
	Claydite	0.75 715	53,63
	Cement-sand binder	0,04 1500	60
	Uniflex 2 floors	0.01 1020	10,2
	Total flat roof:		133,95
	Wall construction	Layer thickness, m density, kg / m3	Characteristic load, kg / m
	Exterior wall		
	Aerated concrete	0.2 500	100
	Mineral wool	0.1 1500	150
	Air gap	0.02 80	0.16
	Facing brick	0.12 1800	216
	Total for exterior wall		466.16
	Internal wall		
	Plaster	0.02 980	19.6
	Grinding	0.03	45

	layer	1500	
	Aerated concrete	0.2	100
		500	
	Grinding layer	0.03	45
		1500	
	Plaster	0.02	19.6
		980	
	Total for internal wall:		70.62

	Horizontal ground pressure		Specifications
	loams		E = 210 кг см2
			γ = 27 kN/m 3
			φ =18 град.
			c = 0.75
	Payment		
	Horizontal intensity of active soil pressure at mark 3		
	Ground level relative to clean floor -0.700		

	For a typical floor	
	Horizontal intensity of active soil pressure at 3m, from distributed load q = 9.81 t / m3	

A.5 Temporary load on the ceiling

To give temporary loads we should check the CH-PK EN 1991-1:2000/2011 table 6.1 to 6.2 there we will take according to the given region nor sultan we will also see the category of our building which are divided into four (A,B,C&D) so here I chosen category A because we have residential building than we will chose our temporary load according to the upper category from table 6.2 in CH-PK EN 1991-1:2000/2011 so we have 2.0 kn and 2 kN

Категории использования	$Q_н$ кН/м^2	$q_н$ кН
Категория А: (жилой дом)	2,0	2,0

Figure A6 Temporary load

A.6 Determination of snow load

Snow load in III snow region:

$$s = \mu i \cdot Ce \cdot Ct \cdot sk \quad \text{(A1)}$$

0.8 · 1 · 1 · 150 = 120 кг/м 2

A.7 Wind load (in the X direction)

Wind pressure on vertical walls in the plan of a rectangular building
Issued by:
Rectangular building 24.5x74.5x57.25 (h) m. Wind area - II.

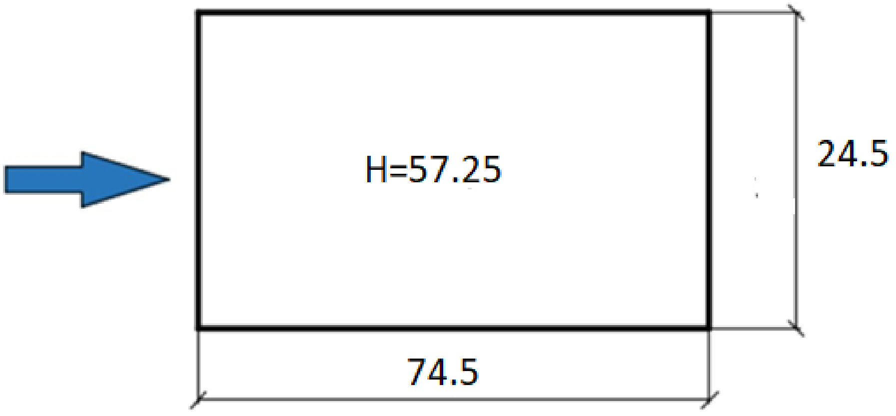
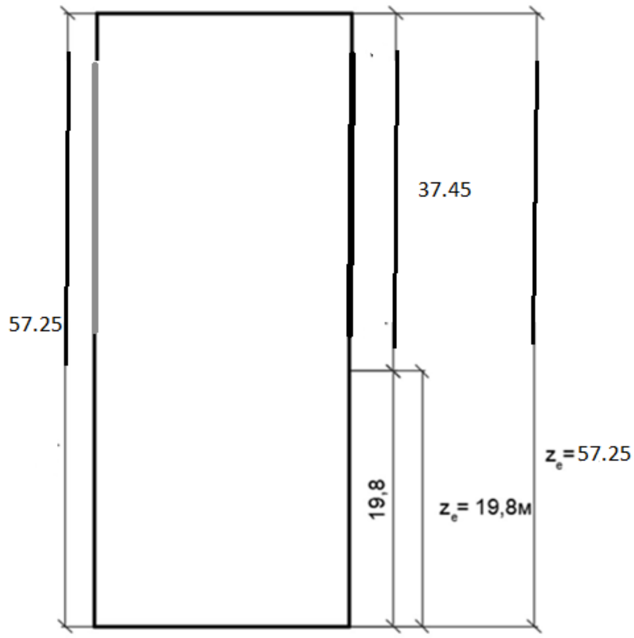


Figure A6 Plan of the building

External pressure on the windward side (zone D):

The recommended value for use as the main height of buildings is ze = 57.25 m. Divide the building into zones according to the height, the external pressure corresponds to the base slope for ze 7.2.2 (1) - according to the methodology h = 57.25 m 2b = 69.55m:



Wind pressure is determined by the following formula:

$$w_e = q_p(z_e)c_{pe} \tag{A2}$$

cpe=+0.8 aerodynamic coefficient of external pressure for the second wind area Basic wind speed = 0.39 kPa:

The wind pressure we are equal to:

$z_e = 19{,}8$м	$C_e(19{,}8)=2{,}8$	$W_e = 2{,}8 \cdot 390 \cdot 0{,}8 = 873{,}6$
$z_e = 27{,}3$м	$C_e(27{,}3)=3{,}02$	$W_e = 3{,}02 \cdot 390 \cdot 0{,}8 = 942{,}24$

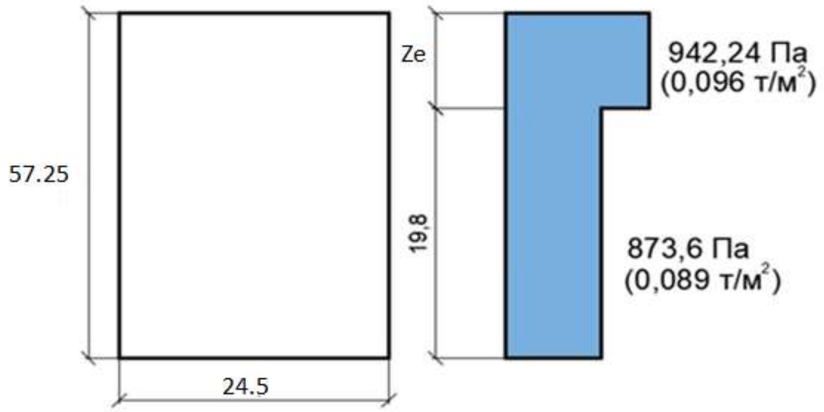


Figure A7 - External pressure diagram

Determining the load on the beams on each floor of the building

1 floor 2 floor 3 floor 4 floor 5 floor	$P = 0{,}089 \cdot \frac{3{,}9}{2} + 0{,}089 \cdot \frac{3{,}9}{2} = 0{,}347$ т/м
6 floor	$P = 0{,}096 \cdot \frac{3{,}9}{2} + 0{,}096 \cdot \frac{3{,}9}{2} = 0{,}374$ т/м
> 7 floor	$P = 0{,}096 \cdot \frac{3{,}9}{2} = 0{,}187$ т/м

External pressure from the lateral region

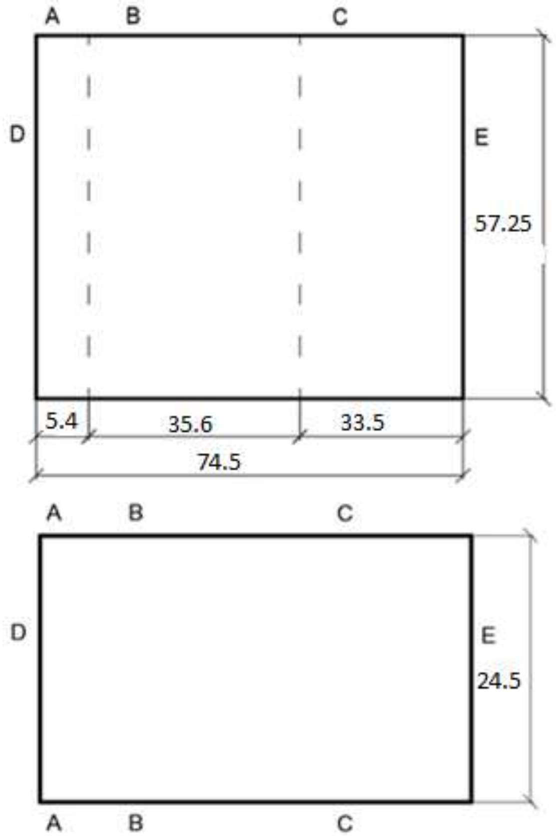


Figure A8 - Side-by-side zoning scheme

Wind pressure Zone A:

$z_e = 27{,}3$м	$C_e\,(27{,}3)=3{,}02$	$W_e = 3{,}02 \cdot 390 \cdot (-1{,}2) = -1413{,}36$

Determining the load on the beams on each floor of the building

1 floor 2 floor 3 floor 4 floor 5 floor 6 floor	$P = 0{,}144 \cdot \frac{3{,}9}{2} + 0{,}144 \cdot \frac{3{,}9}{2} = 0{,}5616$ т/м
> 7 floor	$P = 0{,}144 \cdot \frac{3{,}9}{2} = 0{,}281$ т/м

Wind pressure in zone B:

$z_e = 27{,}3$м	$C_e(27{,}3)=3{,}02$	$W_e = 3{,}02 \cdot 390 \cdot (-0{,}8) = -942{,}24$

Determining the load on the beams on each floor of the building

1 floor 2 floor 3 floor 4 floor 5 floor 6 floor	$P = 0{,}096 \cdot \frac{3{,}9}{2} + 0{,}096 \cdot \frac{3{,}9}{2} = 0{,}374$ т/м
> 7 floor	$P = 0{,}096 \cdot \frac{3{,}9}{2} = 0{,}187$ т/м

Wind pressure Zone C:

$z_e = 27{,}3$м	$C_e(27{,}3)=3{,}02$	$W_e = 3{,}02 \cdot 390 \cdot (-0{,}5) = -588{,}9$

Determining the load on the beams on each floor of the building

1 floor 2 floor 3 floor 4 floor 5 floor 6 floor	$P = 0{,}06 \cdot \frac{3{,}9}{2} + 0{,}06 \cdot \frac{3{,}9}{2} = 0{,}234$ т/м
> 7 floor	$P = 0{,}06 \cdot \frac{3{,}9}{2} = 0{,}117$ т/м

Wind pressure zone E:

$z_e = 27{,}3$м	$C_e(27{,}3)=3{,}02$	$W_e = 3{,}02 \cdot 390 \cdot (-0{,}5) = -588{,}9$

Determining the load on the beams on each floor of the building

1 floor	$P = 0{,}06 \cdot \frac{3{,}9}{2} + 0{,}06 \cdot \frac{3{,}9}{2} = 0{,}234$ т/м
2 floor	
3 floor	
4 floor	
5 floor	
6 floor	
> 7 floor	$P = 0{,}06 \cdot \frac{3{,}9}{2} = 0{,}117$ т/м

A.5 Seismic loads

We will choose our seismic zone by the type of soil as we know we have loam I will choose category III then we will go to Appendix E there we will have difference region like you can see in the following map

When developing design documentation for the construction of new buildings and structures erected in seismic zones, one should take into account:

a) Seismic hazard of zones and construction sites;

b) The results of engineering and geological surveys at the construction site;

c) The results of calculations performed in accordance with this joint venture;

d) Design requirements given in the relevant sections of the joint venture

Note - If the product of the values ag (see 7.5.5) and γIh (see 7.4) does not exceed 0.08 g, then calculations of buildings and structures for seismic effects are allowed not to be performed, but to achieve the goals of this joint venture (see 1.3), observe only the structural requirements adopted regardless of calculation results (see Section 9). If the product of the values ag and γIh does not exceed 0.05 g, then the positions this joint venture is not required to comply

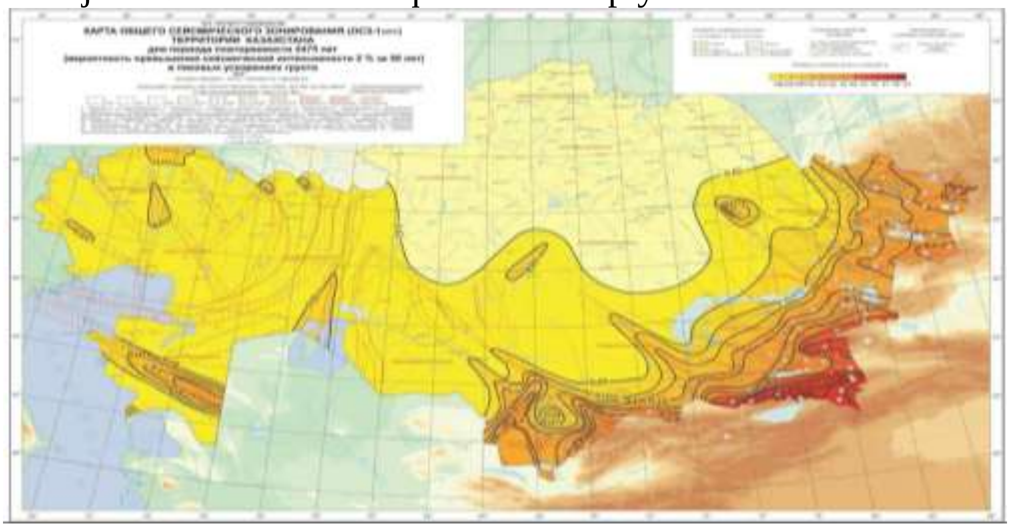


Figure A8 Seismic zone in Kazakhstan

A.10 Fill in the DCL table

From the SN RK EN 1990 documentation, we fill in the DCL table with the basic combination using formulas (6.10), (6.10a) and (6.10b). Fill in the table RSN by the formula (6.10):

$$\sum_{j\geq 1}\gamma_{G,j}G_{k,j}+\gamma_p P+\gamma_{Q,1}Q_{k,1}+\sum_{i\geq 1}\gamma_{Q,i}\psi_{0,i}Q_{k,i}$$

PCH 1	PCH 2	PCH 3	PCH 4	PCH 5	PCH 6	PCH 7	PCH 8	PCH 9	PCH 10	PCH 11	PCH 12
1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35
1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35
1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35
1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35
1.50	1.50	1.50	1.50	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05
1.05	1.05	1.05	1.05	1.50	1.50	1.50	1.50	1.05	1.05	1.05	1.05
0.90	0.00	0.00	0.00	0.90	0.00	0.00	0.00	1.50	0.00	0.00	0.00
0.00	0.90	0.00	0.00	0.00	0.90	0.00	0.00	0.00	1.50	0.00	0.00
0.00	0.00	0.90	0.00	0.00	0.00	0.90	0.00	0.00	0.00	1.50	0.00
0.00	0.00	0.00	0.90	0.00	0.00	0.00	0.90	0.00	0.00	0.00	1.50

From the documentation SN RK EN 1990 we fill in the table of DCL by the formula (6.10a)**:**

$$\sum_{j\geq 1}\gamma_{G,j}G_{k,j}+\gamma_p P+\gamma_{Q,1}\psi_{0,1}Q_{k,1}+\sum_{i\geq 1}\gamma_{Q,i}\psi_{0,i}Q_{k,i}$$

PCH 13	PCH 14	PCH 15	PCH 16	PCH 17	PCH 18	PCH 19	PCH 20	PCH 21	PCH 22	PCH 23	PCH 24
1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35
1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35
1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35
1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35
1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05
1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05
0.90	0.00	0.00	0.00	0.90	0.00	0.00	0.00	0.90	0.00	0.00	0.00
0.00	0.90	0.00	0.00	0.00	0.90	0.00	0.00	0.00	0.90	0.00	0.00
0.00	0.00	0.90	0.00	0.00	0.00	0.90	0.00	0.00	0.00	0.90	0.00
0.00	0.00	0.00	0.90	0.00	0.00	0.00	0.90	0.00	0.00	0.00	0.90

From the documentation SN RK EN 1990 we fill in the table of DCL by the formula (6.10b):

$$\sum_{j\geq 1} \xi_j \gamma_{G,j} G_{k,j} + \gamma_p P + \gamma_{Q,1} Q_{k,1} + \sum_{i\geq 1} \gamma_{Q,i} \psi_{0,i} Q_{k,i}$$

PCH 25	PCH 26	PCH 27	PCH 28	PCH 29	PCH 30	PCH 31	PCH 32	PCH 33	PCH 34	PCH 35	PCH 36
1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
1.50	1.50	1.50	1.50	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05
1.05	1.05	1.05	1.05	1.50	1.50	1.50	1.50	1.05	1.05	1.05	1.05
0.90	0.00	0.00	0.00	0.90	0.00	0.00	0.00	1.50	0.00	0.00	0.00
0.00	0.90	0.00	0.00	0.00	0.90	0.00	0.00	0.00	1.50	0.00	0.00
0.00	0.00	0.90	0.00	0.00	0.00	0.90	0.00	0.00	0.00	1.50	0.00
0.00	0.00	0.00	0.90	0.00	0.00	0.00	0.90	0.00	0.00	0.00	1.50

