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

Hashimi Sayed Mustafa

« Residential building based on prefabricated modular technology in Shymkent »

To the diploma project
EXPLANATORY NOTE

Specialty 5B072900 – Civil Engineering

Almaty 2021

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ALLOWED TO PROTECT
Head of Department
Master of technical science,
lecturer
_________N.V. Kozyukova
«___»________2021 yr.

EXPLANATORY NOTE

to the diploma project

On the theme of « Residential building based on prefabricated modular technology in Shymkent »

5B072900 - "Civil Engeneering"

Prepared by Hashimi Sayed Mustafa

Scientific adviser N.V.Kozyukova
Master of technical science,
Lecturer
«_____»___2021 yr.

Almaty 2021

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Specialty 5B072900 – Civil Engineering

I APPROVE
Head of Department
________N.V. Kozyukova
Master of technical science, lecturer
«___»_______2021 yr.

ASSIGNMENT
Complete a diploma project

Student: Hashimi Sayed Mustafa
Topic: «Residential building based on prefabricated modular technology in Shymkent»
Approved by the Order of the Rector of the University No. 2131-b dated November 24, 2020.
The deadline for the completed work is May 10, 2020.
Initial data for the diploma project: construction area in Shymkent
Structural schemes of the building - frame-wall with cross-beams, structures are made of monolithic reinforced concrete, architectural solution(partitions made of brick walls).
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 slab and diaphgram;
c) Organizational and technological part: development of technological maps, construction schedule and construction plan;
d) Economic part: local estimate, object estimate, summary estimate;
List of graphic material (with exact indication of required drawings):
1 Facade, standard floor plans, parts 1-1 and 2-2 - 4 sheets;
2 KZh columns, specifications - 1 sheet;
3 Technical maps of concrete works, calendar plan, construction site plan - 4 sheets.
11 slides of work presentation are provided.

Recommended main literature: 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
Architectural and analytical	11.01.2021г.-14.02.2021г.				
Calculation and design		15.02.2021г.-23.03.2021г.			
Organizational and technological			24.03.2021г.-01.05.2021г.		
Economic				01.05.2021г.-09.05.2021г.	
Pre-defense	10.05.2021г.-14.05.2021г.				
Anti-plagiarism, norm control	17.05.2021г.-31.05.2021г				
Quality control	26.05.2021г.-31.05.2021г.				
Defense	01.06.2021г.-11.06.2021г.				

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

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

Scientific adviser Kozyukova N.V.
The task was accepted
for execution student Hashimi Sayed Mustafa

Date "__" ________ 20__ yr.

АҢДАТПА

Осы дипломдық жұмыстың мақсаты - Қазақстанның Шымкент қаласында сыйымдылығы 13 млн. Көпқабатты тұрғын үй кешенінің құрылысы. Диссертация сәулет бөлігі, құрылыс бөлігі, технологиялық бөлігі және экономикалық бөлігі болып табылатын төрт бөлімнен тұрады және жобалау, технологиялық және жылу жобалау кезінде есептер шығарылды, бас жоспарға сәйкес сәулет жоспарлау шешімдері негізделді, негізгі және көмекші объектілердің орналасуы жасалды. Жасалды және негізгі техникалық экономикалық көрсеткіштер есептелді. Бұл 56 парақта ұсынылған, 20 кесте, 10 сурет, 54 формула, 2 қосымша, 20 сілтеме.

Түйін сөздер: құрылыс, саз, өндіріс, көп қабатты.

АННОТАЦИЯ

Целью данной дипломной работы является строительство многоэтажного жилого комплекса в городе Шымкент, Казахстан, мощностью 13 миллионов. Диссертация состоит из четырех частей, которые являются архитектурной частью, строительной частью, технологической частью и экономической частью, и в ходе проектирования были выполнены технологические и теплотехнические расчеты, архитектурно-планировочные решения были обоснованы в соответствии с генеральным планом, планировка основных и вспомогательных объектов была сделано, и основные технико-экономические показатели были рассчитаны. Окончательный вариант представлен на 56 страницах, включает 20 таблиц, 10 рисунков, 54 формул, 2 приложения, 20 ссылок.

Ключевые слова: строительство, глина, производство, многоэтажный.

ABSTRACT

The aim of this final thesis is the construction of a multi storey residential complex in Shymkent city of Kazakhstan with a capacity of 13 million. Thesis consists of four parts which are architectural part, construction part, technological part and economic part and during designing, technological and thermal engineering calculations were made, architectural planning decisions were justified according to the master plan, the layout of the main and auxiliary facilities was made, and the main technical and economic indicators were calculated. The final this is presented on 56 pages, includes 20 tables, 10 figures, 54 formulas, 2 appendixes, 20 references.

Keywords: construction, clay, production, multi storey.

CONTENT

INTRODUCTION

Construction, being material-intensive, labor-intensive, capital-intensive, energy-intensive and science intensive production, contains the solution of many local and global problems, from social to environmental. Construction in our country is one of the leading industries economy. Currently, the possibilities of modern construction production is very wide and varied. The main task of capital construction at the present stage is attraction of investments, creation and renewal of fixed assets,intended for the development of production and construction; increasing the efficiency of capital investments in technical re-equipment and reconstruction of existing enterprises, for construction and the commissioning of new facilities. Modern construction world and domestic science offers for the designer a wide range of options for solving engineering problems, a huge selection of a park of machines, equipment, devices and mechanisms, offers many ways to organize work.

As the practice of recent years shows, at present in to a certain extent, the principles of architectural and construction design related to the further development of environmental science. The ecological approach to design has two directions: architectural and construction and engineering and technical (technological). Architectural and construction considers issues related to the organization of residential territories, the design of master plans of cities, the choice of volumetric planning and structural solutions of buildings and their conditions operation; Engineering - issues related to the creation of new technological processes and equipment to reduce or completely eliminate production and other emissions into the environment Wednesday. By using these solutions effectively, we can reduce the volume construction work by 30%. The project strictly adheres to the provisions of GOST and SNiP.

The use of a multi-storey residential building is primarily aimed at: save urban areas, since during the construction of multi-storey residential buildings it is possible Significantly increase the density of the settlement. Urban growth is "broad" and it aggravates the transportation problem and increases the length of engineering networks. Ultimately success the case depends on specific specialists, their professional training, breadth of outlook, flexibility of thinking, ability to find the optimal solution from all possible.

When choosing multi-storey residential buildings in large cities, the urban situation is taken into account, as well as the conditions for the reconstruction of central squares. Construction is an engineering operation for the construction of buildings and structures such as residential buildings.

1 Architectural and construction section

1.1 Basic information about the construction site

The graduation project was developed for the construction of "residential complex" located at: Shymkent, with territory of 141.2712 hectares.. ”The degree of fire resistance of building is II “Fire safety of buildings and structures. The graduation project is designed for the following construction conditions:

Humidity zone - normal;

Climatic region - IV(IVG);

wind speed zone IV;

snow zone III;

Climatic parameters of the cold season: air temperature of the coldest day: -17.7 ˚C; air temperature on the coldest five-day period: -14.3 ˚C; the construction area is seismic hazard, The construction site is located in the residential and administrative buildings zone.

1.2 Natural and climatic and engineering-geological conditions

Characteristic features of the climate of this territory are: 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. The wind regime of the study area is quite heterogeneous and changes with distance from the mountains. Maximum wind speed is 6m/s in January.