From the SN RK EN 1990 documentation (6.14b) we fill in the DCL table with a characteristic combination using the formula:

$$\sum_{j\geq 1} G_{k,j} + P + Q_{k,1} + \sum_{i\geq 1} \psi_{0,i} Q_{k,i}$$

PCH 37	PCH 38	PCH 39	PCH 40	PCH 41	PCH 42	PCH 43	PCH 44	PCH 45	PCH 46	PCH 47	PCH 48
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
0.70	0.70	0.70	0.70	1.00	1.00	1.00	1.00	0.70	0.70	0.70	0.70
0.60	0.00	0.00	0.00	0.60	0.00	0.00	0.00	1.00	0.00	0.00	0.00
0.00	0.60	0.00	0.00	0.00	0.60	0.00	0.00	0.00	1.00	0.00	0.00
0.00	0.00	0.60	0.00	0.00	0.00	0.60	0.00	0.00	0.00	1.00	0.00
0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.60	0.00	0.00	0.00	1.00

From the documentation SN RK EN 1990 (6.16b) we fill the quasi-constant combination in the table DCL by the formula:

$$\sum_{j\geq 1} G_{k,j} + P + \sum_{i\geq 1} \psi_{2,i} Q_{k,i}$$

PCH 37
1.00
1.00
1.00
1.00
0.60
0.20
0.00
0.00
0.00
0.00

A11 Analyzing

After analyzing we will have the following graphs and characteristic. The first thing that we should consider it during design it's the stability of the structure

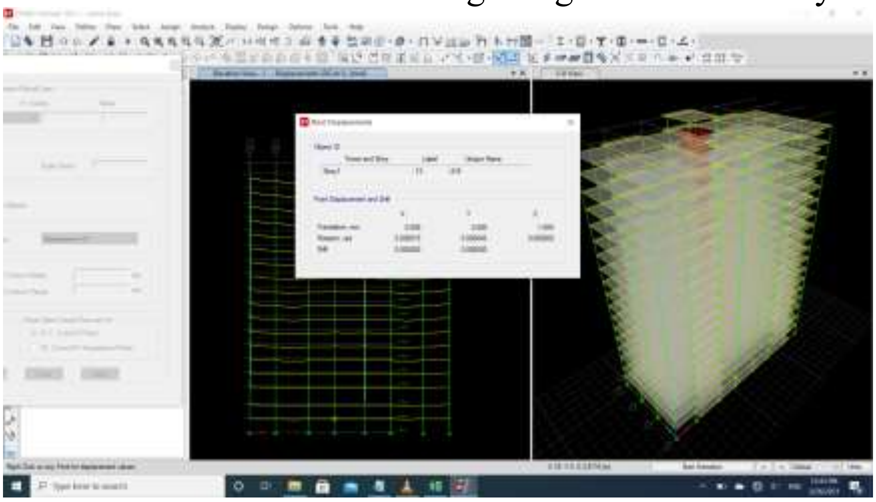


Figure A9 Displacements graph

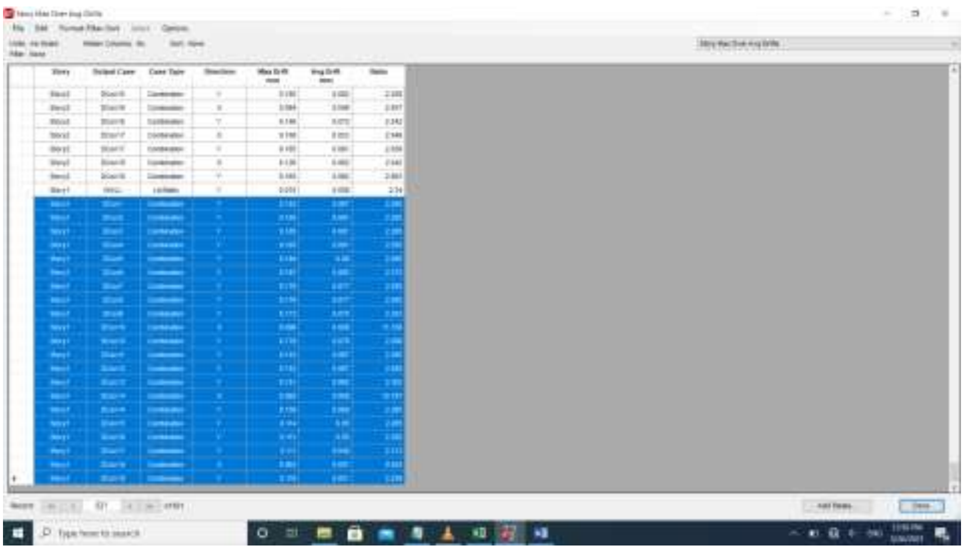


Figure A10 Seismic zone in Kazakhstan

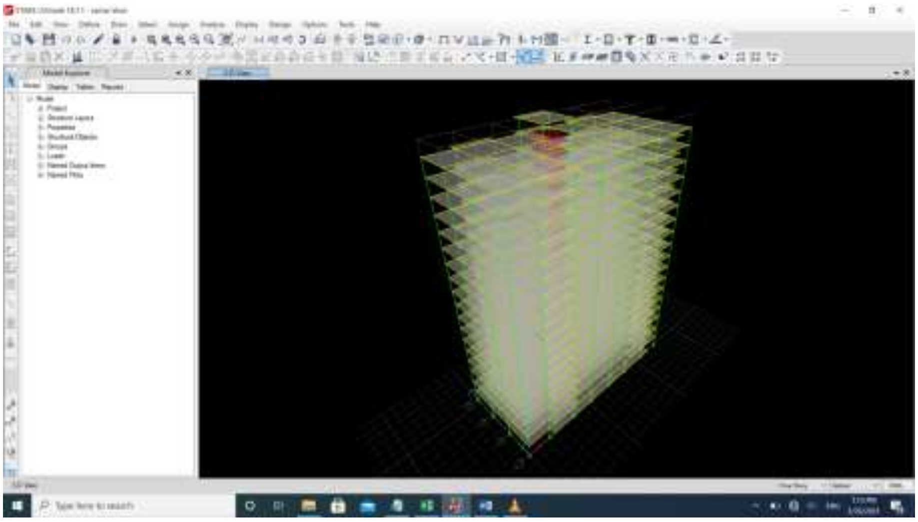


Figure A11 3D View of design

A12 Checking results

A12.1 Determining the subsidence of the foundation

We determine the subsidence of the foundation in accordance with Annex B to the documentation SP RK 5.01.102-2013.

Smax = 2.64 sm is equal to the maximum subsidence as shown in the figure. This is less than the allowable value (10 cm). That is, the subsidence condition is fulfilled.

Relative subsidence difference:

$$\frac{(26{,}2 - 26{,}2)}{33000} = 0{,}0 < \frac{\Delta S}{L} = 0{,}002$$

The contract has been fulfilled.

A12.2 Check the curvature of the ceiling

Bending inspection of the ceiling According to paragraph 7.4.1 of the documentation SN RK 1992, if the calculated deviation of the beam, slab or cantilever beam exceeds 1/250, the appearance and overall suitability of the supporting structure may be impaired.

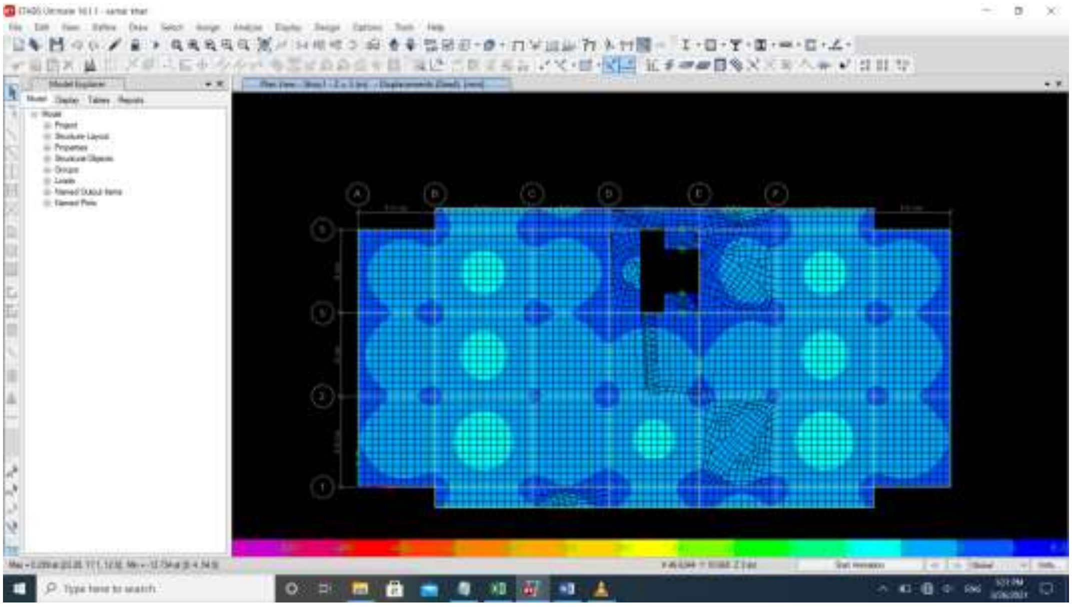


Figure A12 Displacements according Z dr

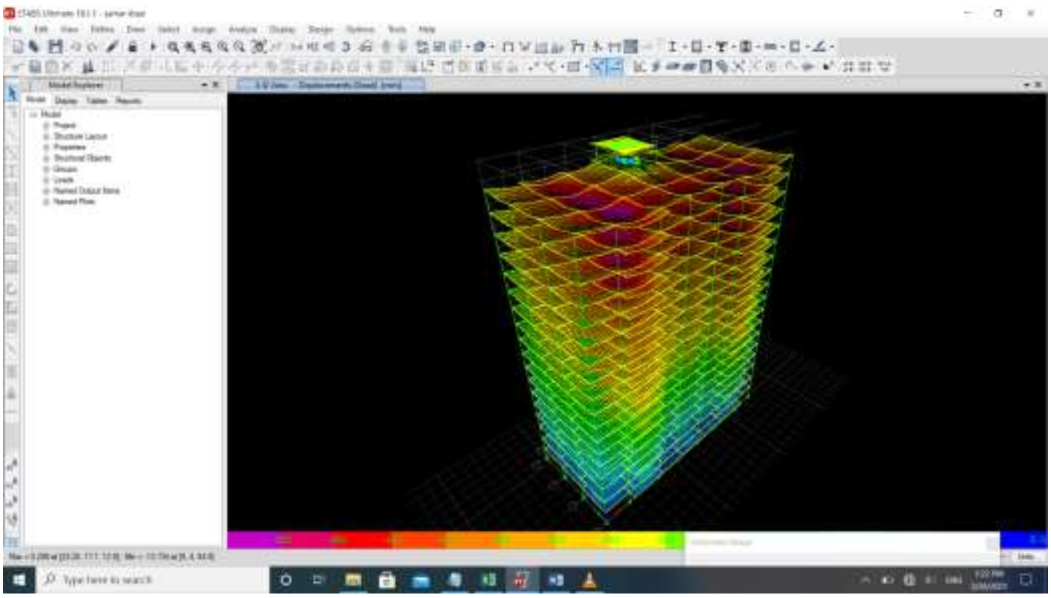


Figure A13 3D View of displacements according Z dr

A12.3 Check the horizontal deviation of the floors of the building

We define the building according to appendix B to the documentation SP RK 5.01.102-2013. According to the analysis of the Lira orientation, the maximum subsidence smax = 38.6 sm. This is less than the allowable value (10 cm). That is, the subsidence condition is fulfilled.

According to section 10.14 of SNiP 2.01.07-85 documentation, we determine the horizontal deviations due to wind. According to Table 22 of Section 10.14, the horizontal deviation for multi-storey buildings shall be less than h / 500. h is the height of multi-storey buildings equal to the distance from the top of the foundation to the axis of the roof crossbar.

Checking the horizontal deviation in the X direction on DCL9:

$$26{,}3 \text{ мм} \not< \frac{1}{500} \cdot h = \frac{1}{500} \cdot 31500 = 63 \text{ мм}$$

Checking the horizontal deviation in the direction U on DCL11:

$$48{,}6 \text{ мм} \not< \frac{1}{500} \cdot h = \frac{1}{500} \cdot 31500 = 63 \text{ мм}$$