Figure 1 - Wind rose according to the weather station of city A of the camp

1.3 General plan Landscaping

The general plan was developed in accordance with the urban planning situation and the required orientation of the premises, the master plan for the development of areas, taking into account the 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 greening of the site envisaged by the project reduces the general dust content and eliminates local foci of dust.

1.4 Constructive solutions of the object

Residential building reinforced concrete monolithic frame with a bezel-less system. Dimensions of columns 500x500 mm, diaphragms of rigidity 300 mm, thickness of floor slabs 220 mm(360 with insulation and roofing layers). Foundations - raft with a monolithic grillage Walls:

-the external walls should be made of a gas block 250 mm thick / D 500 / ;

-internal partitions of aerated concrete blocks with a thickness of 100, 200 mm;

-in bathrooms made of ceramic, ceramic, full-body brick, M75 GOST 530- 2012 with M100 solution, thickness 120, 250 mm. Ceilings and coatings

- monolithic; Stairs
- monolithic; Protections
- aluminum; Platforms
- monolithic reinforced concrete; Lintels
- prefabricated reinforced concrete in brick walls and partitions; The construction of the mine is reinforced concrete. The insulation is adopted according to the heat engineering calculation; the roof is flat, rolled; gutter
- internal organized with heating. Outside lining:

1. Basement walls
 - granite tiles;
2. Walls - fiber-cement slabs;
3. Decorative lamellas - aluminum;
4. Porch - heat-treated granite;
5. The blind area of the building is paving stones.

Doors: metal entrance doors; entrance groups on the 1st floor - a glazed door, an aluminum frame; doors in technical rooms - metal;

Windows: Stained-glass windows - triple glazing, profile - aluminum, color - white; Stained-glass

1.5 Space planning solution

Projected object " residential complex " located at: Shymkent, located on the allotted territory of 141.2712 hectares. The following types of engineering equipment are provided for in the building: centralized heating from a thermal power station, hot water supply, water supply, sewerage, electric lighting, telephone installation, radio communication. The level of a clean floor of the 1st floor, corresponding to the absolute mark of 345.60 on a vertical layout, is accepted as a mark of 0,000. 12 A building with dimensions in axes of 60 x16.15 m. For vertical communication of floors, one staircase of type L1 and a fire escape of type P2 are provided. Evacuation exits are provided directly through stairwells with a vestibule with a direct exit to the outside. The height of floors are 3m.

Responsibility class I.

The degree of fire resistance of the high-rise part - I,

Low part fire resistance - II.

Class of constructive fire hazard C-I.

Fire hazard of building structures - K0

1.6 Thermo technical calculation of the outer wall

According to the joint venture of the Republic of Kazakhstan 2.04-01-2017 “Construction Climatology” and the joint venture of the Republic of Kazakhstan 2.04-107-2013 “Construction Heat Engineering”. "Construction heat engineering" it is necessary to determine the thickness of the insulation for the outer wall. We determine the value of the degree days of the heating period:

$$GSOP = (t_{in} - t) * z \qquad (1)$$

Where t_{in} = 21℃ - temperature of internal air, ℃;

t = 3.1 C - average temperature of the heating period;

z = 155 days. -the duration of the heating period;

$$GSOP = (21-3.1) * 155 = 2864\ ° C * day$$

The required heat transfer resistance of enclosing structures that meet sanitaryhygienic and comfortable conditions is:

$$Rreq = n* (t\ in – t\ ext) / \Delta tn * \alpha_{in} \qquad (2)$$

$$R\ req = 1*(21+17.7)/4.5 * 8.7 = 0.\ 9$$

Therefore we take the Req = 2.45

The heat transfer resistance of the building envelope should be determined by the formula

Where α_{in} = 8.7

α_{ex} = 23

$$R0 = 1/ \alpha_{in} +\delta_1/ \gamma_1+ \delta_2/\gamma_2+ \delta_3/\gamma_3 + \delta_4/\gamma_4+ 1/\alpha ex$$

$$R0 = 1/ 8.7+0.\ 25/ 0.22 +0.15/0.22+ 0.02/0.18+ 0.1/0.03+ 1/23$$

$$R0 = 5.4\ *c/BT \geq Rtp = 2.45\ M2*C/Bt$$

2 Anti seism0ic activities

Seismic hazard - seismic hazard impacts in the considered territory. Seismic hazard determined in space, in time (frequency or probability for a certain period of time) and in intensity (in points or in kinematic parameters of soil movements). The seismic hazard of construction zones should be determined with using a map of seismic generating zones of the territory of Kazakhstan, a set of maps of the general seismic zoning of the territory of the Republic Kazakhstan or according to the list of settlements located in seismic areas. List of settlements located in seismic zones Of the Republic Residential projected building is located in seismic zone, therefore, anti-seismic measures are necessary. Seismicity of the work area according to SP 2.03-30-2017, is 7 points. Clarified seismicity should be taken equal to 6 points. The residential building has a length of 61 meters, since our frame is reinforced concrete then the length should not exceed 48 meters, therefore we split the building about to one meter. Anti-seismic seams should be performed by erecting paired walls, paired frames or frames and walls. In buildings located on construction sites with a seismicity of 8 points or more, it is not allowed to provide the possibility of mutual movements of adjacent compartments due to the movement of span structures, freely lying on the structures of adjacent compartments.

3 Calculation and design

Constructive solution of the administrative building - multi-storey building with non-beamed ceilings. Spatial frame of the building solved by a frame scheme in both directions. Crossbars of multi-storey of multi-span frames is a bezel-less slab rigidly connected to the columns. Slab-column conjugation is non-drip, in the area of columns in the slab additional transverse reinforcement is installed, designed for force from punching.

Table 1 - Collection of loads

Downloads		
Dead weight		Auto
Floor construction	Layer thickness, m density, kg / m3	Characteristic load, kg / m2
For the basement:		
Bituminous waterproofing	0.01 1400	fourteen
Extruded polystyrene foam	0.1 40	4
Cement-sand screed	0.05 1800	90
Basement total:		108
For a typical floor:		
Cement-sand screed	0.05 1800	90
Moisture resistant plywood	0.1 600	60
Glue		1.2
Oak parquet	0.015 1800	27
Sun it for a typical floor:		178.2
For flat roofs:		
Concrete slope layer	0.05 1800	90
Vapor barrier		0.015
Extruded polystyrene foam	0.15 40	6
Bituminous waterproofing (2 layers)	0.02 1400	28
Everything for a flat roof:		124.015
Wall construction	Layer thickness, m density, kg / m3	Characteristic load, kg / m
External self-supporting walls (wall height 4.4m):		
Gas block	0.3	792

Continuation of table - 1

	600	
Extruded polystyrene foam	0.1 / 40	17.6
Facing brick	0.12 / 1800	950.4
Total for self-supporting walls:		1760
External self-supporting walls (parapet height 0.5m):		
Gas block	0.3 / 600	90
Extruded polystyrene foam	0.1 / 40	2
Facing brick	0.12 / 1800	108
Total for the parapet:		200
Partitions (height 4.4m)		
Drywall	0.0125 / 600	33
Soundproofing Isover	0.075 / 14	4.62
Drywall	0.0125 / 600	33
Total for partitions:		70.62
Horizontal pressure from the ground	Characteristics	
Fine sand	E= 300000 kg⁄cm	
	γ= 1.95 t⁄m	
	Φ= 36 deg.	
	c= 0	
Payment		
Horizontal intensity of active soil pressure at 3.3		
Ground level with respect to clean floor -0.600		
$1.95 \cdot 3.3 \cdot tg \left(45 - \frac{36}{2}\right) = 1.671$ т/м		
Horizontal intensity of active soil pressure at 3.3 ~~m, from~~, q= 5t/m		
1.298 + 1.671 = 2.969		
Live loads according to EN1991		
Overlap	2 kN / m2 = 0.2 t / m2	
Stairs	2 kN / m2 = 0.2 t / m2	
Unexploited roof	0.4 kN / m2 = 0.04 t / m2	

3.1 Calculation of slab

Initial data: Plate of rectangular cross section with bottom reinforcement with dimensions b = 1000 mm, h = 220 mm; c1 = 30 mm; Concrete has a normal class C25 / 30 (f_{ck} = 25 MPa, γ_c = 1.5, f_{cd} = 14.2 MPa, α_{cc} = 0.85). Valves of class S500 ($f_{ук}$= 500 MPa, f_{yd} = 140 MPa, Es = 20 * (10) ^ 4 MPa, α_{cc} = 0.85).