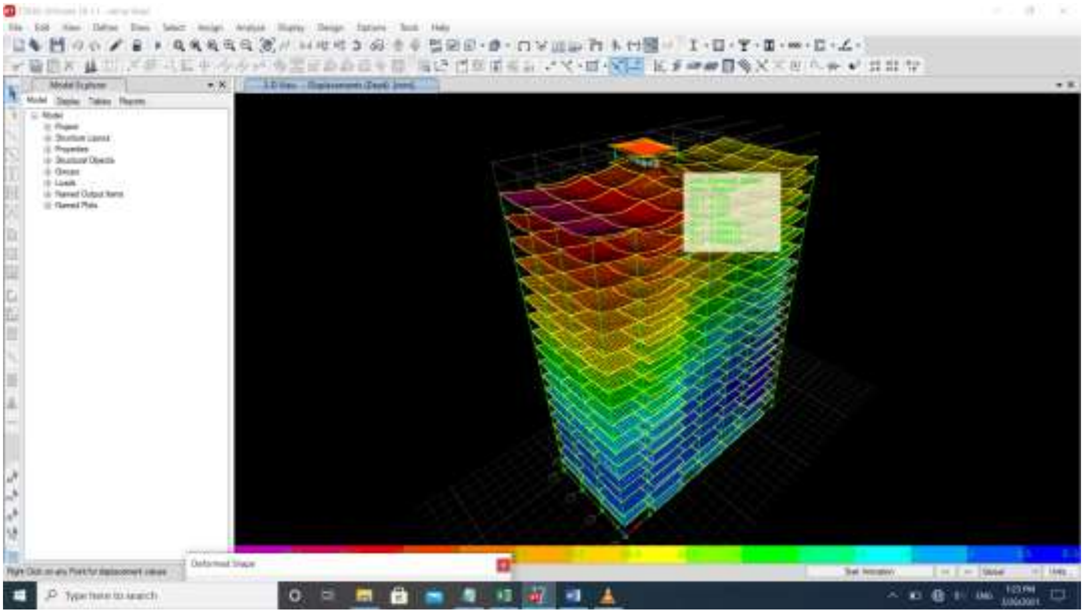


Figure A14 Horizontal deviation according Y dr

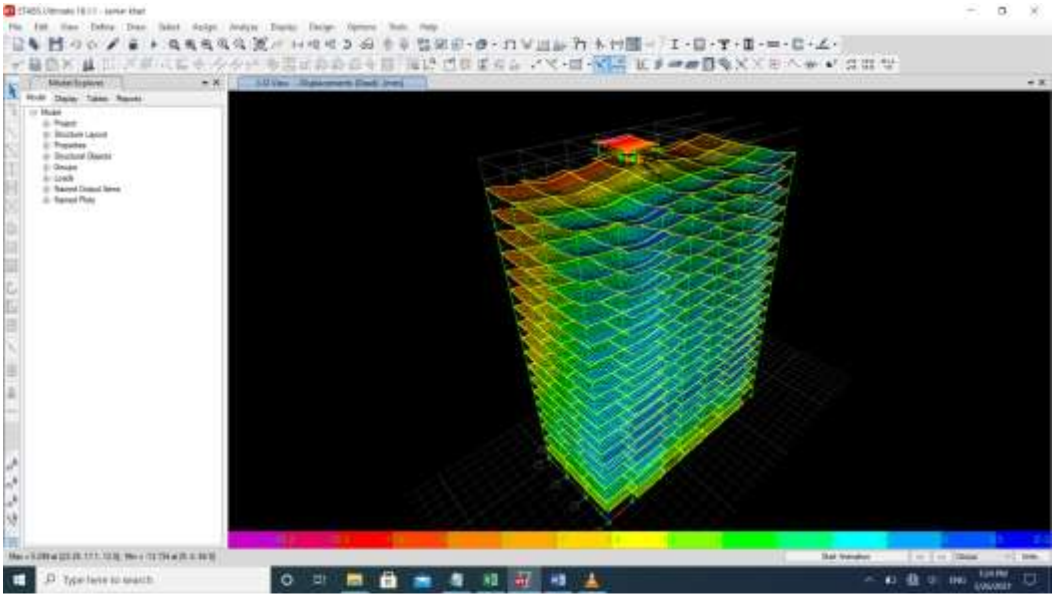


Figure A15 Horizontal deviation according X dr

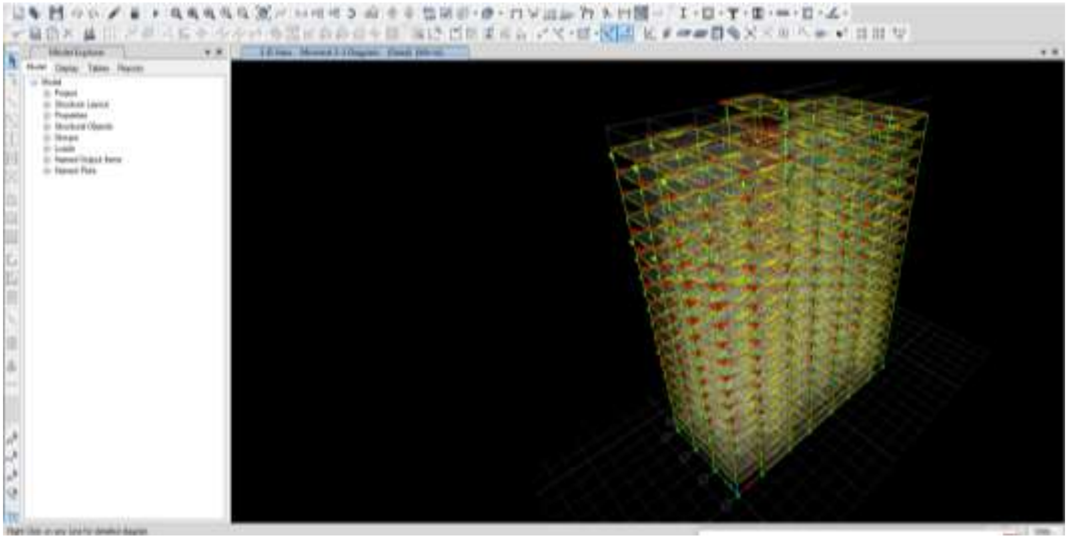


Figure A15 Bending moment according 3 axises

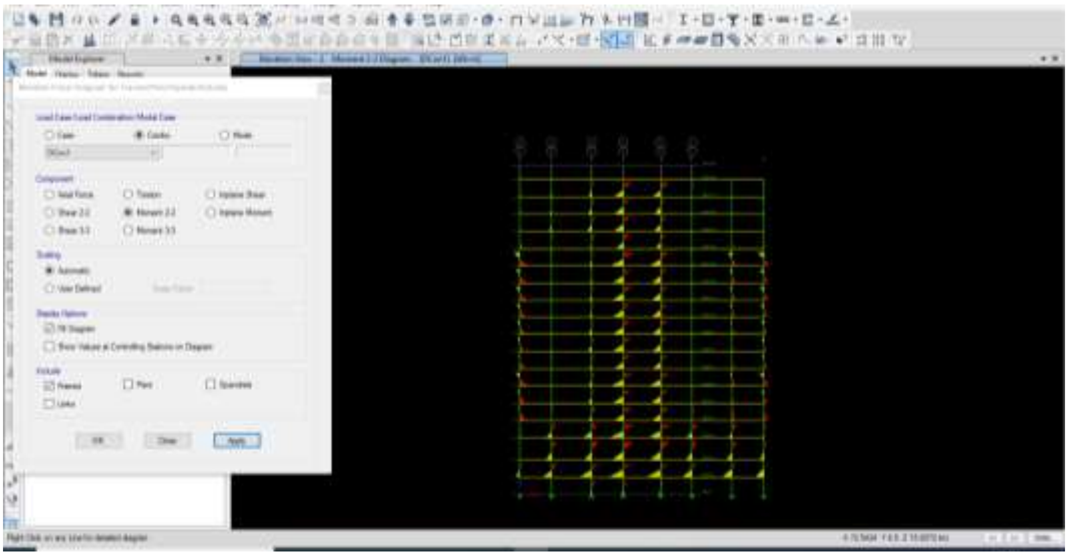


Figure A16 Bending moment according axis 2-2

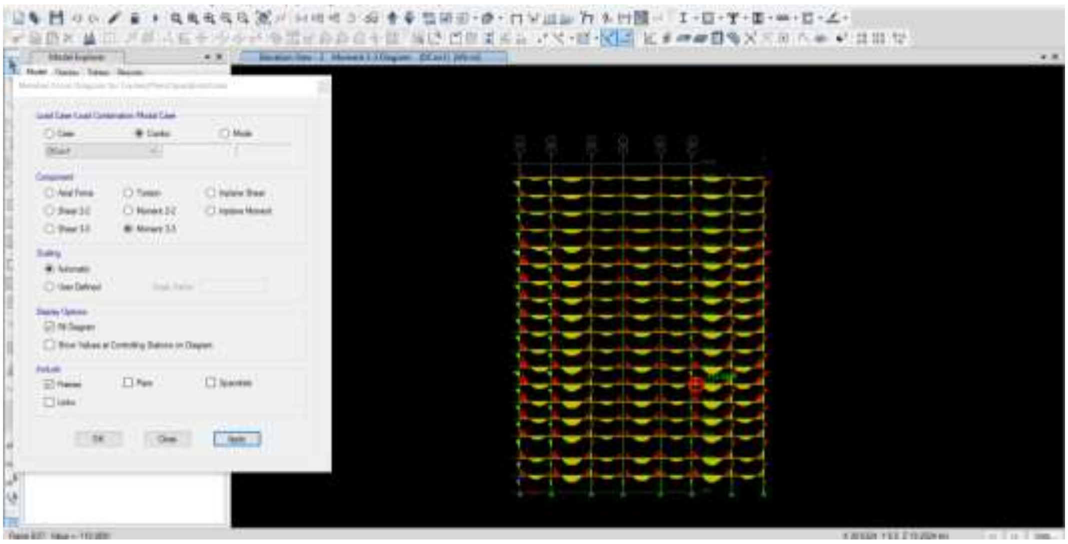


Figure A17 Bending moment according axis 3-3

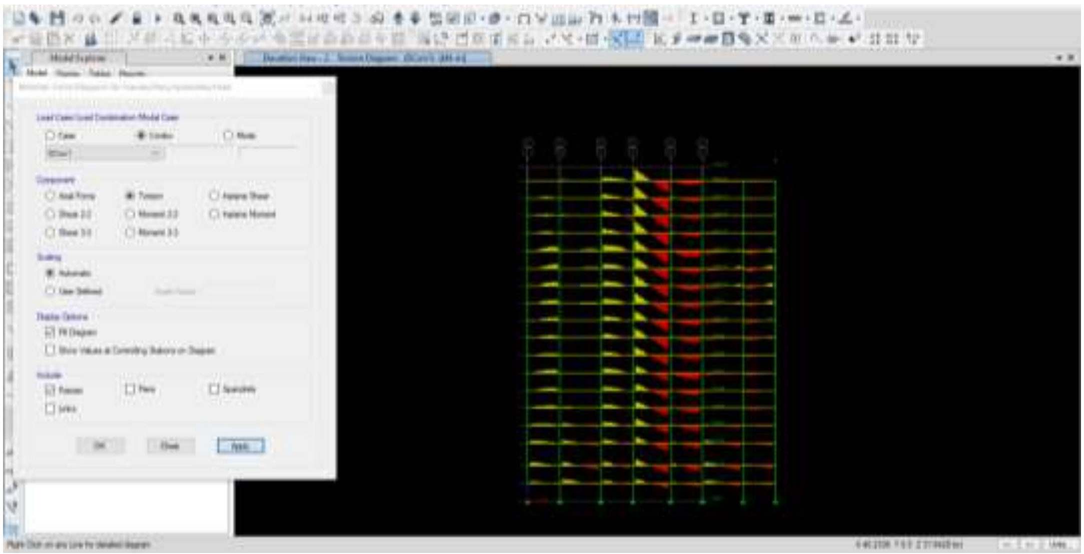


Figure A18 Torsion

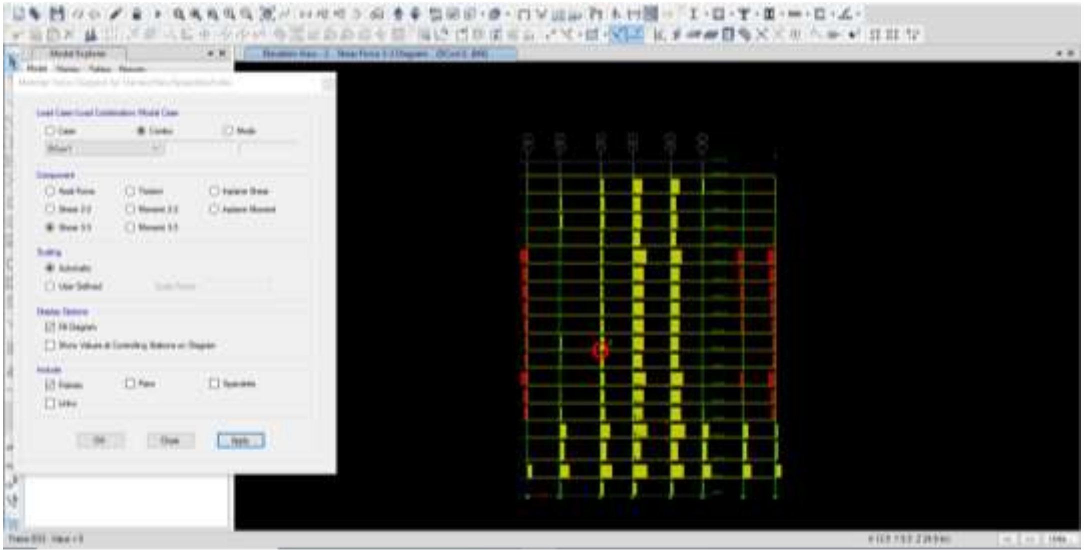


Figure A19 Shear force according 3-3

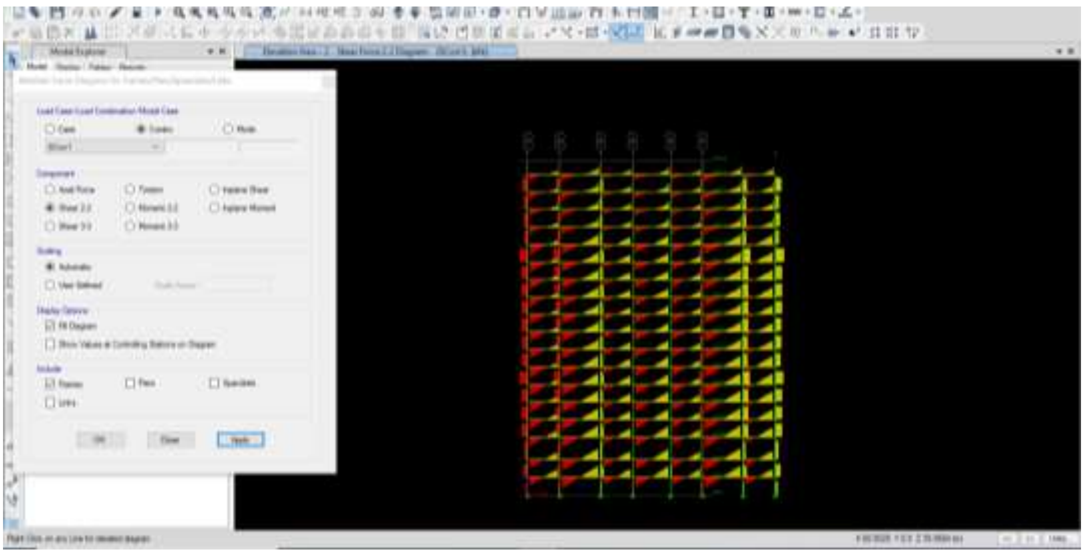


Figure A20 Shear force according 2-2

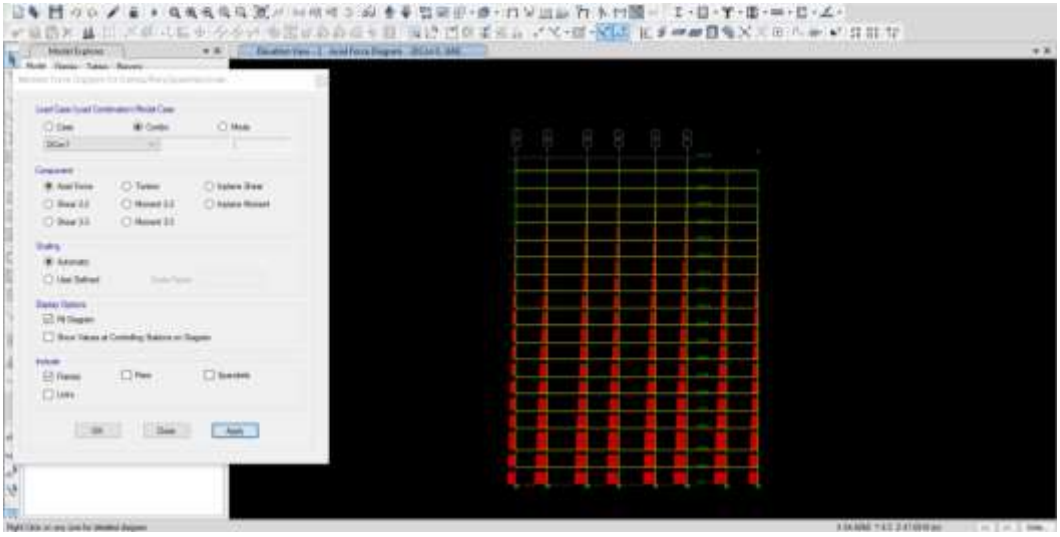


Figure A21 Axial force

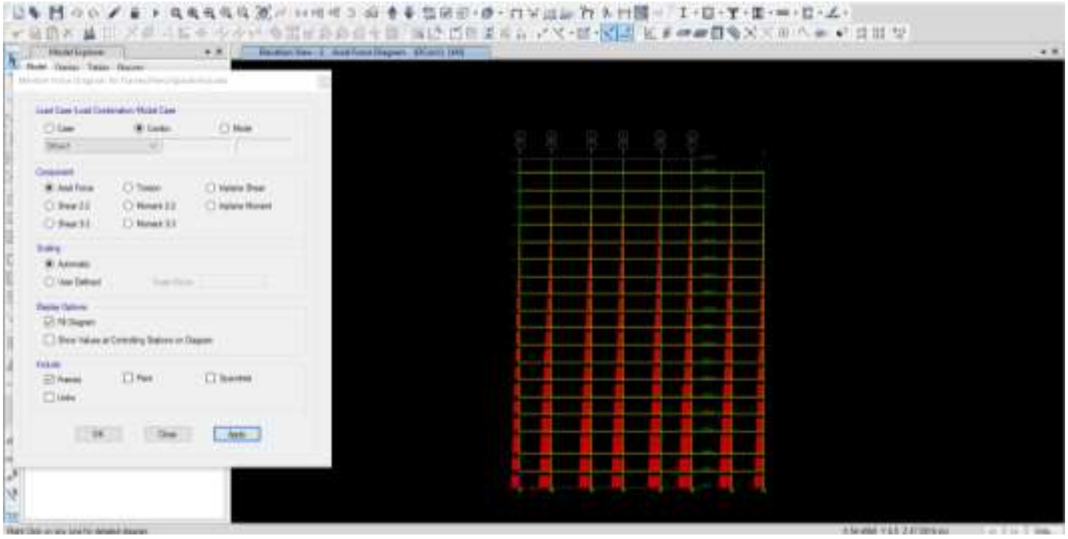


Figure A22 Inplan shear

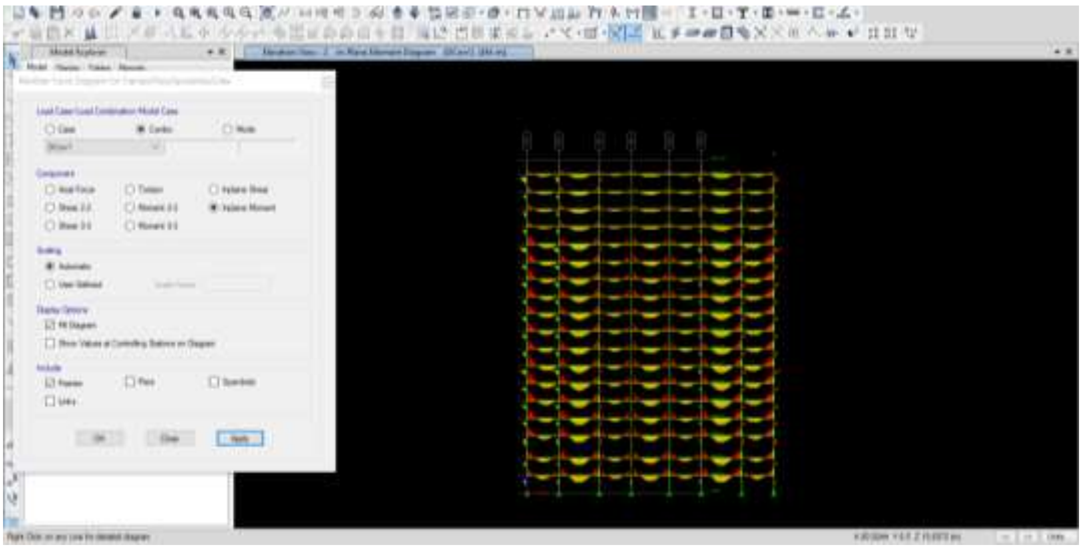


Figure A23 Inplan moment

Appendix B

Table B1 - Calculation of temporary buildings at the construction site

	unit of measurement	Standard indicator	Accepted number in the project with Ntot = 122 people.
Sanitary facilities			
Wardrobe	м2	0,9 м2 на 1 чел.	109
Heating room	м2	1 на 1 чел.	122
Bathroom	м2	0,05 м2 на 1 чел.	6
Personal hygiene room	м2	0,18 м2 на 1 чел.	21
Shower room	м2	0,43 м2 на 1 чел.	52
Restroom	м2	0,07 м2 на 1 чел.	8.5
Drying room	м2	0,2 м2 на 1чел.	24
Dining room	м2	0,6 м2 на 4 чел.	19
Medical Center	м2	20 м2 на 300 – 500 чел.	20
Control room	м2	6 м2 на 1 чел	200

Table B2 - Schedule of the need for basic machines, mechanisms

№	Name	Brand, type	Main parameter	Need, pcs.
1. Earthmoving and road machinery				
1.1	Backhoe excavator	«ЭО-4111	ёмк.1,0 $м^3$	1
1.2	Excavator "Belarus"	ЭО – 2621	ёмк. 0,25 $м^3$	2
1.3	Trailed roller with pneumatic drive	ДУ-16А	25т	2
1.4	Self-propelled vibratory roller	ДУ – 25	4 т	2
1.5	Bulldozer	ДЗ - 42	79,4 кВт	1
1.6	Motor grader	ДЗ-99	99 кВт.	1
1.7	Asphalt distributor	ДС-39Б	4000л.	1
1.8	MUSTANG 5-P4 drilling rig			1
1.9	Mud pump NB-50 or concrete pump SB-207			1
2. Construction of frames				
2.1	Automobile crane "XCMG"	QY25K	25,0 т.	1
2.2	Automobile crane "XCMG"	QY25K	25,0 т.	1

2.3	Stationary tower crane QTZ100A Lstr-50m	QTZ100A	10 т.	1
2.4	Concrete pump truck with a maximum delivery distance of up to 32m	PutzmeisterBSF	40,0 м³/час	1
2.5	Concrete mixer truck	СБ-92	V= 8м³	6
2.6	Dump truck	Камаз	15т	10
2.7	Welding transformer (welding station)	СТЭ – 34		6
2.8	Heating transformer	ТМТО – 80		8
2.9	Crane - pipelayer	ТО – 1530		1
2.10	Trailer - pipe carrier Pletevoz	ПВ – 204		2
2.11	Deep vibrator	ИВ – 47		12
2.12	Concrete mixer		250,0 л.	3
2.13	Welding units 2-post for manual welding on a tractor		79 кВт	1
2.14	Manual arc welding machine	СДУ – 250		4
2.15	Electric compressor	ЗИФ		2
2.16	Mobile power plant	ПЭС – 100	400/230 В	2

Table B3 - List of calculation of labor costs and the number of machine shifts.

Name of work	Units	Number		§§ ENiR	Norm per unit of measurement		Effort and machine changes				Name of machines	The composition of the link of workers
							to the site		to the building			
		to the site	to the building		person-hour	mash.-hour	people-days	machine-shift	people-days	machine-shift		
1 Construction and assembly work												
Underground part of the building												
Soil development 1 gr. excavator with bucket □, 5 m3 waste	1□□ м³	-	39,5	E2-1-11	-	2,8	-	-	-	13,8	Э-5□4	The machinist 6р-1

Manual soil work	1□□ м^3	-	□,9	E2-1-47	-	1,3	-	-	-	□,15		
Backfill	1□□ м^3	-	25,5	E2-1-22	-	1,1	-	-	-	3,51	ДЗ-42	The machinist 5p-1
Concrete preparation for foundation	м^3	-	13		2,9	-	-	-	4,71	-		
Foundations device	1□□ м^2	-	12,9	E4-1-2	□,4	1,2	-	-	□,65	1,94		
Ground part of the building												
Installation of bulk blocks of elevator shafts pcs.	шт.	-9	9	E4-1-15	□,35	1,4	-□,39	-1,58	□,35	1,58	МСК-1□-2□	Installers: 5 discharge-1; 4p-1; 3p-1. Machinist 6-rank-1
Installation of internal wall panels up to 1□ m2 area pcs.	шт.	2□□ 23□	43□	E4-1-8	□,4	1,6	1□ 11,5	4□ 46	21,5	86	МСК-1□-2□	Installers: 5razr-1; 4p-1; 3p-1. Machinist. 6 size-1
Installation of internal wall panels up to 15 m2 in area.	шт.	6□ 5□	11□	E4-1-8	□,5	2	3,75 3,13	15 12,5	6,88	27,5□	МСК-1□-2□	Installers: 5razr-1; 4p-1; 3p-1. Machinist. 6 size-1
Installation of reinforced concrete staircases pcs.	шт.	2 -	18	E4-1-1□	2,2	□,55	□,14 -	□,55 -	4,95	1,24	МСК-1□-2□	Installers: 4p-1; 3p-1; 2p-1. Machinist. 6 size-1
Installation of reinforced concrete ladders pcs.	шт.	2 -	18	E4-1-1□	2,2	□,55	□,14 -	□,55 -	1,24	4,95	МСК-1□-2□	Installers: 4p-1; 3p-1; 2p-1. Machinist. 6 size-1
Installation with	шт.	6□ 6□	12□	E4-1-	□,48	2,4	3,6 3,6	18 18	7,2	36	МСК-1□-	Installers: 5razr-1; 4p-1;

deadbolts up to 5t pcs.			6								2□	3p-2; 2p-1. Machinist. 6 size-1
Installation of floor slabs up to 5m2	шт.	14□ 12□	26□	E4-1-7	□,56	□,14	9,8 8,4	2,45 2,1	18,2	4,55	МСК-1□-2□	Installers: 4p-1; 3p-2; 2p-1. Machinist. 6 size-1
Installation of floor slabs up to 1□ m2	шт.	25□ 26□	51□	E4-1-7	□,18	□,72	5,63 5,85	22,5□ 23,4□	11,48	45,9□	МСК-1□-2□	Installers: 4p-1; 3p-2; 2p-1. Machinist. 6 size-1
Brick exterior wall	$м^3$	169,2	338,4	E3-3	3,7	-	78,26	-	156,5	-		Chaplains 3-size-2
Outer wall cladding of gas-silicate blocks	$м^3$	423	846	E3-3	2,6	-	137,5	-	275	-		Chaplains 3-size-2
Roofing and finishing work												
Roll blood device	1□□ $м^2$	-	5,12	E7-3	6,5	-	-	-	33,28	-	Machines CO-99	Rovers: 3 rd-1; 2p.-1
Filling door openings	1□□ $м^2$	-	5,6	E8-1-33	5,1	-	-	-	28,56	-		
Glazing of wood crossbeams	1□□ $м^2$	-	1□,24	E8-1-33	4,8	-	-	-	49,15	-		Glass-makers 3-rd-1
Linoleum flooring device	1□□ $м^2$	-	38,8	E19-16	□,31	-	-	-	12,□3	-		Obschiters with synthetic materials 4 times-1; 3p.-1
Ceramic tile flooring	1□□ $м^2$	-	2,16	E19-19	□,56	-	-	-	1,21	-		Obschiters with synthetic materials 4 times-1; 3p.-1
Improved interior wall plastering	1□□ $м^2$	-	21,6	E8-1-2	9,6	-	-	-	2□7,4	-		Plasters: 4-size-2; 3p.-2; 2p.-1
Blinding work	1□□ $м^2$	-	15,3	E8-1-35	1,6	-	-	-	24,48	-		Tile makers 4-size-1; 3p.-1
Painting works	1□□ $м^3$	-	13	E8-1-15	□,19	-	-	-	2,47	-		Malyar 3 times-1

Improved exterior wall plastering	1□□ $м^2$	-	22,2	E8-1-2	9,6	-	-	-	213,1	-		Plasters: 4-size-2; 3p.-2; 2p.-1
Total:									1□8□,3	227,1		
2 Special work												
Sanitary and technical work 1□%:												
aboveground part of the building 5% of construction and installation works									54	11,5		
underground part of the building 5% of construction and installation works									54	11,5		
Electrical work 4%:												
aboveground part of the building 3% of construction and installation works									43,2	6,9		
underground part of the building 1% of construction and installation works									32,4	2,3		
Low-cost jobs 2%:												
aboveground part of the building 1.5% of construction and installation works									16,2	3,45		
underground part of the building □, 5% of construction and installation works									5,4	1,15		
Territory gadget 2% of construction and installation works									21,6	4,6		
Greening 1% from construction and installation works									1□,8	2,3		
Delivery of the object □, 5% of construction and installation works									5,4	1,15		
Total:									1323,3	272,□		
3 Preparatory work												
Site planning 3% of construction and installation works									31,5			
Construction of temporary buildings 5% of construction and installation work									52,5			
Sanitary and technical work 4% of construction and installation work									42			

Appendix C

Table C.1- Local Estimation

Name of Object - Campus with a sports complex using vacuum thermal insulation in Karagandy

Name of the Building - Campus with a sports complex using vacuum thermal insulation in Karagandy

Object Number -

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

on the Campus with a sports complex using vacuum thermal insulation in Karagandy

Basics

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

Compiled in prices for 01.1. 2001 y

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

Continuation of Appendix C

Continuation of Table C.1

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

<u>SECTION 2 FOUNDATION</u>

1	**E0106-50-2**	**Installation of Formwork**	**39.039**	**799.97**	**235.22**	**31230**	**9183**	**6069**	**0.56**	**22**
		м2		**74.25**	**73.80**	**2899**	**2881**	**105**	**0.15**	**6**

Continuation of Table C.1

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

SECTION 3. COLUMN

Continuation of Appendix C

Continuation of Table C.1

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

Continuation of Appendix C

Continuation of Table C.1

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

Continuation of Appendix C

Continuation of Table C.1

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

Continuation of Appendix C

Continuation of Table C.1

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

Continuation of Appendix C

Continuation of Table C.1

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

Made up ______________________ Rahimi Ahmad Samar

Appendix D

Table D.1 - Estimate of Cost of Calculation

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

ESTIMATE CALCULATION OF THE COST OF CONSTRUCTION

Compiled in prices for 01.1. 2001 y

No. of estimates and calculations	Name of works and costs	Estimated cost, Thous.Tenge			Total,Thous. Tenge
		construction and installation works	equipment, furniture and inventory	other costs	
2	3	4	5	6	7
1	Campus with a sports complex	126166.6	--	--	126166.6
	Total=1 row	126166.6	--	--	**126166.6**
	Temporary buildings and structures 1,1 percentage multiple to 2 row 7column	1387.8326	--	--	1387.8326
	Return of materials from temporary buildings and structures 15 percentage multiple to 3r7c	208.17489	--	--	208.17489
	Total=3 row	1387.8326	--	**--**	**1387.8326**
	Total 2r+5r	127554.4326	--	**--**	**127554.4326**
	Additional costs in the production of work in the winter1,2%*6r7c	1530.653191	--	**--**	1530.653191
	Seniority costs 1%*6r7c			1275.544326	1275.544326
	Additional vacation costs 0,4%*6r7c			510.2177304	510.2177304
	Total 7r+8r+9r	**1530.653191**		**1785.762056**	**3316.415248**
	Total 6r+10r	129085.0858		1785.762056	130870.8478
	Including refundable amounts=4r	208.17489		--	208.17489
	Total according to the estimated calculation in the base prices of 2001..=11r	129085.0858		1785.762056	130870.8478
	Total estimated at current prices in 2021. 13r*3,42	441470.9934		6107.306233	447578.2996
	Including refundable amounts in current prices 12r7c*3,42	711.9581238			711.9581238
	Taxes, fees, mandatory payments,2%*14r7c			8951.565993	8951.565993
	Estimated cost at current price level 14r+16r	441470.9934		15058.87223	456529.8656
	НДС (12%)*17r7c			54783.58388	54783.58388
	Construction cost17r+18r	441470.9934		69842.4561	511313.4495

Appendix E

Table E.1 – Object Estimation

OBJECT ESTIMATE

Campus with a sports complex using vacuum thermal insulation in Karagandy

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

Compiled in prices for 01.1. 2001 y

№ п/п	No. of estimates and calculations	Name of works and costs	Estimated Cost, Thous. Tenge				Normative Labor Intensity	Estimated Wages
			construction and installation works	equipment, furniture and inventory	other costs	Total		
1	2	3	4	5	6	7	8	9
1	1	Campus with a sports complex	126166.6	--	--	126166.6	38.082	2736.023
2		Total	126166.6	--	--	126166.6	38.082	2736.023
3		Temporary buildings and structures	1387.8326	--	--	1387.8326	38.082	2736.023
4		Return of materials from temporary buildings and structures	208.17489	--	--	208.17489	38.082	2736.023
5		Total	1387.8326	--	--	1387.8326	38.082	2736.023
6		Total	127554.4326	--	--	127554.4326	38.082	2736.023
7		Additional costs in the production of work in the winter	1530.653191	--	--	1530.653191	38.082	2736.023
8		Seniority costs			1275.544326	1275.544326	38.082	2736.023
9		Additional vacation costs			510.2177304	510.2177304	38.082	2736.023
10		Total	1530.653191		1785.762056	3316.415248	38.082	2736.023
11		Total	129085.0858		1785.762056	130870.8478	38.082	2736.023
12		Including refundable amounts	208.17489		--	208.17489	38.082	2736.023
13		Total according to the estimated calculation in the base prices of 2001.	129085.0858		1785.762056	130870.8478	38.082	2736.023
14		Total estimated at current prices in 2021.	441470.9934		6107.306233	447578.2996	38.082	2736.023
15		Including refundable amounts in current prices	711.9581238			711.9581238	38.082	2736.023
16		Taxes, fees, mandatory payments,			8951.565993	8951.565993	38.082	2736.023
17		Estimated cost at current price level	441470.9934		15058.87223	456529.8656	38.082	2736.023
18		НДС (12%)			54783.58388	54783.58388	38.082	2736.023
19		Construction cost	441470.9934		69842.4561	511313.4495	38.082	2736.023