Table 2 - Forces from DCL

L.Case		ELEM type	ELEM	NX, t/m**2	NY, t/m**2	TXY, t/m**2	MX, (t*m)/m	MY, (t*m)/m	MXY, (t*m)/m	QX, t/m	QY, t/m
	1 - Own weight										
1		44	36479	-153.222	-79.3499	-33.3001	0.563701	6.02683	14.9894	-5.22026	-1.42406
	2 - Floor weight										
2		44	36479	-33.7276	-16.8217	-8.19566	2.70231	1.84858	4.8779	-1.50195	-0.54791
	3 - Walls weight										
3		44	36479	-112.476	-57.8385	-27.7403	-3.45961	-0.40187	14.5994	-4.86514	-0.4147
	4 - Soil pressure										
4		44	36479	-0.03017	-0.01691	-0.0022	0.001562	-0.00075	-0.00216	-0.00048	0.000146
	5 - Temporary loads according RN1991										
5		44	36479	-32.883	-16.3492	-8.0714	2.68156	1.85988	4.90081	-1.50708	-0.55027
	6 - Snow load										
6		44	36479	-0.63497	-0.35519	-0.09485	0.015542	-0.00855	-0.01715	0.003866	0.001784
	7 - Wind load X										

continuation of table - 2

7		44	36479	-0.27109	0.056531	-1.02022	-0.07497	0.012363	-0.02623	-0.02725	0.001692
	8 - wind load Y										
8		44	36479	0.860934	0.511791	0.302399	-0.03015	-0.0011	0.009871	-0.00984	0.001024
	9 - 7 - Seismic X										
9 - 7		44	36479	1.56886	2.61253	-2.68425	-0.72497	0.239972	-0.31779	-0.50679	-0.0226
	9 - S1 - Seismic X										
9 - S1		44	36479	1.56886	2.61253	-2.68425	-0.72497	0.239972	-0.31779	-0.50679	-0.0226
	11 - 19 - Seismic Z										
11 - 19		44	36479	5.66559	1.6032	4.21616	0.357576	-0.03595	0.031958	0.171315	-0.00542
	11 - S1 - Seismic Z										
11 - S1		44	36479	5.66559	1.6032	4.21616	0.357576	-0.03595	0.031958	0.171315	-0.00542
Total								9.7			

The bending moment Med = 9.7 T*M = 97 kN * m acts on the plate. Determination of the cross-sectional area of the reinforcement Bending moment acting in section:

Meds = Med-Ned * zs1 = 97 kN * m. (Ned = 0),

d = h-c1 = 220 - 30 = 190 mm.

The required area of longitudinal reinforcement is determined according to:

$$Kd = \frac{d}{\sqrt{\frac{97}{b}}} = 19/9.8 = 2$$

Kd = 2 dimensionless binding factor

Determine k_s according to table B.3 for normal concrete ≤C 25/30 → ks = 2,4

$As1 = ks1 * M_{eds} / d + Ned / \sigma_{s1d} = 2.4 * 97 / 19 + 0/435 = 12.25 (cm)^2$

Accept: 5Ø18 (As1 = 12.72 (cm) ^ 2)

We determine the value of the coefficient.

$$\alpha_{eds} = Meds/fcd*b*d^2 \quad (3)$$

$$97*10^3/14.2*0.19^2$$

$$\alpha_{eds} = 0.018$$

$$\alpha_{eds} \leq \alpha_{(eds,\ lim)} = 0.372$$

$$0.018 \leq 0.372$$

Calculation of checking the width of the opening of cracks normal to the longitudinal axis of the element.

Working section height

$$d = h - c_{cov} - d_{sw} - Ø16 / 2 = 220 - 30 - 16/2 = 182 \text{ mm}$$

$$\rho = As1 / bd = 1272/1000 \cdot 182 = 0.006989\ (0.69\%).$$

Check the width of the crack opening by a simplified method, using the data in table. 8.3 for rectangular sections reinforced with reinforcement of class St500 with $0.5\% \leq \rho \leq 1.0\%$, the shoulder of an internal force pair is determined:

$$z = 0.85\ d = 0.85 \cdot 182 = 154.7 \text{ mm}$$

Stresses in tensile reinforcement are determined by the formula;

$$\sigma s = Med / As1 \cdot z \ (11)$$

$$\sigma s = 236.15 \text{ N / mm2}$$

According to the table 8.4 $dmax$ = 20 mm at σs = 236.15 MPa and wk, lim = 0.4 mm.

The accepted diameter Ø = 18mm ≤ $Ømax$ = 20 mm, i.e. it is not necessary to check the crack opening width by calculation.

$$\omega = 0.0636$$

$$\sigma sd = f_{yd} = 140 \text{ MPa}$$

Required tensile reinforcement area:

$As1 = 1/\sigma sd\ (\omega*b*d*f_{cd} + N_{ED}) = 1/140\ (0.0636*1000*190*14.2) = 1225 \text{ mm}^2$

We accept 5Ø18(As2 = 12.72 (cm) ^ 2)

We determine the value of the coefficient

$$\alpha_{eds} = Meds/fcd*b*d^2$$

$$= 97*10^3/14.2*0.19^2$$

$$\alpha_{eds} = 0.018$$

$$\alpha_{eds} \leq \alpha_{(eds,\ lim)} = 0.372$$

$$0.018 \leq 0.372$$

Required tensile reinforcement area:

$$Ast = 1/\ \sigma_{s1d}\ (\frac{Meds}{\xi * d} + N_{ED}) = 1/435\ (\frac{97*10\ 3}{0.96*19} + 0) = 12.25$$

We accept 5Ø18(As2 = 12.72 (cm) ^ 2).