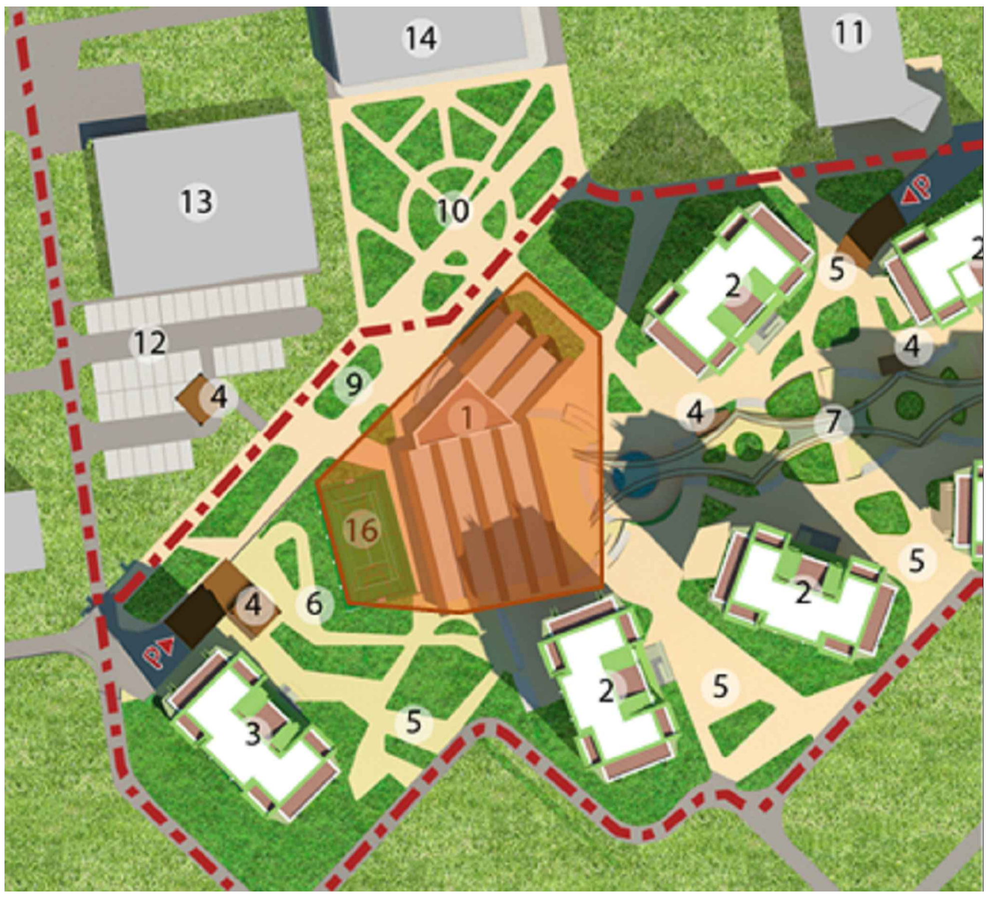
ВЫПОЛНЕНО В СТУДЕНЧЕСКОЙ ВЕРСИИ ПРОГРАММЫ AUTODESK

ВЫПОЛНЕНО В СТУДЕНЧЕСКОЙ ВЕРСИИ ПРОГРАММЫ AUTODESK

Front veiw

Side view

General plan



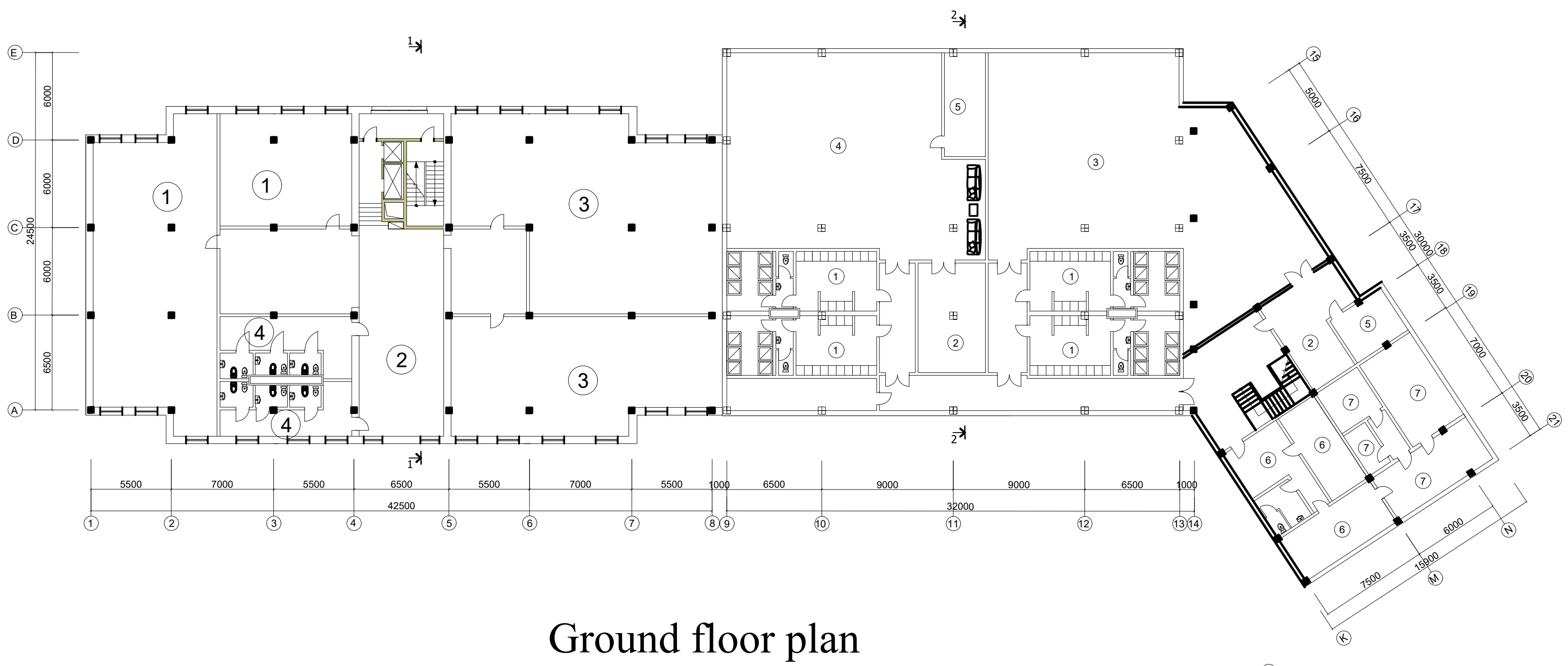
						KazNITU-5B072900-Civil Engeneering-03.08.02-2021-DP		
						Campus with a sports complex using vacuum thermal insulation in Karagandy		
Chan.	Num.par.	List	№doc	Sign	Date			
Head of Depart		Kozyukova N.V				Architectural and analytical part	stage	list	lists
Supervisor		Kozyukova N.V					DP	1	9
Consultant		Kozyukova N.V							
Controller		Bek A.A.				General plan, Views	Civil engineering and building materials department		
Created		Rahimi A.S.							

Farmat A3

ВЫПОЛНЕНО В СТУДЕНЧЕСКОЙ ВЕРСИИ ПРОГРАММЫ AUTODESK

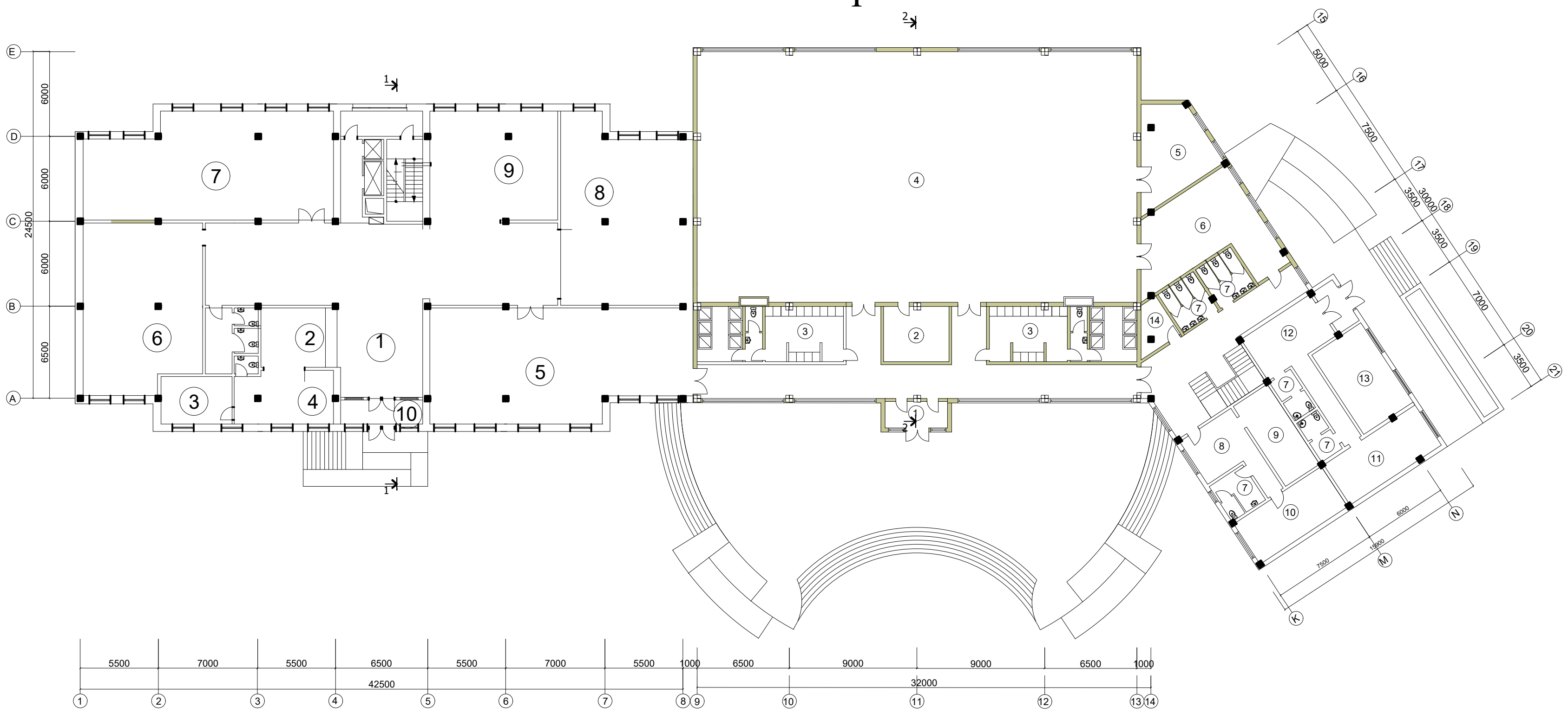
Basement floor plan

Explication
1- Prayer
2- Lobby
3- Sports facilities and leisure
4- Sanitary unit



EXPLICATION
1 - Locker room
2 - Inventory
3 - Gym
4 - Sports hall
5 - Utility room
6 - Room of those. staff
7 - Technical rooms

Ground floor plan



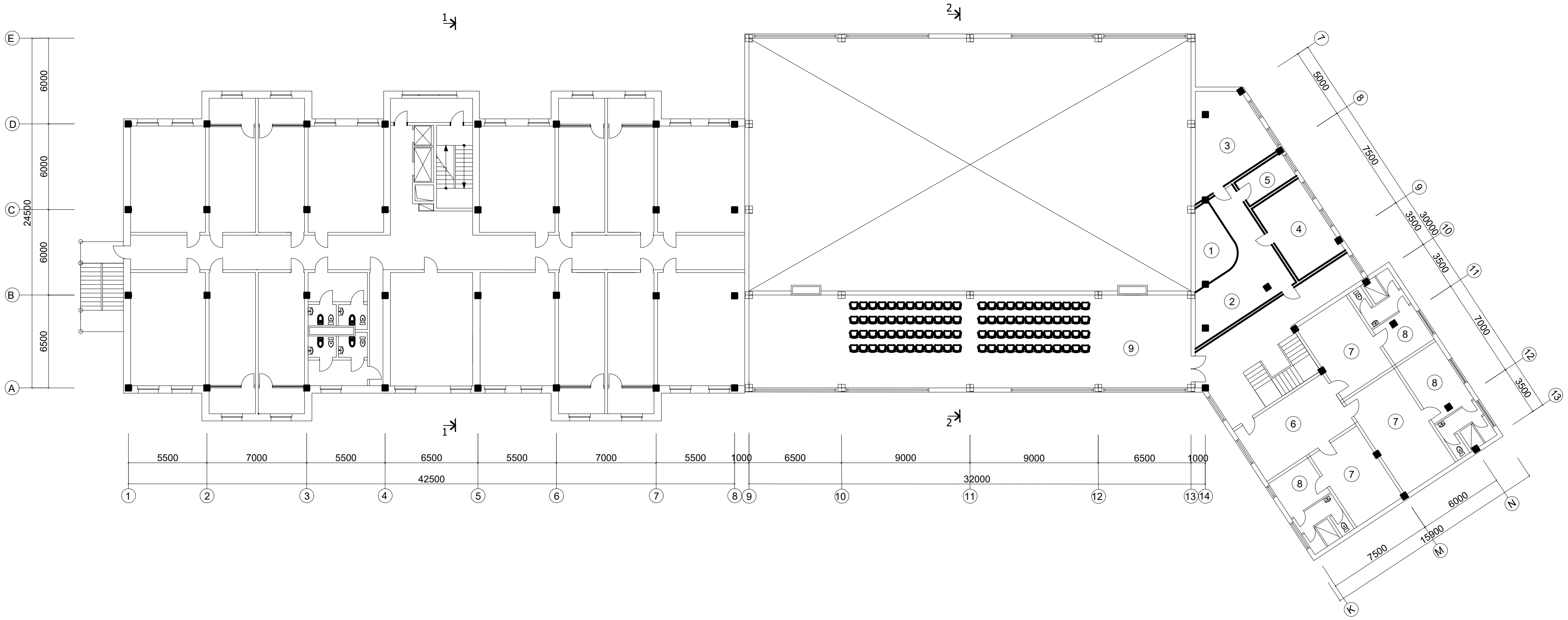
EXPLICATION
1 - Tambour
2 - Inventory
3 - Locker room
4 - Universal hall
5 - Warehouse for storage of collapsible chairs
6 - Utility room
7 - Sanitary unit
8 - Reception of the first-aid post
9 - Procedural
10 - Insulator
11 - Campus Directorate
12 - Waiting room
13 - Office

Explication
1- Lobby
2- Warden
3- Storage
4- Watchman's room
5- Classroom
6- The manager's room
7- Assembly hall
8- Clubroom
9- Drawing room
10- Tambour

Chan.	Num.par.	List	№doc	Sign	Date	KazNITU-5B072900-Civil Engeneering-03.08.02-2021-DP		
						Campus with a sports complex using vacuum thermal insulation in Karagandy		
Head of Depart	Kozyukova N.V					Architectural and analytical part	stage: DP	list: 2 / lists: 9
Supervisor	Kozyukova N.V							
Consultant	Kozyukova N.V							
Controller	Bek A.A.					Section 1-1, 2-2	Civil engineering and building materials department	
Created	Rahimi A.S.							

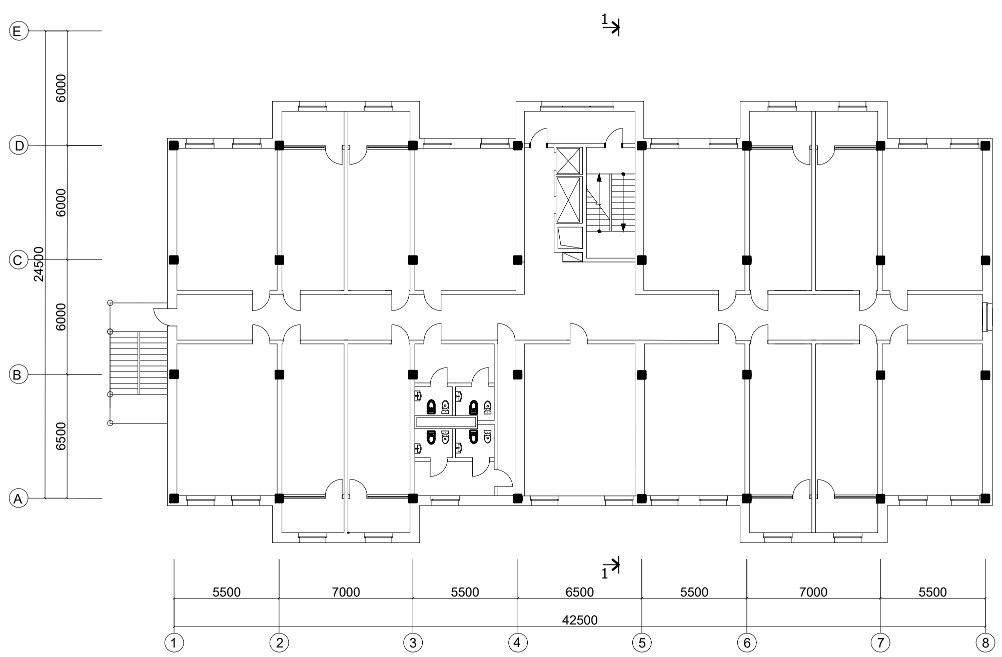
Farmat A3

Second floor plan



EXPLICATION
1 - Secretary
2 - Waiting room
3 - Directorate of the sports complex
4 - Department
5 - Sanitary unit
6 - waiting room
7 - Coaching
8 - Locker room
9 - Tribune

Typical floor plan



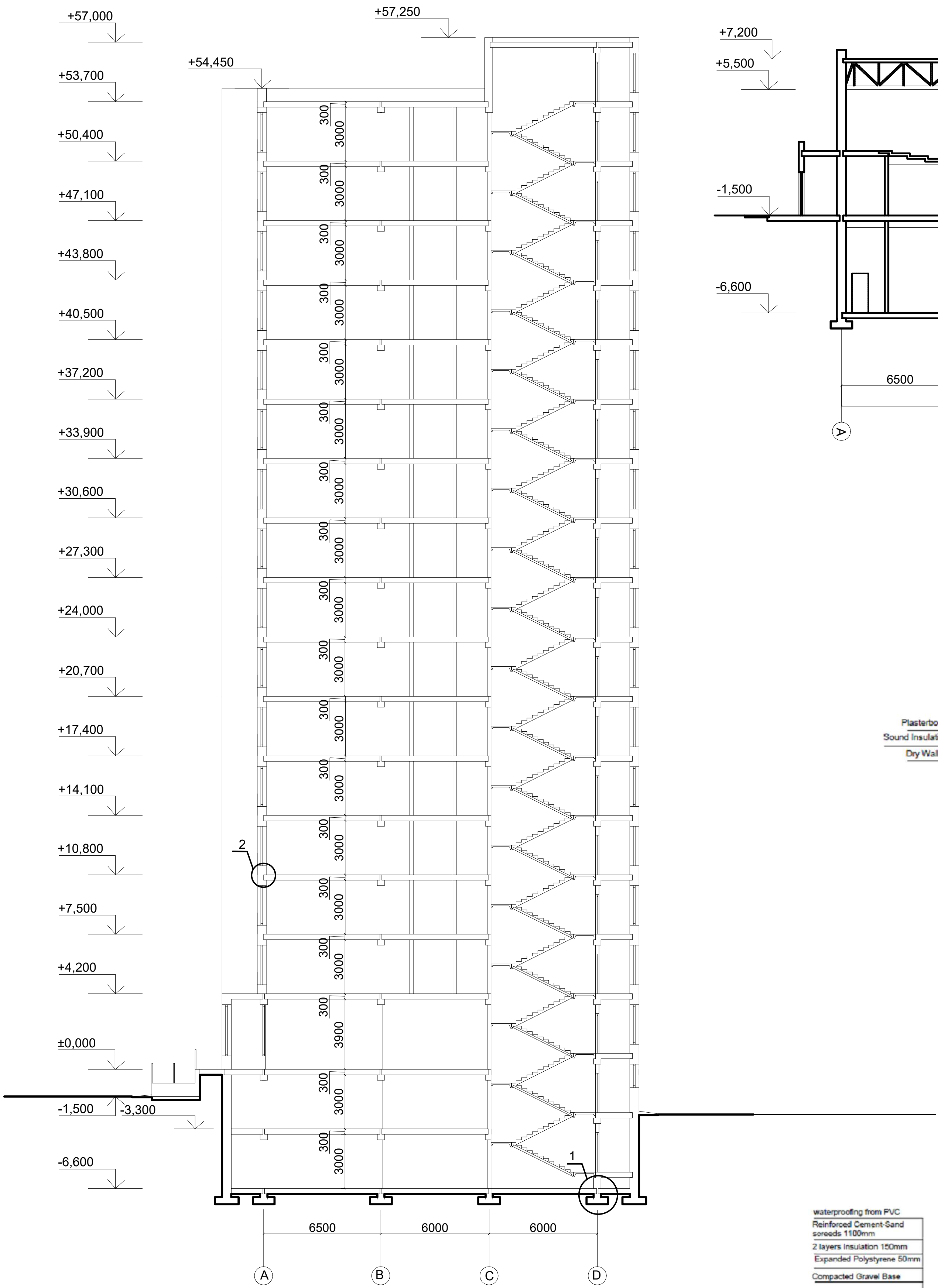
Chan.	Num.par.	List	№doc	Sign	Date	KazNITU-5B072900-Civil Engeneering-03.08.02-2021-DP		
						Campus with a sports complex using vacuum thermal insulation in Karagandy		
Head of Depart.		Kozyukova N.V.				Architectural and analytical part	stage	list	lists
Supervisor		Kozyukova N.V.					DP	3	9
Consultant		Kozyukova N.V.							
Controller		Bek A.A.				Section 1-1, 2-2	Civil engineering and building materials department		
Created		Rahimi A.S.							