4 calculation of diaphragm

4.1 Calculation of a vertical diaphragm with a height 30m

For class B10 concrete $f_{ck} = 12$ MPa; $f_{cd} = 6.8$ MPa; $E_b = 24000$ MPa; $\gamma_{b2} = 0.9$, Armature class S500 Ø 10…40 c $f_{yd} = 435$ MPa; $E_s = 200000$ MPa. Coefficient of reduction of the area of reinforcement to the area of concrete; $\alpha = \frac{200}{30} = 8.3$. Forces act in the lower section of the diaphragm, eccentricity.;

$$N = N_1 = 400\ kH, Q = \frac{541}{2} = 270.5\ kH; M = \frac{7159}{2} = 3579\ kH;$$

$$e_0 = \frac{3579000}{400} = \quad 7159\ mm; \quad e_{ol} = 0$$

The relative eccentricity is determined by the formula from [2]:

$$\delta_e = \frac{e_0}{h} \tag{4}$$

where e_0 - eccentricity,

h - length of reinforced concrete panel

$$\delta_e = \frac{7159}{5630} = 1.15$$

But no less relative eccentricity, which is determined by the formula from [2]:

$$\delta_{e,min} = 0.5 - 0.01(\frac{l_0}{h} + \gamma_{b2} f_{cd}) \tag{5}$$

where l_0 - calculated length of the console,

h - length of reinforced concrete panel,

f_{cd} - design compressive strength of concrete

$$\delta_{e,min} = 0.5 - 0.01\left(\frac{48000}{5630} + 0.9 \times 6.8\right) = 0.36$$

The influence of the duration of the action of the load on the deflection at the eccentricity of its action is taken into account by the coefficient according to the formula from [2]:

$$\varphi_l = 1 + \beta N_1 \frac{e_{0l} + 0.5h - a}{N(e_0 + 0.5h - a)} \tag{6}$$

where β - coefficient taken depending on the type of concrete according to table.

N_1 - the same, from the action of constant and longed loads

$$\varphi_l = 1 + \frac{3070 - 400}{7159 + 2670} = 1.4$$

With symmetric reinforcement

$$\xi = \frac{400000}{0.9 \times 6.8 \times 200(5630 - 400)} = 0.07; x = 0.07 \times 5740 = 400\ mm$$

For the reduced I-section minus the voids.

$$b'_f = 200\,mm; b = 200 - 80 = 120\,mm;\ h'_f = 690\,mm; I = \left[200 \times \frac{690^3}{12} + 200 \times 690 \times (3070 - 345)^2\right] 2 + \frac{120(5630 - 2 \times 690)^3}{12} = 314 \times 10^{10}\,mm^4$$

Minimum reinforcement determined using table [2] for flexibility:

$$\lambda = \frac{40000}{5630} = 6.5$$

$$A'_s = A_s = 0.002 \times 120 \times 5740 = 1378\,mm^2$$

Section geometrical characteristics:

$$I_s = 2 \times \frac{1378(5740 - 400)^2}{4} = 197 \times 10^8\,mm^4$$

Conditional critical force, determined by the formula [2]:

$$N_{cr} = \frac{6.4E_b}{l_0^2}\left[\frac{I}{\varphi_l}\left(\frac{0.11}{0.1+\delta_e/\varphi_p} + 0.1\right) I_s\, E_s/E_p\right] \quad (7)$$

$$N_{cr} = \frac{6.4 \times 30000}{4000^2}\left[\frac{314 \times 10^{10}}{1.4}\left(\frac{0.11}{0.1 + 1.2} + 0.1\right) + 197 \times 10^8 \times 8.3\right] = 55440\,kH$$

The value of the coefficient η, which takes into account the influence of the deflection on the value of the eccentricity of the longitudinal force e_0, should be determined by the formula [2]:

$$\eta = \frac{1}{1 - \frac{N}{N_{cr}}} \quad (8)$$

$$\eta = \frac{1}{1 - \frac{400}{55440}} = 1.01$$

$$e = 1.01 \times 7159 + 0.5 \times 6180 - 400 = 7478\,mm$$

The required symmetric reinforcement according to the formula [2]:

$$A'_s = A_s = \frac{N[e - (1 - 0.5\xi h_0)]}{[f_{yd}(h_0 - a')]} \quad (9)$$

$$A'_s = A_s = \frac{400000[7478 + (1 - 0.5 \times 0.07)5740]}{[435(5740 - 400)]} = 420\,mm^2 < 1378\,mm^2$$

Structural reinforcement remains 8∅16 S500 c $A_s = 1378\,mm^2$on every face.

Strength calculation of the diaphragm section inclined to the longitudinal axis.

$$Q = 214\text{ kH}; N = 500\text{ kH}.$$

Checking the strength condition of the inclined strip between cracks according to the formula [2]:

$$\varphi_{w1} = \frac{Q}{[0.3(1-\beta\times f_{cd})\gamma_{b2}\times f_{cd}\times b\times h_0]} \quad (10)$$

$$\varphi_{w1} = \frac{214000}{[0.3(1-0.01\times 6.8)0.9\times 6.8\times 120\times 5740]} = 0.18 < 1.4,$$

Those sustainability is assured. Coefficient taking into account the influence of longitudinal compressive force on the bearing capacity of an inclined section[3].

$$\varphi_n = 0.1\times\frac{400000}{0.9\times 0.73\times 120\times 5740} = 0.11$$

Transverse force perceived by concrete according to the formula [2]:

$$Q_{b0} = \varphi_b\left(1+\varphi_f+\varphi_n\right)\gamma_{b2}\times f_{cd}\times b\times h_0 \quad (11)$$

$$Q_{b0} = 2(1+0.11)0.9\times 0.73\times 120\times\frac{5740}{2} = 500\ kH > Q = 214\ kH$$

Consequently, transverse reinforcement is not required by design.

4.2 Calculation of the diaphragm section

Consequently, transverse reinforcement is not required by design.

$$l_0 = H = 3000\ mm, N = N_1 = 400\ kH, M = 0.$$

$$e_{a1} = \frac{4800}{600} = 6.7\ mm = e_{a2} = \frac{200}{30} = 6.7\ mm;\ \delta_e = \frac{6.7}{200} = 0.03 < \delta_{e,min}$$
$$= 0.5-0.01\left(\frac{4800}{200}+0.9\times 6.8\right) = 0.24;\ \varphi_l = 1+\frac{100-30}{6.7+70} = 1.9; I$$
$$= 5630\times\frac{200^3}{12} - 30\times 80\times\frac{80^3}{12} = 3990\times 10^6\ mm^4.$$

Minimal reinforcement with flexibility:

$$\lambda = \frac{4800}{200} = 24;$$
$$A_s' = A_s = 0.0025\times 5630\times 170 = 2610\ mm^2;$$
$$I_s = 2\times\frac{2610(170-30)^2}{4} = 26\times 10^6\ mm^4;$$

Conditional critical force, determined by the formula 6.4 [2]:

$$N_{cr} = \frac{6.4\times 30000}{4800^2}\left[\frac{3990\times 10^{10}}{1.9}\left(\frac{0.11}{0.1+0.3}+0.1\right)+26\times 10^6\times 8.3\right]$$
$$= 10600\ kH;$$

The value of the coefficient η, which takes into account the influence of the deflection on the value of the eccentricity of the longitudinal force e_0, should be determined by[4].

$$\eta = \frac{1}{1 - \frac{400}{10600}} = 1.05;$$

$$e = 1.05 \times 6.7 + 70 = 78\ mm.$$

The relative height of the compressed zone of concrete

$$\xi = \frac{400000}{0.9 \times 6.8x5630 \times 170} = 0.08$$

$$A'_s = A_s = \frac{400000[78 - (1 - 0.5 \times 0.08)170]}{435 \times 140} < 0$$

According to the calculation, the reinforcement is not required, but it is assigned for structural reasons $A'_s = A_s = 2610\ mm^2$. In addition to the previously defined aperture $8\emptyset 16$ S240 c $A_s = 1608\ mm^2$ need to add $\Delta A_s = 2610 - 1608 = 1002\ mm^2$. With a distance between the rods S = 200 mm, the required cross-sectional area of each $A_s = 1002 \times \frac{200}{6180-400} = 34.5\ mm^2$, for example $1\emptyset 8$ A-III c $A_s = 50.3\ mm^2$.