Farmat A3

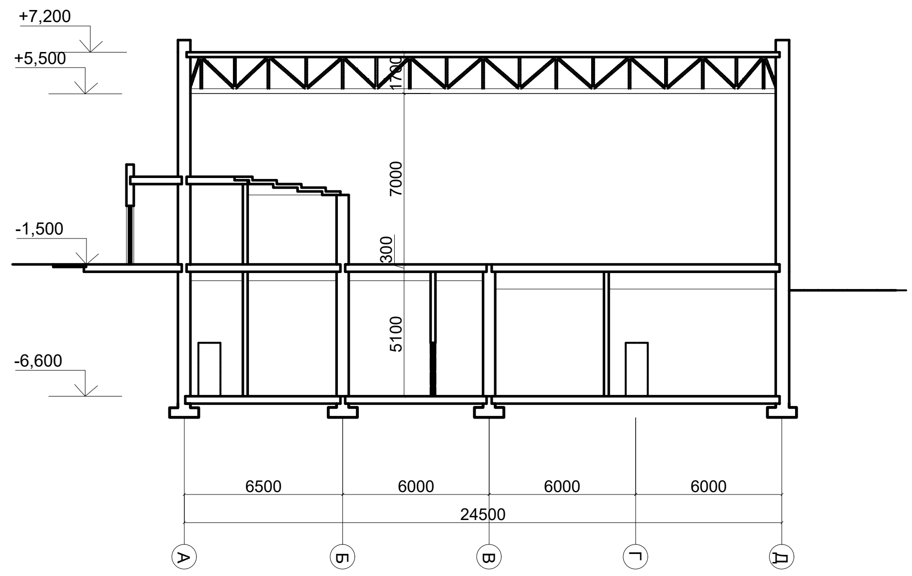
ВЫПОЛНЕНО В СТУДЕНЧЕСКОЙ ВЕРСИИ ПРОГРАММЫ AUTODESK
ВЫПОЛНЕНО В СТУДЕНЧЕСКОЙ ВЕРСИИ ПРОГРАММЫ AUTODESK
ВЫПОЛНЕНО В СТУДЕНЧЕСКОЙ ВЕРСИИ ПРОГРАММЫ AUTODESK

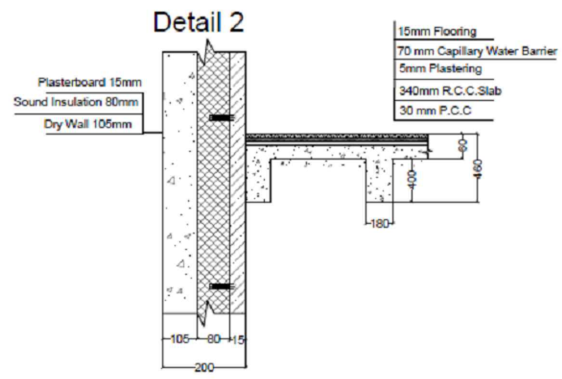
ВЫПОЛНЕНО В СТУДЕНЧЕСКОЙ ВЕРСИИ ПРОГРАММЫ AUTODESK

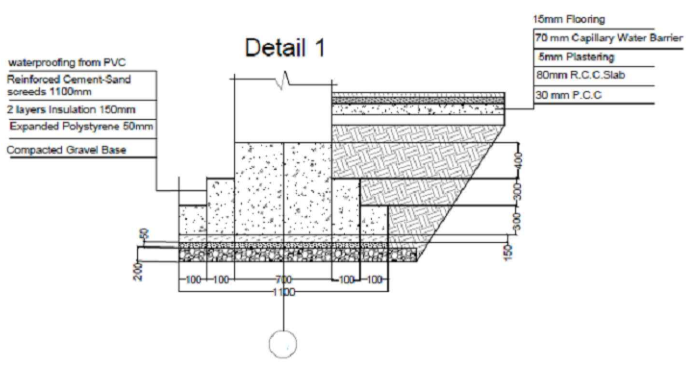
Section 1-1



Section 2-2







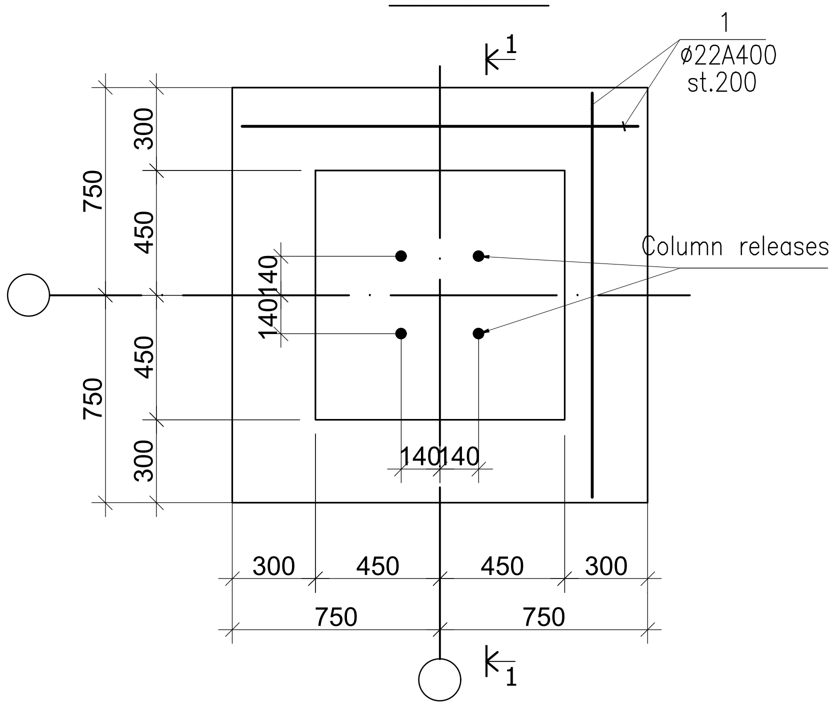
						KazNITU-5B072900-Civil Engeneering-03.08.02-2021-DP		
						Campus with a sports complex using vacuum thermal insulation in Karagandy		
Chan.	Num.par.	List	№doc	Sign	Date			
Head of Depart.	Kozyukova N.V					Architectural and analytical part	stage	list	lists
Supervisor	Kozyukova N.V						DP	4	9
Consultant	Kozyukova N.V								
Controller	Bek A.A.					Section 1-1, 2-2	Civil engineering and building materials department		
Created	Rahimi A.S.								

Farmat A3

ВЫПОЛНЕНО В СТУДЕНЧЕСКОЙ ВЕРСИИ ПРОГРАММЫ AUTODESK

ВЫПОЛНЕНО В СТУДЕНЧЕСКОЙ ВЕРСИИ ПРОГРАММЫ AUTODESK

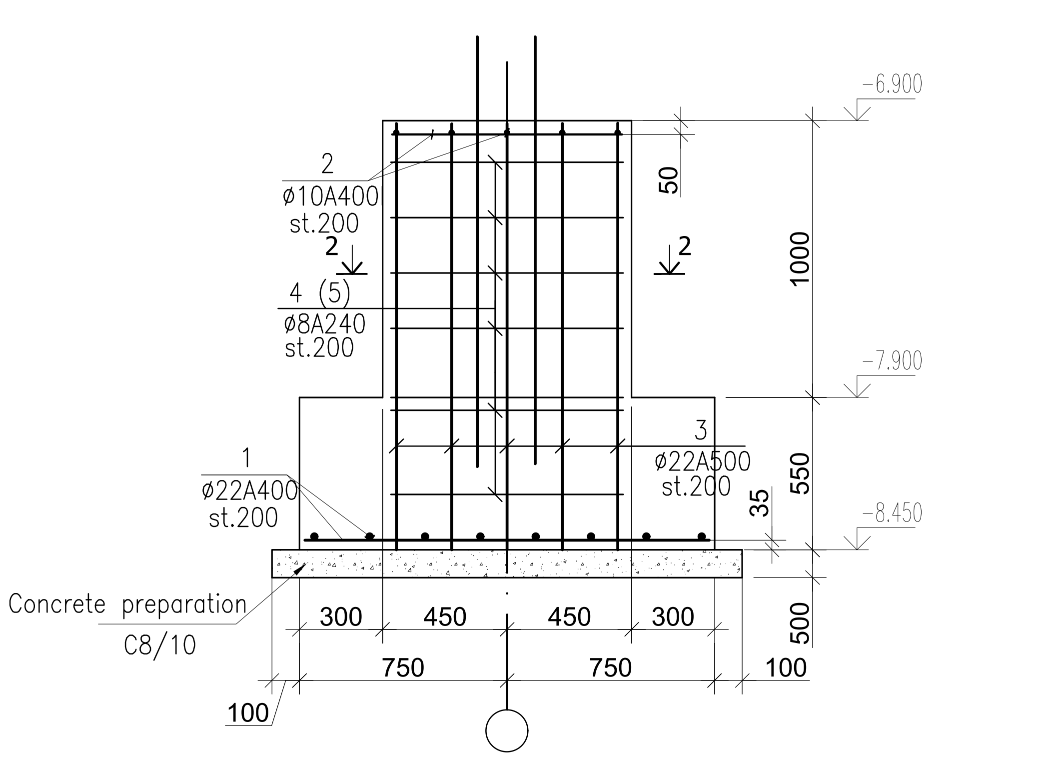
Foundation

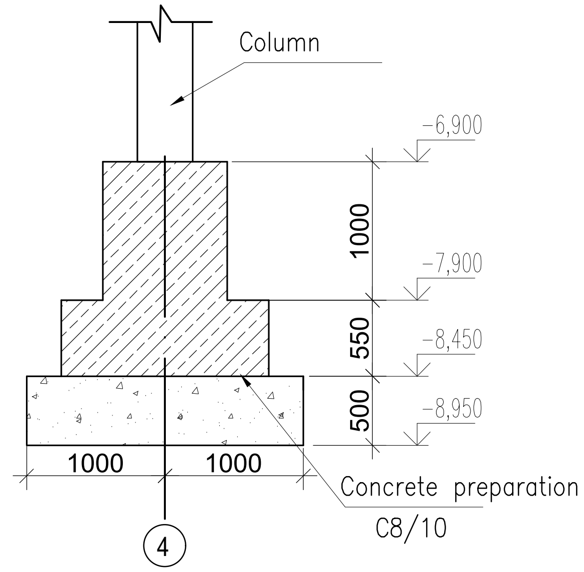


Specification of material consumption for a monolithic foundation

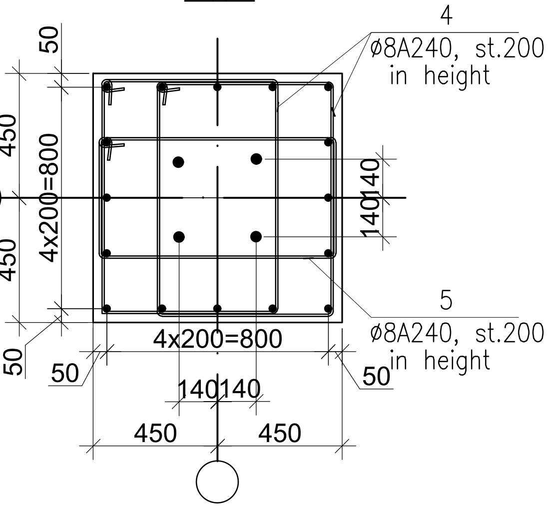
Brand, No.	Designation	Name	amount	Weight units, kg	Total
1	ГОСТ 5781-82*	ø 22 A400 L = 1430	16	1.269	20.30
2	ГОСТ 5781-82*	ø 10 A400 L = 830	10	0.512	5.12
3	ГОСТ 5781-82*	ø 22 A400 L = 1520	16	1.836	29.38
4*	ГОСТ 5781-82*	ø 8 A240 L = 3120	14	1.232	17.25
5*	ГОСТ 5781-82*	ø 8 A240 L = 2520	7	0.995	6.97
	Materials (edit)	Concrete C16/20, m3	1.87		
	Concrete preparation	Concrete C8/10, m3	0.30		

1 - 1

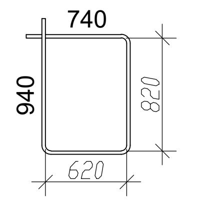
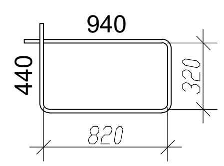




2 - 2



Details

No.	Sketch
4*	
5*	

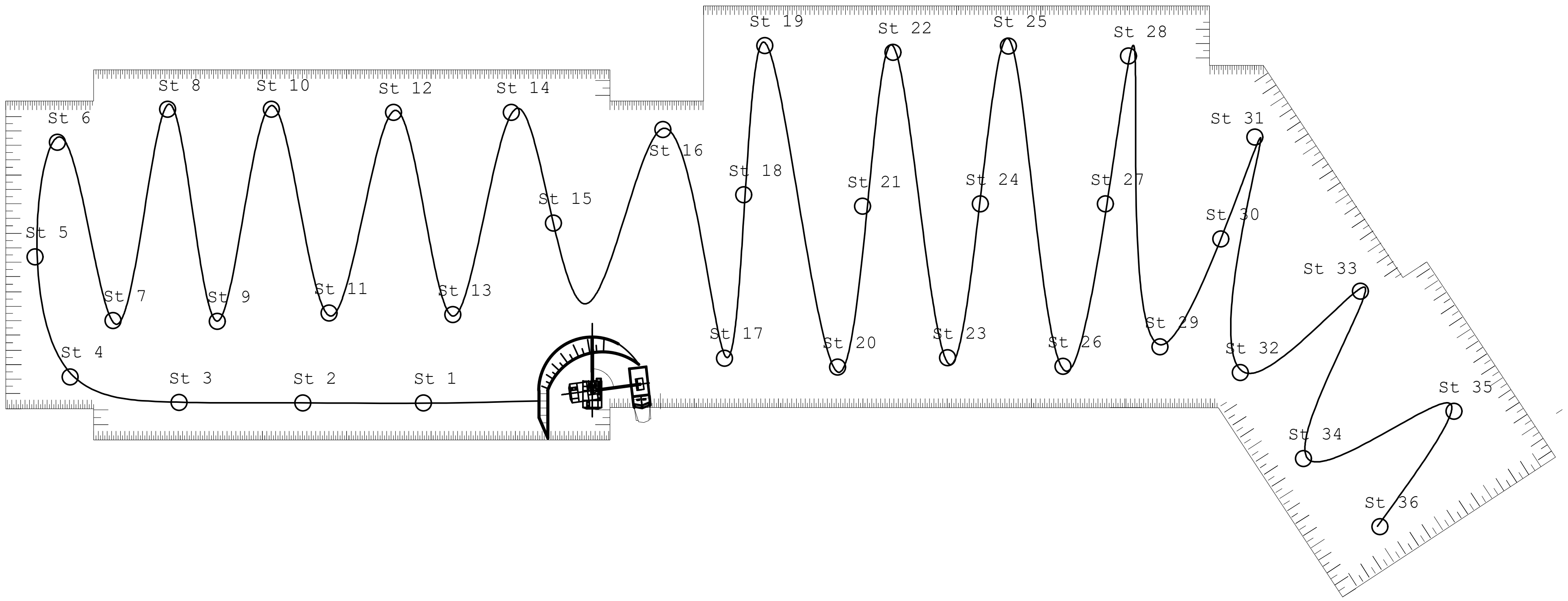
Chan.	Num.par.	List	№doc	Sign	Date	KazNITU-5B072900-Civil Engeneering-03.08.02-2021-DP			
						Campus with a sports complex using vacuum thermal insulation in Karagandy			
Head of Depart.	Kozyukova N.V					Calculation and design part	stage	list	lists
Supervisor	Kozyukova N.V						DP	5	9
Consultant	Kozyukova N.V								
Controller	Bek A.A.					Foundation design	Civil engineering and building materials department		
Created	Rahimi A.S.								

Farmat A3

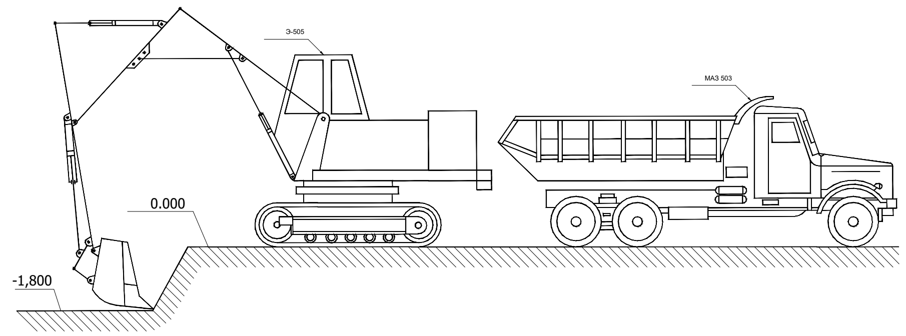
ВЫПОЛНЕНО В СТУДЕНЧЕСКОЙ ВЕРСИИ ПРОГРАММЫ AUTODESK

ВЫПОЛНЕНО В СТУДЕНЧЕСКОЙ ВЕРСИИ ПРОГРАММЫ AUTODESK

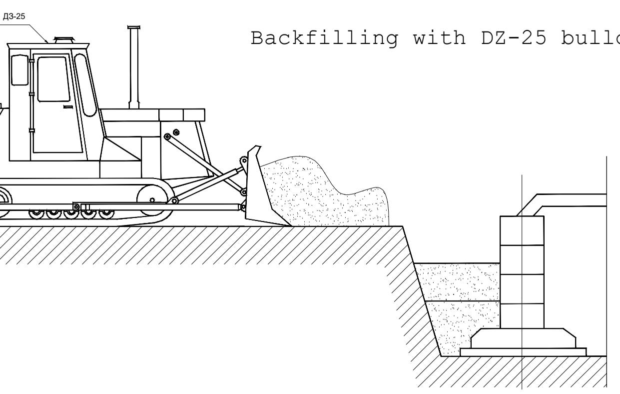
Scheme excavator working area



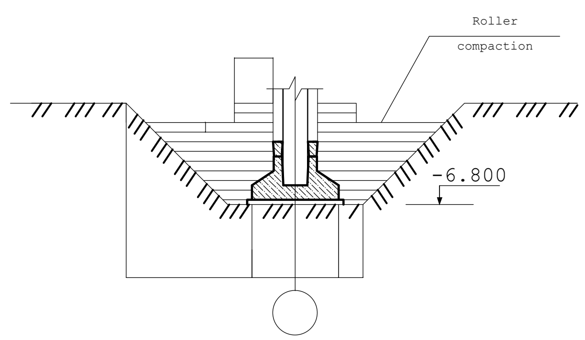
Trench excavation with an excavator in MAZ 503



Backfilling with DZ-25 bulldozer



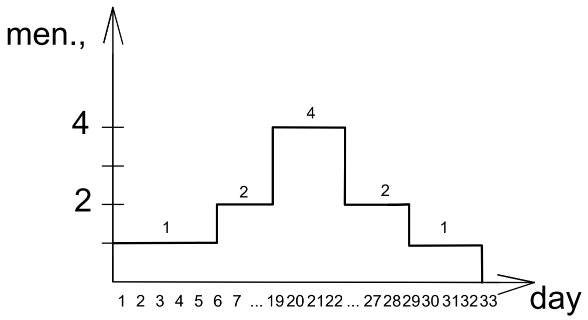
Soil compaction scheme



Work schedule

№ п/п	Name of works	Scope of work		Total costs		Required machines		Continue work in days	number shifts	Number workers per shift	Mount, days June-July (1 2 3 4 5 6 7 ... 19 20 21 22 ... 27 28 29 30 31 32 33)
		units	quant.	men/day	mash/days	name	quant.				
1	Cutting off the vegetation layer	1000 м3	2,813		0,895	дз-25	1	0,8	1	1	1
2	Dump trench development	100 м3	30,51		9.92	Э-505	1	5	2	1	1
	Development of a trench for transport	100 м3	2,75		1.135	Э-505 МАЗ-503	2	0,5	2	1	1
3	Development of shortage of soil	1 м3	203,28	48,2				12	2	2	2
4	Isksus device. crushed stone bases	1 м3	26,208	2.95				0,5	1	4	4
5	Installation of foundations	р.	49	7.96	1.96		1	2,5	2	2	2
	Installation of foundation beams	р.	77	10.68	2.12		1	6,5	1	2	2
6	Waterproofing device	100 м3	5,29	2.69				1,5	1	2	2
7	backfilling	100 м3	30,51		3.01	дз-25	1	3	1	1	1
8	Soil compaction	100 м3	0,152		0.0017	д-480	1	0,5	1	1	1
9	Final layout of the territory	1000 м3	28,136		0.39	дз-25	1	0,5	1	1	1

Labor movement schedule



Ncp=Q/T=455.6/33=13,8

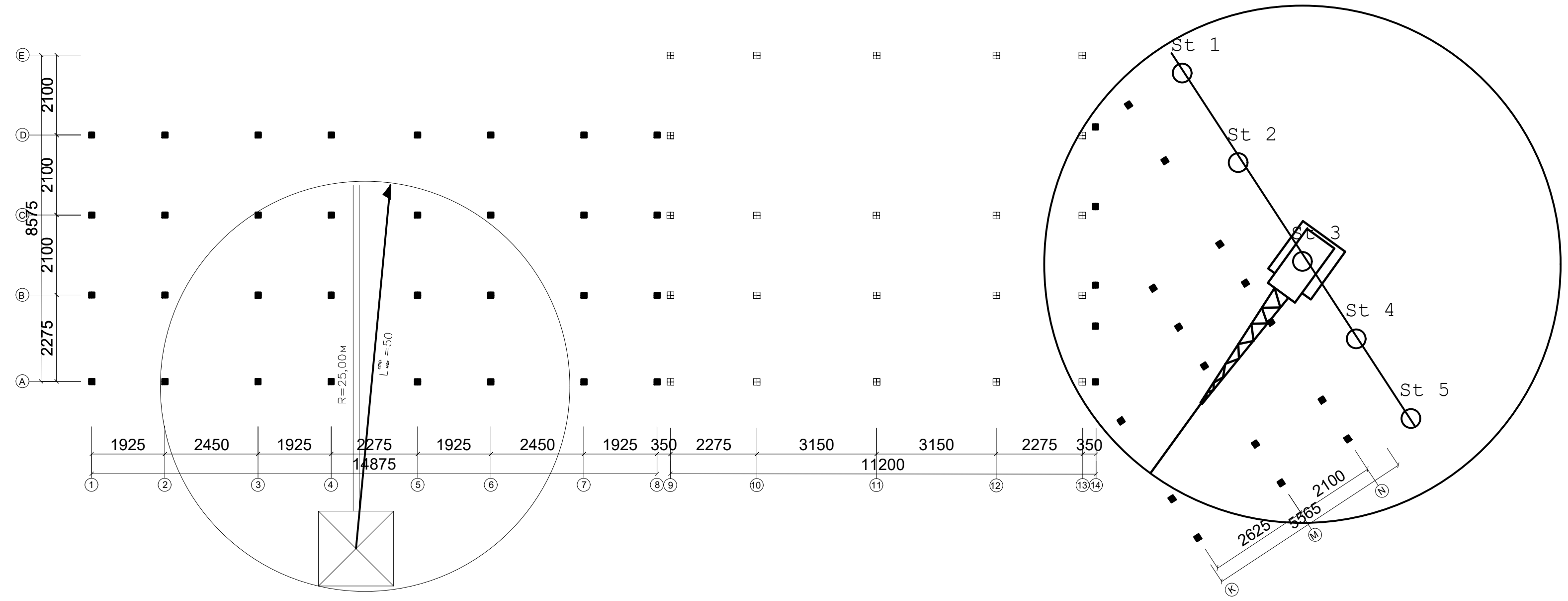
Kн=Nma/Ncp=4/13,8=0,3

Kн=0,3< 1,5

Chan.	Num.par.	List	№doc	Sign	Date	KazNITU-5B072900-Civil Engeneering-03.08.02-2021-DP		
						Campus with a sports complex using vacuum thermal insulation in Karagandy		
Head of Depart.		Kozyukova N.V				Organizational and technological part	stage: DP	list: 6 / lists: 9
Supervisor		Kozyukova N.V						
Consultant		Kozyukova N.V						
Controller		Bek A.A.				Earthworks technological map	Civil engineering and building materials department	
Created		Rahimi A.S.						

Farmat A3

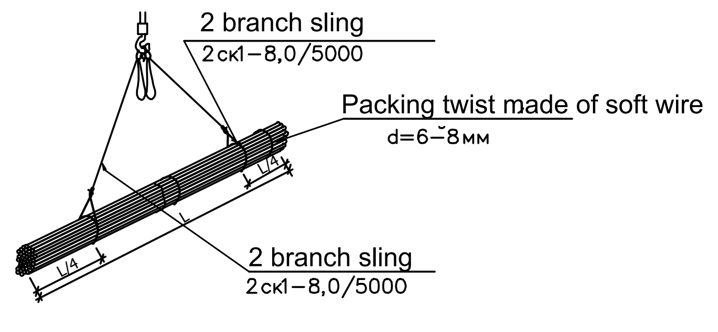
Work flow diagram for reinforcing monolithic columns К–1



Statement of the need for mounting devices, equipment, tools

№	Name, main parameters	amount	Brand and parameters	Sketch or link to GOST
1	Rotary bunker	3	БП–0,5	ГОСТ 21807–76
2	2-branch sling	2	2ск1–8,0/5000	ГОСТ 25573–82
3	Universal lanyard	2	УСК 1–3,2/6000	РД 10–33–93
4	Vibrator for compacting concrete mix	2	ИВ–66 Дн–38	Каталог ЦНИИОМТП
5	Concrete smoothing machine	1	СО–135	Каталог ЦНИИОМТП
6	Receiving tray	1	V<2,0 м куб	ГОСТ 21807–76
7	Lighthouse rail	2	-	Каталог ЦНИИОМТП
8	Rail with level	1	-	Каталог ЦНИИОМТП
9	The rule is universal	2	-	ГОСТ 10403–80
10	Construction steel trowel	2	-	ГОСТ 3620–76
11	Construction steel shovel	2	-	инв.
12	Mechanical brush	2	-	инв.
13	Measuring tape	2	-	Каталог ЦНИИОМТП

Reinforcement package slinging diagram



Reinforcement slinging scheme
column frames

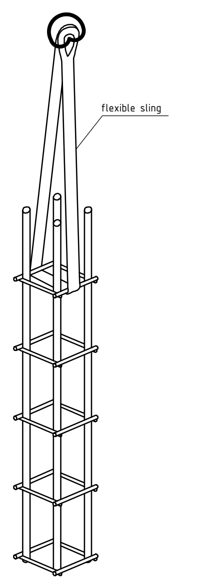


Схема подачи опалубки колонн краном

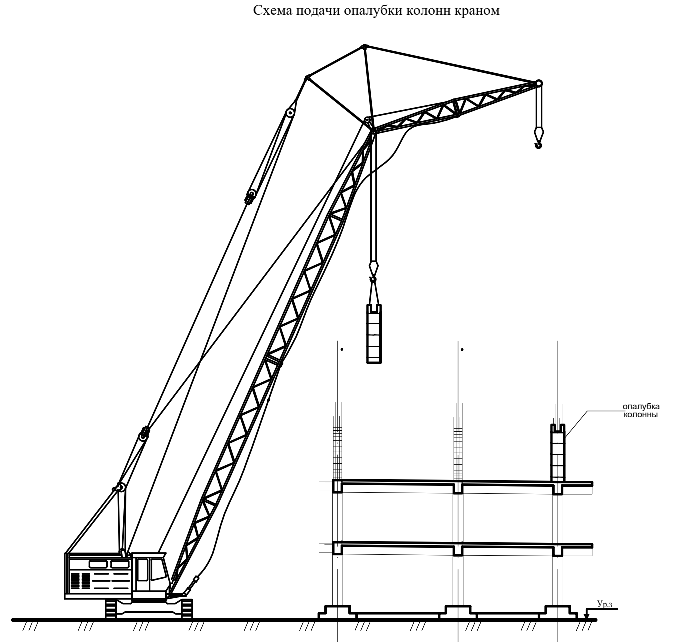
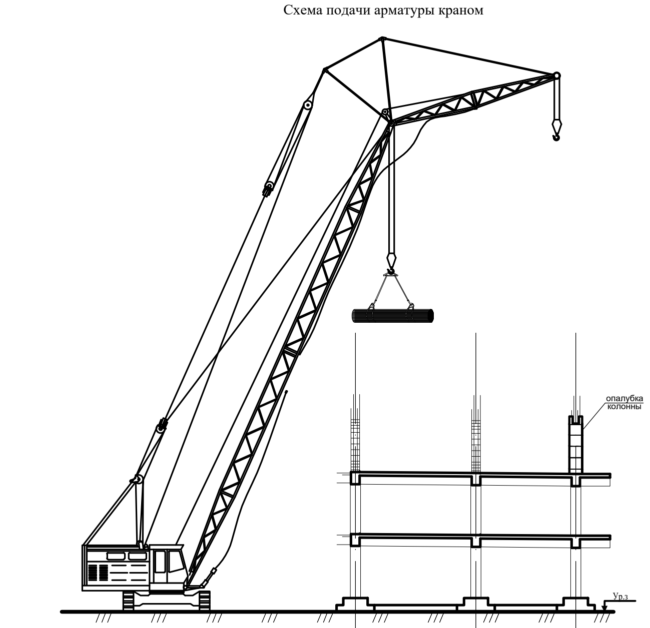
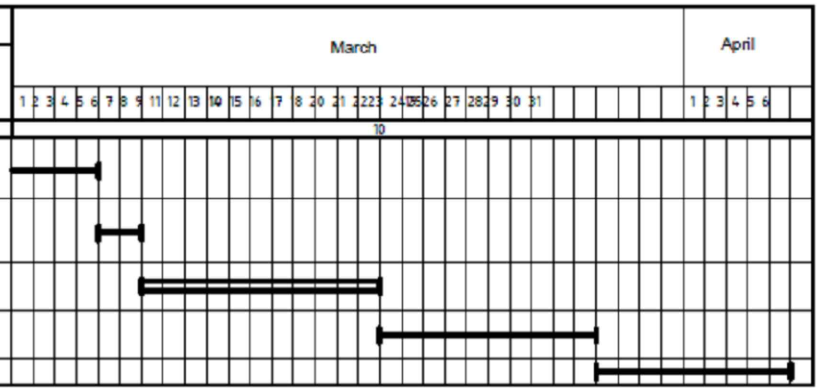


Схема подачи арматуры краном

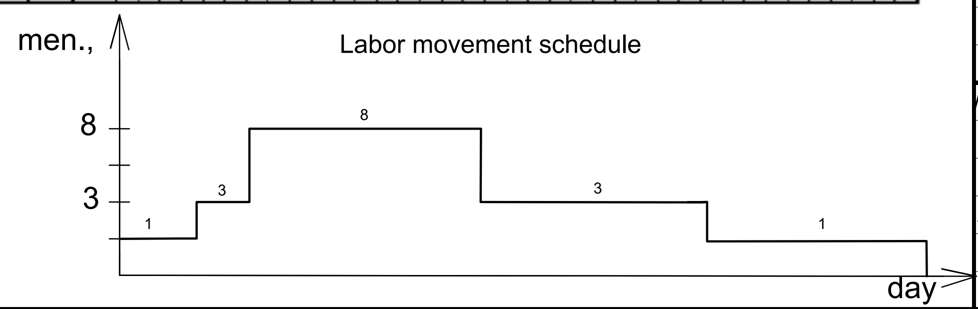


Work schedule

№ п/п	Process name	Ед. изм.	Scope of work	Labor costs: рабочих, чел.-см	Labor costs: маш.-час, маш.-см	The accepted composition of the link	Продолж. работ: Кол-во рабочих	Продолж. работ: Дни	March / April
1	2	3	4	5	6	7	8	9	10
1	Installation of column reinforcement cages	1 шт.	36 13,43	3,23		Комплексная бригада Арматурщики 4р – 2 3р – 2 Бетонщики (они же плотники 3р) 4р - 3 3р - 3 Машинист 5р – 1	4 3		
2	Installation of steel embedded parts of columns	1 шт.	232 8,41		–		2 4		
3	Column formwork device	1 м²	101,8 44,94		–		2	11	
4	Column concreting	1 м³	10,2 19,3	1,76			2 10		
5	Disassembly of the column formwork	1 м²	101,8 18,43		–		2	9	



Labor movement schedule



Chan.	Num.par.	List	№doc	Sign	Date
Head of Depart.		Kozyukova N.V.			
Supervisor		Kozyukova N.V.			
Consultant		Kozyukova N.V.			
Controller		Bek A.A.			
Created		Rahimi A.S.			