Checking the strength of the section inclined to the longitudinal axis of the panel: at random eccentricity $e_a = 6.7$ mm bending moment $M = Ne_a = 500000 \times 6.7 = 3350000\ H * mm$, by its magnitude, it is possible to determine the lateral force for a beam freely lying on the supports at;

$$l_0 = 4800\ mm: Q = \frac{4M}{l_0} = 4 \times \frac{4000000}{4800} = 1041\ H.$$

$$\varphi_n = 0.1 \times \frac{400000}{0.9 \times 0.57 \times 5540 \times 170} = 0.146$$

Transverse force perceived by concrete according to the formula [2]:

$$Q_{b0} = 2(1 + 0.11)0.9 \times 0.73 \times 5630 \times \frac{170}{2} = 716213\ H > Q = 1041\ H.$$

Transverse reinforcement parallel to the narrow panel edges is not required by design. It is only necessary to supply structural transverse reinforcement - 6 Ø S240 in the plane of the diaphragm with a step - S = 2 × 200 = 400 mm, i.e. diaphragm panels are reinforced with meshes - 200/400/8/3 with extreme rods - 4x3 Ø 16 A-III, joined by welding at the junction of the panels. Prefabricated diaphragm panels must be checked for the forces that arise during lifting, transportation and installation. The reinforcement of the stiffening diaphragm is shown in accordance with figure[4].

5 Analyzing in LIRA-SAPR:

5.1 Vertical load

There is a given condition the vertical design component of seismic does not need to be taken into account. DCL combinations are composed by combinations:

$$a_{gv} = 0.8 * a_g = 0.8 * 0.256 = 0.2 < 0.25g$$

$$\sum_{j\geq 1} \gamma_{G,j} G_{k,j} "+" \gamma_p P "+" \gamma_{Q,1} Q_{k,1} "+" \sum_{i>1} \gamma_{Q,i} \psi_{0,i} Q_{k,i} \quad (12)$$

$$\sum G\ k + P + ed + \sum \Psi\ Q \quad (13)$$

$$\begin{cases} \sum_{j\geq 1} \gamma_{G,j} G_{k,j} "+" \gamma_P P "+" \gamma_{Q,1} \psi_{0,1} Q_{k,1} "+" \sum_{i>1} \gamma_{Q,i} \psi_{0,i} Q_{k,i} \\ \sum_{j\geq 1} \xi_j \gamma_{G,j} G_{k,j} "+" \gamma_P P "+" \gamma_{Q,1} Q_{k,1} "+" \sum_{i>1} \gamma_{Q,i} \psi_{0,i} Q_{k,i} \end{cases} \quad (14)$$

Table 3 - DCL combinations

Name	View	RSN 1 (6.10)	RSN 2 (6.10)	RSN 3 (6.10)	RSN 4 (6.10a)	RSN 5 (6.10b)	RSN 6 (6.10b)
Own weight	Constant, G	1.35	1.35	1.35	1.35	1	1
Floor construction	Constant, G	1.35	1.35	1.35	1.35	1	1
Wall construction	Constant, G	1.35	1.35	1.35	1.35	1	1
Horizontal pressure from the ground	Constant, G	1.35	1.35	1.35	1.35	1	1
Temporary loads on EN1991	Temporary, Q	1.50	1.05	1.05	1.05	1.50	1.05
Snow load	Temporary (snow), Q	0.75	1.50	0.3	0.3	0.3	1.50
Wind load x	Temporary (wind), Q	0.90	0.90	1.50	0.90	0.2	0.2
Seismic x	Seismic, Ae	0.00	0.00	0.00	0.00	0.00	0.00
Seismic	Seismic, Ae	0.00	0.00	0.00	0.00	0.00	0.00

Table 4 - DCL combinations

Name	View	RSN 7 (6.10b)	RSN 8 (6.12b)	RSN 9 (6.12b)	RSN 10 (6.12b)	RSN 11 (6.12b)	RSN 12 (6.14b)	RSN 13 (6.16b)
Own weight	Constant, G	1.15	1.00	1.00	1.00	1.00	1.00	1.00
Floor construction	Constant, G	1.15	1.00	1.00	1.00	1.00	1.00	1.00
Wall construction	Constant, G	1.15	1.00	1.00	1.00	1.00	1.00	1.00
Horizontal pressure from the ground	Constant, G	1.15	1.00	1.00	1.00	1.00	1.00	1.00
Live loads according to EN1991	Temporary, Q	1.05	0.30	0.30	0.30	0.30	1.00	0.30
Snow load	Temporary (snow) Q	0.75	0.00	0.00	0.00	0.00	0.30	0.20
Wind load x	Temporary (wind) Q	1.50	0.00	0.00	0.00	0.00	0.00	0.00
Seismic x	Seismic, Ae	0.00	1.00	-1.00	0.30	-0.30	0.00	0.00
Seismic	Seismic, Ae	0.00	0.30	0.30	-1.00	-1.00	0.00	0.00

This building model is designed in accordance with the design features of the designed building. The stiffness and overlap diaphragms were modeled by finite elements of a flat shell. The design model of the building is adopted in the form of a spatial multimass discrete system with masses concentrated in nodes. Each node has 6 degrees of freedom.

The wind load acts on the building from the windward (active pressure) and windward (suction) sides. The calculated value of the intensity of the wind load.

Wind region IV,. Snow load in the III snow region:

$$s = \mu i \cdot Ce \cdot Ct \cdot sk \quad (15)$$

$$s = \mu i \cdot Ce \cdot Ct \cdot sk = 0.8 \cdot 1 \cdot 1 \cdot 150 = 120 \text{ кг/м } 2$$

Table 5 - Wind pressureWe

Ze=17.6 m	Ce17.1: = 1.55	We = 1.55 · 770 · 0.8 = 954.8 Pa = 97.36 kg / m
Ze= 33.3m	Ce30.8: = 1.95	We = 1.95 · 770 · 0.8 = 1 201.2 Pa = 122.49 kg / m

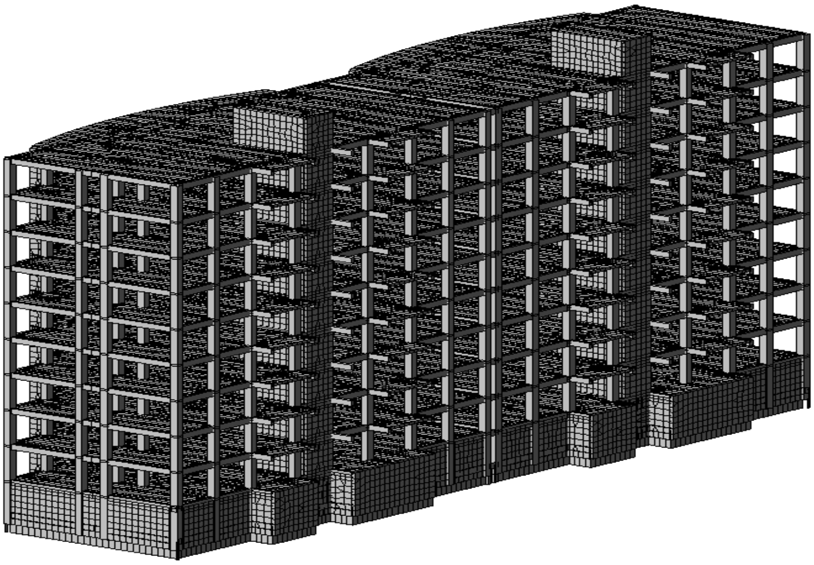

Figure 2 - The initial spatial model of the building

Average pressure under the foundation:

P= N/A = 30654/840m2 = 36.4 t/m2

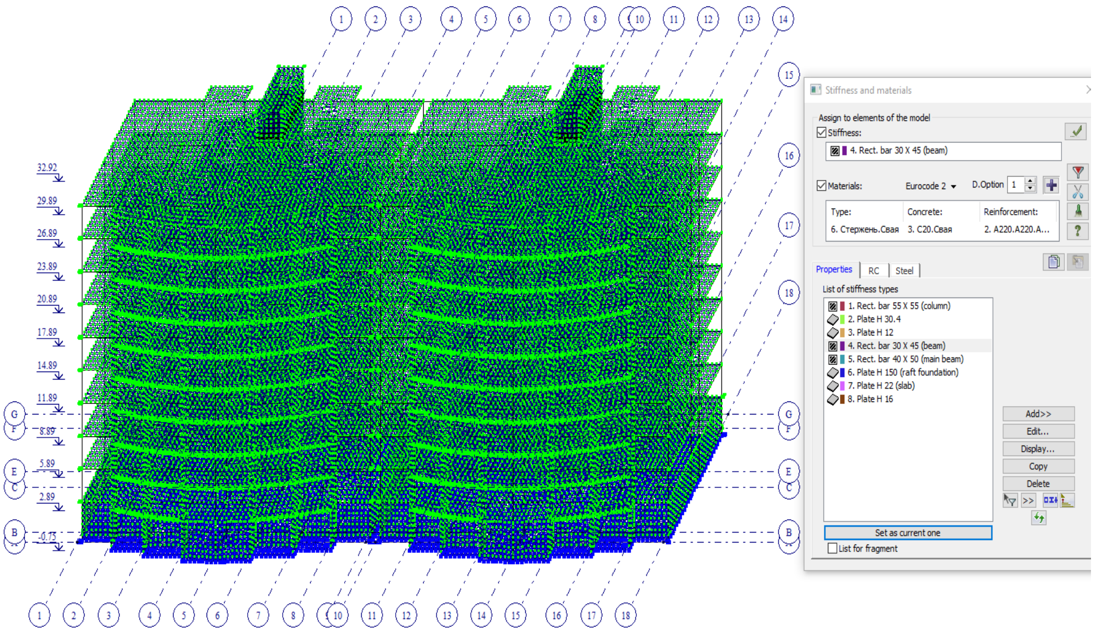

Figure 3 - The initial spatial model of the building

The first calculation file is needed to detect sediment near the foundation slab. The second calculation file is needed to identify deflections in horizontal elements. The third, fourth and fifth calculation file is required to verify compliance with the conditions of SP 2.03-30-2017 “Construction in seismic regions of the Republic of Kazakhstan”. Since the city of Astana is not a seismically dangerous region, there is no need to rely on the fulfillment of the conditions of SP 2.03-30-2017.

5.2 Girdle deformations of the base:

According to Appendix B [1] SP RK 5.01-102-2013-Osnovaine;Industrial and civil one-story and multi-story buildings with full frame: the same, with the device of reinforced concrete belts or monolithic floors, as well as buildings with a monolithic structure, maximum draft base is equal to S_{max}, μ = 10 cm.

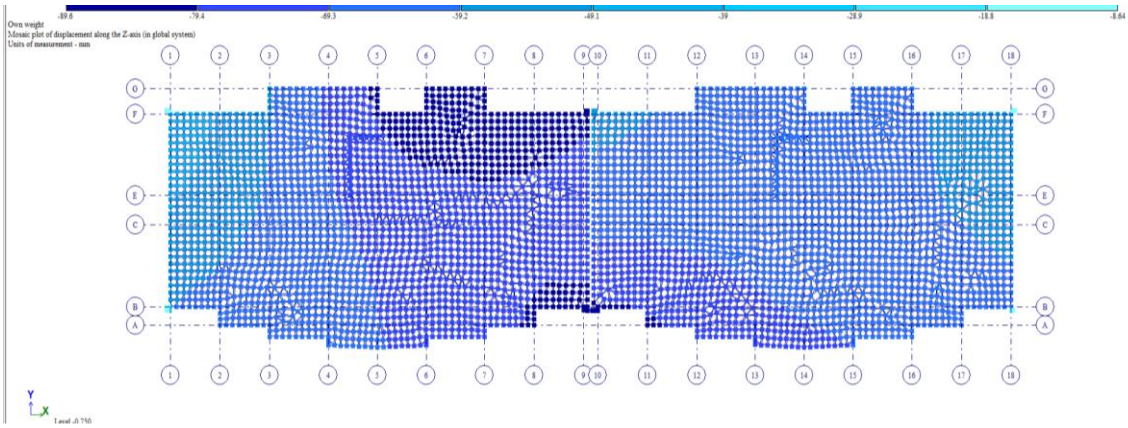

Figure 4 - Isofields of base displacements along the Z axis

Max deformation = 89.6mm<100mm
condition is met

5.3 Deflection of the slab and girder

we determine the deflection in one span:

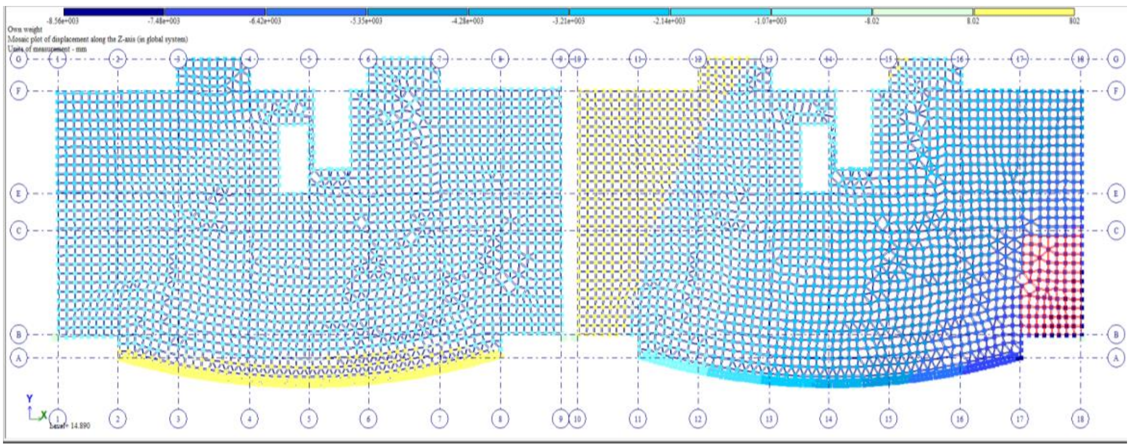

Figure 5 - chosen span

Appearance and general serviceability of the carrier structures can be violated if the calculated deflection of the beam, slab or a cantilever beam with a constant combination of influences exceeds L / 250 span. (Sn pk en 1992-1-1 + np Design of reinforced concrete structures for buildings, 7.4 Control of deflections).