KazNITU-5B072900-Civil Engeneering-03.08.02-2021-DP

Campus with a sports complex using vacuum thermal insulation in Karagandy

Organizational and technological part

stage	list	lists
DP	7	9

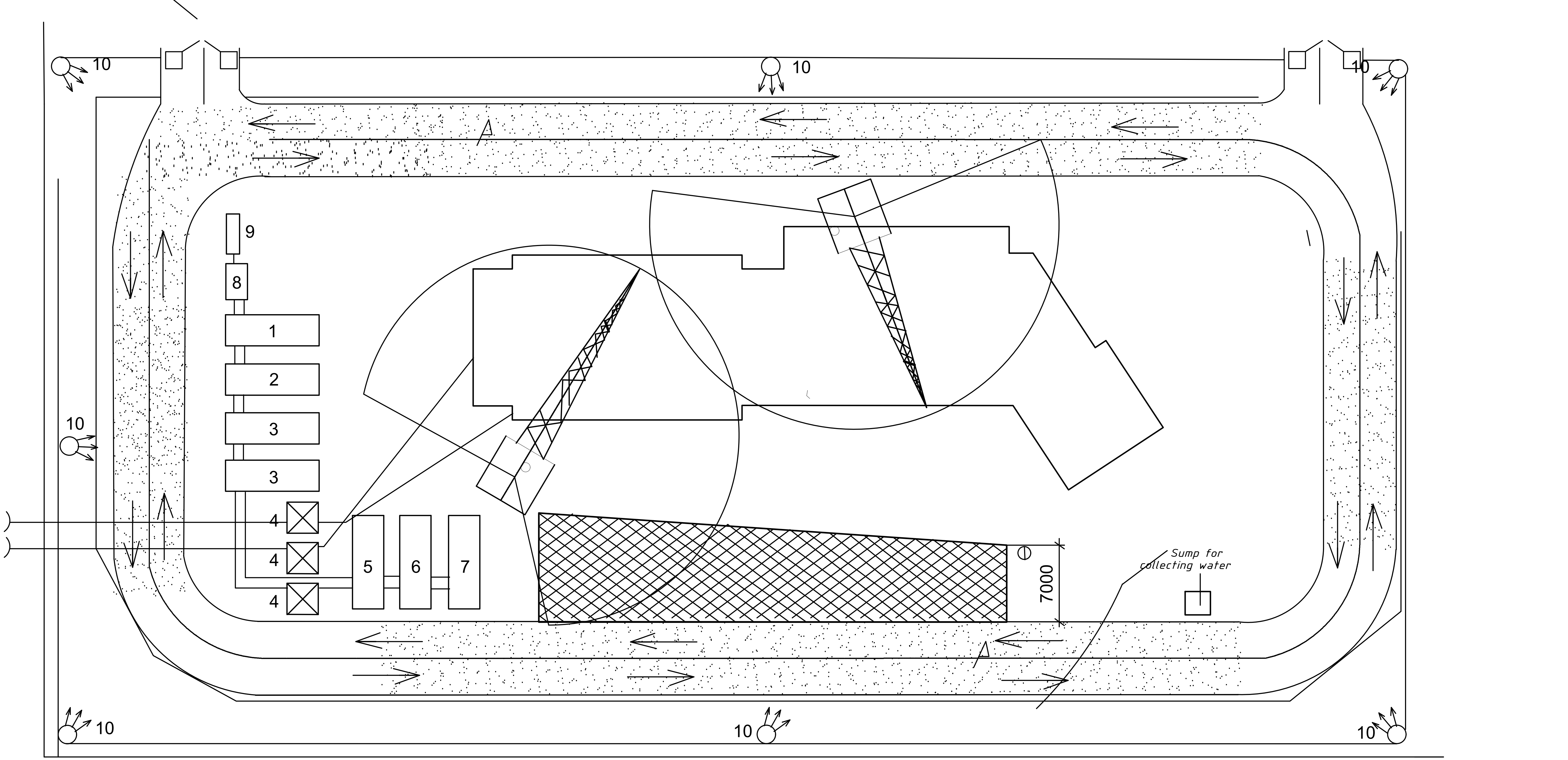
Technological scheme for reinforcement work

Civil engineering and building materials department

Farmat A3

ВЫПОЛНЕНО В СТУДЕНЧЕСКОЙ ВЕРСИИ ПРОГРАММЫ AUTODESK
ВЫПОЛНЕНО В СТУДЕНЧЕСКОЙ ВЕРСИИ ПРОГРАММЫ AUTODESK
ВЫПОЛНЕНО В СТУДЕНЧЕСКОЙ ВЕРСИИ ПРОГРАММЫ AUTODESK

GENERAL MASTER PLAN
M 1 : 200



SYMBOLS

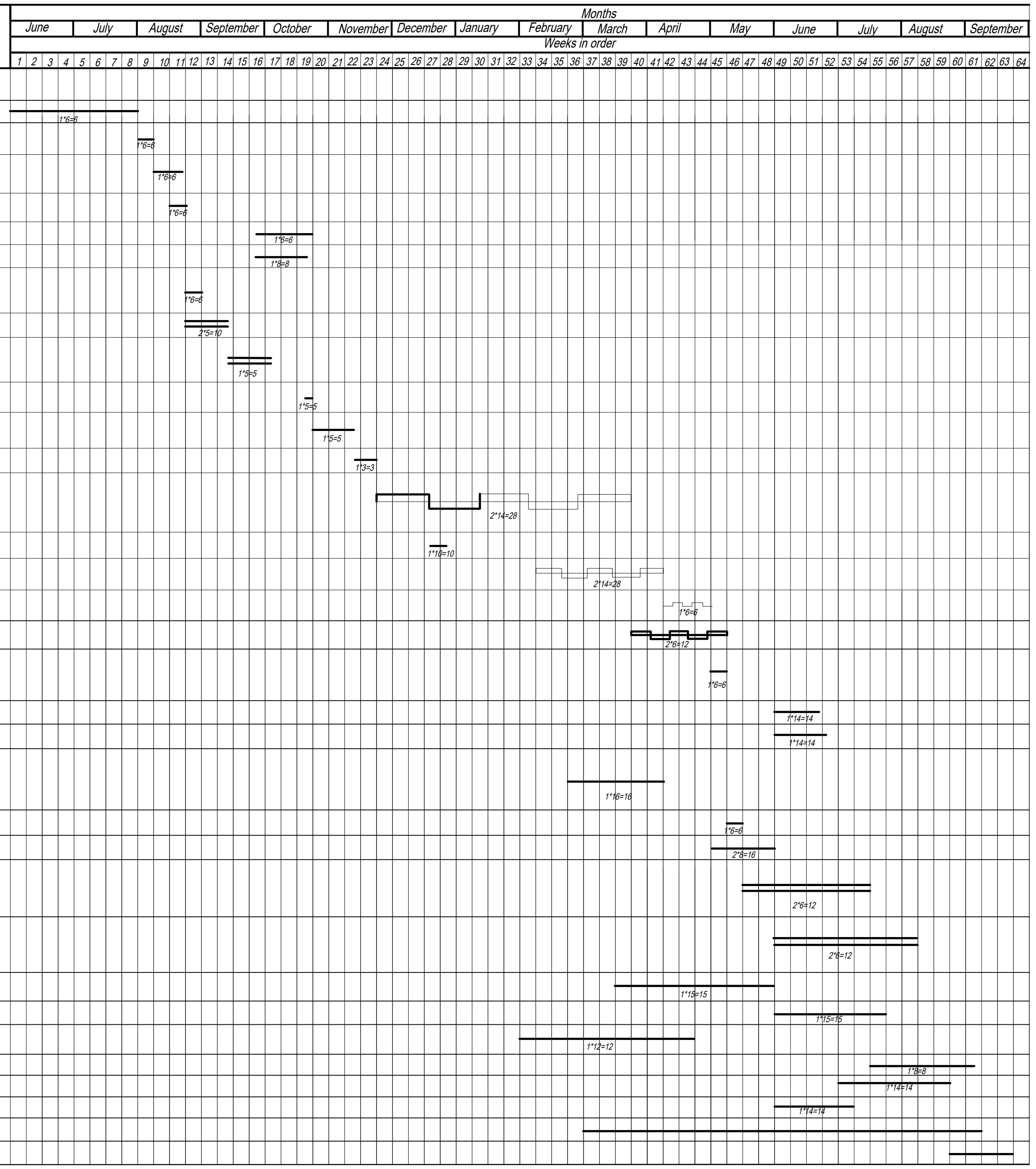
SKETCH	NAME	Number	NAME
	Projected building	1	Food reception room and rest
	Building in perspective	2	Toilet and shower room
	Warehouse area	3	Office and control room
	Construction site fencing	4	Sump for collecting water
	Fencing the construction site with a protective canopy	5	Areas for unloading vehicles
Cm1, Cm2	The extreme working stands of the crane	6	Area for receiving mortar and concrete
	Sump for collecting water	7	Inventory household premises for workers
Roз	Crane danger area radius	8	Temporary transformer substation
	Crane danger area border	9	Site for garbage containers
	Crane action limitation line	10	Lighting
	Limitation of the zone of movement of cargo by crane		
	construction waste container		
	Direction of traffic		
Rp	Crane working radius		

Chan.	Num.par.	List	№doc	Sign	Date	KazNITU-5B072900-Civil Engeneering-03.08.02-2021-DP
						Campus with a sports complex using vacuum thermal insulation in Karagandy
Head of Depart		Kozyukova N.V				Organizational and technological part
Supervisor		Kozyukova N.V				stage: DP; list: 8; lists: 9
Consultant		Kozyukova N.V				
Controller		Bek A.A.				GENERAL MASTER PLAN
Created		Rahimi A.S.				Civil engineering and building materials department

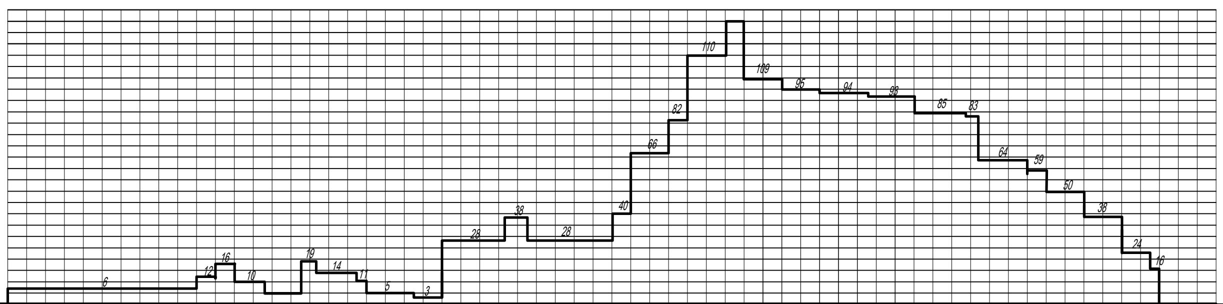
Calendar sachedule

N п/п	Наименоваание работ	Scope of work: Unit rev.	Scope of work: number	Labor-intensive, man days	consumable machines: name and types	consumable machines: number of machine shifts	number of shifts	number of workers per shift	duration of work in days
1	Total construction period including:								305
	Works of the preparatory period								60
2	**Excavation.** Vertical layout	1000 $м^2$	1,862		ЭО-3322	0,088	1	6	6
3	Soil development Manual soil finishing	1000 $м^3$ 100 $м^3$	7,45 7,45	29,58 230,95	ЭО-3322	51,96	1	6	9
4	Transportation of soil by dump trucks over a distance of 15 km	100 т	134,10		КрАЗ 256Б1		1	6	6
5	backfilling	1000 $м^3$	6,153	106,7	ДЗ - 17	5,676	1	6	17
6	Soil compaction with a vibratory rammer	100 $м^3$	68,36	127,83	ИЭ 4502	31,01	1	8	16
7	**Zero cycle works.** Laying blocks and strip foundations	100 шт	2,94	32,59	КБ - 403	12,43	1	6	5
8	Installation of basement wall blocks	100 шт	14,2	131,61	КБ - 403	53,58	2	5	13
9	Wall waterproofing: - horizontal - lateral	 100 $м^2$ 100 $м^2$	 1,3 3	 6,2 33,3	СО- 122А	 0,065 0,15	1	5	14
10	Installation of underlying concrete floors	$м^3$	11,33	5,183	СБ - 124		1	5	1
11	Floor slabs	100 шт	7,3	188,94	КБ - 403	24,55	1	5	13
12	Blind area device	100 $м^2$	3,57	18,45		1,44	1	3	6
13	**Works above zero.** Aerated concrete masonry: - external walls - internal walls	 $м^3$ $м^3$	 2300 945	 1627,25 615,43		 115,0 47,25	2	14	80
14	Laying jumpers	100 шт	26	57,23		29,51	1	10	6
15	Brickwork partitions	100 $м^2$	61,75	1188,9		22,34	2	14	42
16	Installation of plasterboard partitions	100 $м^2$	8,35	100,7			1	6	16
17	Laying floor slabs	100 $шт^2$	7,3	188,94	КБ - 403	24,55	2	6	30
18	Installation of flights of stairs Installation of staircases Arrangement of a metal fence	100 м 100 $м^2$ 100 м	1,68 1,8 1,8	12,09 9,34 10,27	КБ - 403	3,07 2,37 0,58	1	6	5
19	Linoleum flooring	100 $м^2$	36,9	195,57		3,92	1	14	14
20	Ceramic flooring	100 $м^2$	15,8	236,56		5,8	1	14	16
21	Installation of window blocks Installation of door blocks Installation of window sill boards Installation of stained-glass windows	100 $м^2$ 100 $м^2$ 100 $м^2$ 100 $м^2$	4,568 10,06 0,55 3,685	117,61 140,63 8,62 201,71		4,92 14,5 0,06 8,89	1	16	28
22	Installation of roof slabs	100 шт	1,46	37,78		4,9	1	6	6
23	Roofing device	100 $м^2$	10,54	166,3		8,76	1	8	20
24	**Interior decoration** Plastering works Painting works Facing works	 100 $м^2$ 100 $м^2$ 100 $м^2$	 133,27 124,072 2,556	 1230,9 690,16 59,2		 62,14 1,07	2	16	62
25	**Exterior decoration.** Plastering works Painting works Facing works	 100 $м^2$ 100 $м^2$ 100 $м^2$	 57,865 26,21 9,63	 499,12 72,2 962,34		 15,33 3,29 24,22	2	16	46
26	Plumbing work	%	7,5	793,4			1	15	52
27	Mounting hardware	%	5	528,93			1	15	36
28	Electrical installation equipment	%	6	634,75			1	12	52
29	Instrumentation and automation	%	2,5	264,46			1	8	33
29	Gasification	%	5	528,93			1	14	37
29	Improvement of the territory	%	3,5	370,25			1	14	26
29	Various works	%	19	2009,9			1	16	125
30	State Commission								20

Q = 15387,9 t = 918



WORKER MOVEMENT SCHEDULE



Chan.	Num.par.	List	№doc	Sign	Date
Head of Depart		Kozyukova N.V			
Supervisor		Kozyukova N.V			
Consultant		Kozyukova N.V			
Controller		Bek A.A.			
Created		Rahimi A.S.			

KazNITU-5B072900-Civil Engeneering-03.08.02-2021-DP

Campus with a sports complex using vacuum thermal insulation in Karagandy

Organizational and technological part	stage	list	lists
	DP	9	9

Calendar sachedule

Civil engineering and building materials department

Format A3

МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ РЕСПУБЛИКИ КАЗАХСТАН
СӘТБАЕВ УНИВЕРСИТЕТІ

RESPONSE

OF THE SUPERVISOR
for the graduation project

Rahimi Ahmad Samar
5B072900-Civil Engineering

Topic: “Campus with a sports complex using vacuum thermal insulation in Karagandy

Graduation project of Rahimi Ahmad Samar made in accordance with the requirements and includes all the necessary sections of the diploma project.

In the Architectural part, facades, sections, floor plans and connection nodes of structures are presented. The thermotechnical calculation of the wall fencing was made.

In the constructive section, the calculation of the foundation, reinforced frames on the LIRA CAD program is performed. In the technological part, technological maps for earthworks and reinforcement works have been developed.

The economic part of the project is calculated according to the program of ABC. All drawings are made in Autocad.

In general, the graduation project was performed at a good level, the student Rahimi Ahmad Samar showed good knowledge both during training and during the implementation of the project. The work deserves a good grade.

Supervisor
Master of technical science, lecturer

___________________Kozyukova N.V.

«30» may 2021 yr.

Протокол анализа Отчета подобия Научным руководителем

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

Автор: РАХИМИ Ахмад Самар

Название: Campus with a sports complex using vacuum thermal insulation in Karagandy

Координатор:Надежда Козюкова

Коэффициент подобия 1:0.5

Коэффициент подобия 2:0

Замена букв:129

Интервалы:0

Микропробелы:3

Белые знаки: 0

После анализа Отчета подобия констатирую следующее:

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

Обоснование:

……

……………………… ……………………………………

Дата *Подпись Научного руководителя*

Протокол анализа Отчета подобия

заведующего кафедрой / начальника структурного подразделения

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

Автор: РАХИМИ Ахмад Самар

Название: Campus with a sports complex using vacuum thermal insulation in Karagandy

Координатор: Надежда Козюкова

Коэффициент подобия 1:0.5

Коэффициент подобия 2:0

Замена букв:129

Интервалы:0

Микропробелы:3

Белые знаки:0

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

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

Обоснование:

…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………

………………………
………………………………………………………

Дата *Подпись заведующего кафедрой /*

начальника структурного подразделения

Окончательное решение в отношении допуска к защите, включая обоснование:

………
………
………
………
………

………………………
…………………………………………………

Дата *Подпись заведующего кафедрой /*

начальника структурного подразделения