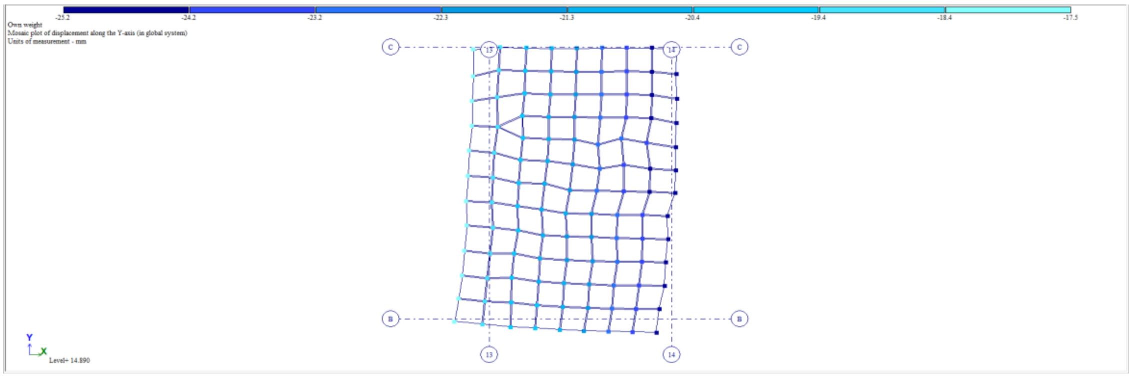

Figure 6 - slab deflection

L/250

5550/250 = 22.2mm

25.2-17.5 = 7.7mm

Condition met

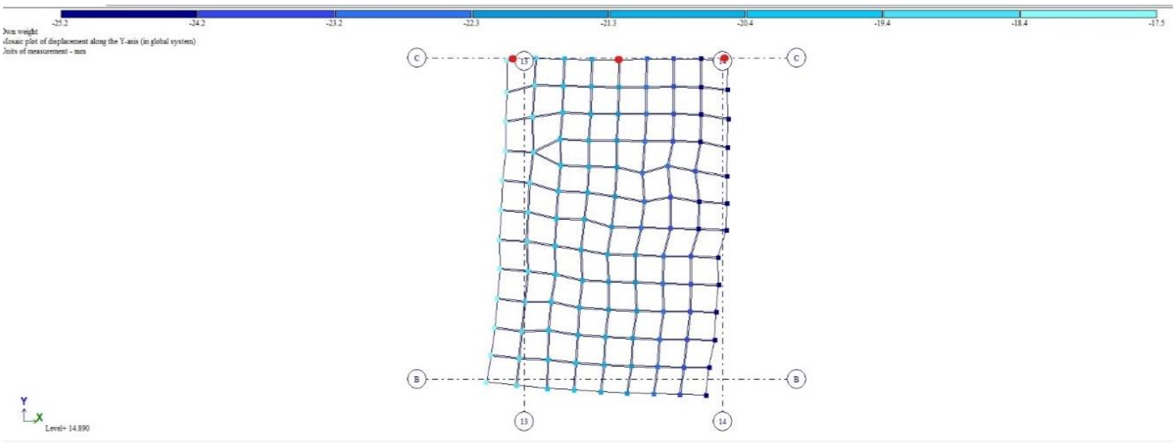

Figure 7 - Crossbar deformation

L/250

5550/250 = 22.2mm

22.3-20.4=1.9mm

Condition is met

5.4 Horizontal movement from the wind

According to SNiP 2.01.07-85 (with amendment 1 1993), 1. Multi-storey buildings Any h / 500, where h is the height of multi-storey buildings, equal to the distance from the top foundation to the axis of the roof girder.

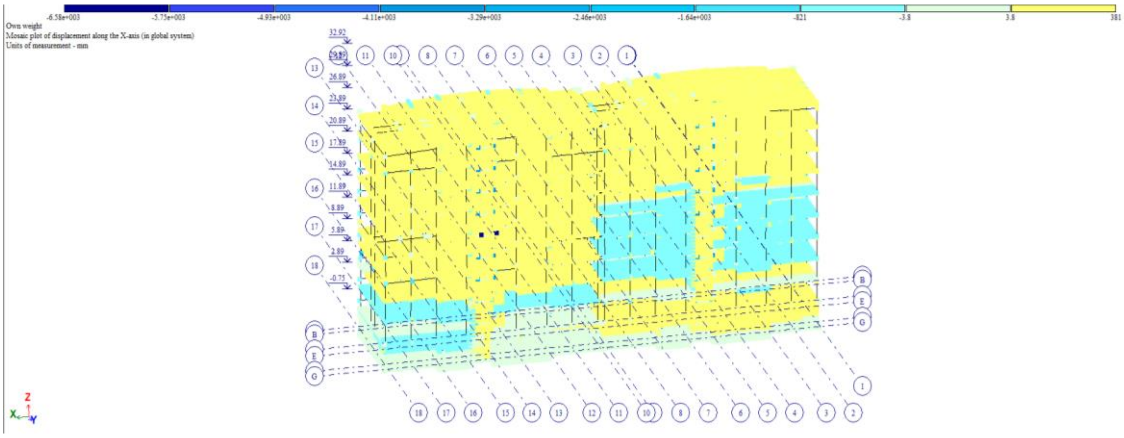

Figure 8 - Displacement along x
h/500
27000/500=54mm
16.53<54mm
met

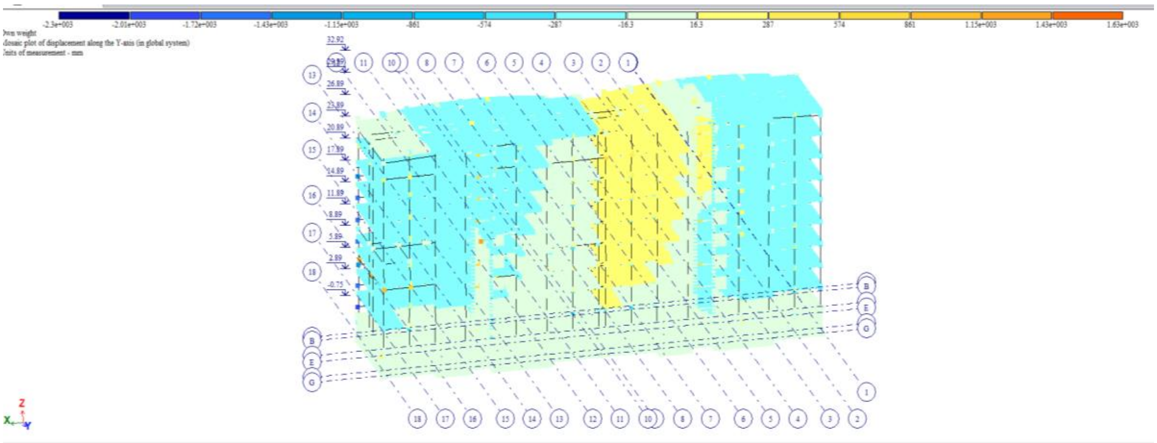

Figure 9 - Displacement along y

h/500
27000/500=54mm
23mm<54mm
Condition is met

6 Organizational and technological

6.1 Determination of work volume

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

Table 6 – Technological preparation

(Name of processes)	**(Unit of measure)**	**(Volume of work)**	
		(on one base)	**(in total)**
(The construction of temporary fencing)	(m)	156	
(Concrete preparation for foundations)	(m3)	3.6	
(Reinforcement installation, incl.:)		7092	
a) grids installation	(pieces/t)	4964.4	
b) frames installation	(pieces/t)	2127.6	
(Formwork installation)	(m2)	1241.8	
(Concreting of foundations)	(m3)	70.92	
(Formwork removal)	(m2)	1241.8	
(Foundation waterproofing)	(m2)	300	
(Soil compaction)	(m2)	334	
(Final land planning)	(m2)	1866	
(Removal of temporary fencing)	m	200	

6.2 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):

$$P_{fen} = (20 + l_1) \cdot 2 + (20 + l_2) \cdot 2, (m) \quad (16)$$

where, l_1, l_2– length and width of the
structure in plan, respectively (per the task), m.
Distance from the axis of the building in each direction is 20 m.

$$\text{So } P_{fen} = (20 + 36) \cdot 2 + (20 + 24) \cdot 2 = 156\text{m}$$

6.3 Concrete preparation

In soft soils for monolithic foundations is arranged concrete preparation from lean concrete.The quantity of concrete preparation for one foundation is (for raft foundation).

Table 7 – control maintenance of concrete

Name of indicators	unit	number
Volume of concrete to be laid	M^3	220.8
Duration of work shift	shift	21
Labor intensity of work	Man-shift	101
Production petson-shift	M^3/person shift	4.2
Salary per person-shift	Tg/person shift	1899.3

We accept concrete mixer 88363B, Concrete pump BC-126.
The volume of the transported mixture is 5 m3.
KAMAZ-55111 base car.
he operational performance of the concrete pump is determined by the following formula:

$$Pe = Pt * K1 * K2 \quad (17)$$

where Pt = 80 m3 / h - technical capacity of the concrete pump, K1 = 0.5 - use of coefficient of technical performance performance
K2 = 0.65 - coefficient of reduction of concrete pump performance

$$Pe = 80 * 0.5 * 0.65 = 26 \text{ m3 / h}$$

$$W_p = F_p \cdot h_p, m^3 \quad (18)$$

where, h_p – thickness of concrete preparation, h_p=0,1m;
F_p – area of preparation

$$F_p = a_1 \cdot b_1, m^2$$

$$F_p = 6 \cdot 6 = 36\ m^2$$

$$W_p = 36 \cdot 0.1 = 3.6\ m^3$$

where, a_1 and b_1 – the dimensions of concrete preparation, ref. foundation section.

election of the number of auto-concrete mixers for concreting columns, diaphragms .

Pbet = 2 * 4 / 1.6 = 5.0 m3 / h,

N = 5.0 * 8 / 35.4 = 1.13

We accept concreting poles, diaphragms and walls with 2 auto-concrete mixers 88363B per shift.

Selection of the number of auto concrete mixers for concreting paving slabs.

Pbet = 2 * 4 / 0.57 = 14.04 m3 / hour,

N = 14.04 * 8 / 35.4 = 3.17

We accept 4 concrete mixers 69363B per shift for concreting slabs.

6.4 Reinforcement installation

Reinforcement consumption for the raft foundation:

$$G_1 = g \cdot V_{s/f},\ t \qquad (19)$$

where, g – reinforcement frame consumption for $1m^3$ of concrete, kg/m^3 (100–150 kg/m^3);

$$G_1 = 100 \cdot 70.9 = 7092\ t \qquad (20)$$

$$V_{s/f} = (h_{f\ (s)} \cdot 0{,}3 \cdot P_{base.}) + (h_{f\ (b)} \cdot 0{,}8 \cdot P_{base}),\ m^3 \qquad (21)$$

where, $V_{s/f}$ – volume of raft foundation, m^3;

$h_{f\ (b)}$– the height of the foundation base, ref. monolithic strip foundation;

$h_{f\ (s)}$– the height of the structure basement, ref. monolithic strip foundation section;

P_{base} – total foundation length per the scheme

$$V_{s/f} = (3.9 \cdot 0{,}3 \cdot 36) + (0.3 \cdot 0{,}8 \cdot 36) = 70.92 m^3$$

Reinforcement weight distribution between grid and frame conditionally accepted as: for the grid–0,7G_1; for the frame – 0,3G_1.

0.7*7092 = 4964.4

0.3*70.92 = 2127.6

The quantity of formworks is equal to the area of the surfaces form. It is necessary to count the area of rectangular side faces of the foundation and trapezoidal inner glass surfaces.

The scheme of foundations reinforcement, type of reinforcement structures and reinforcing bars consumption in real conditions is included in the working drawings of the foundations. In the Course Project the amount of reinforcement work is defined as follows. Accepted the foundation reinforcement in the form of a horizontal grid at the bottom and vertical spatial frame at the entire height of the concrete preparation to the top of column footing.

6.5 Concreting of foundations

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

$$V_{s/f}=(h_{f\ (s)} \cdot 0,3 \cdot P_{base.}) + (h_{f\ (b)} \cdot 0,8 \cdot P_f),\ m^3 \quad (22)$$

where, $V_{s/f}$ – volume of strip foundation, m^3;

$h_{f\ (b)}$– the height of the foundation base, ref. monolithic strip foundation section;

$h_{f\ (s)}$– the height of the structure basement, ref. monolithic strip foundation section;

P_f – total foundation length per the scheme (8 page).

$$V_{s/f}=(3.9 \cdot 0,3 \cdot 36) + (0.3 \cdot 0,8 \cdot 36) = 70.92\ m^3$$

In the course project adopted the following form of waterproofing – waterproofing coating. Painting is done by applying bituminous mastics to the surface to be painted.The number of applied layers is 2. Waterproofing is carried out in accordance with E4-3- 184.

To calculate the amount of work necessary to find the surface waterproofing area.

$$S_{waterproof} =[(h_{f\ (s)} \cdot P_{\text{exterior walls}}) + ((0,25 + 0,3) \cdot P_{\text{exterior walls}})] = 2, m^2$$

where, $h_{f\ (s)}$– the height of the structure basement, ref monolithic strip foundation section (figure.3); $P_{\text{exterior walls}}$– perimeter of the exterior walls of the building.

$$S_{waterproof} =[(3.9 \cdot 60) + ((0,25 + 0,3) \cdot 60)] \cdot 2 = 300\ m^2$$

6.6 Concrete compaction

Compaction volume is measured mainly by the area of compaction that can be found, given by the average value of the compacted.

$$v_{com} = \frac{v_{bf}}{h_c}\ \text{m}^2 \quad (23)$$

V_{bf} – backfilling **v**olume, m^3;

h_c – compacted layer thickness, 0,2÷0,4 m.

$$v_{com} = \frac{167.5}{0.5} = 334 \text{ m}^2$$

6.7 Final land planning

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

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

where, $S_{1(a)}$– cutting area of the vegetation layer of the pit (trench);

$S_{building}$– area of the building.

$$S_{planning} = 1866 - 864 = 1002\ m^2$$

$$S_{building} = l_1 \cdot l_2, m^2 \qquad (24)$$

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

$$S_{building} = 36*24 = 864\ m^2$$

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

$$P_{fen} = (20 + l_1) \cdot 2 + (20 + l_2) \cdot 2, m, \qquad (25)$$

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

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

$$P_{fen} = (20 + 36) \cdot 2 + (20 + 24) \cdot 2 = 200\ m$$

6.8 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. When mounting the structure monolithic strip foundations with basement to be used column– tower crane.

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

Tower and jib rail cranes:

When choosing the crane, it is required:to determine the technical capacity of crane type;to prepare feasibility evaluation of its use;

Initial data in this case are: dimensions and space–planning decision of a building or structure;dimensions, weight and operating position of mounted element with allowance for mounting equipment;mount technology;
work performance conditions (access roads, storages, proximity of adjacent structures and utilities, soil and climatic features, structure of the underground part, etc.)

the schemes for determination of the mounting characteristics of tower cranes and jib rail cranes when mounting (a) aboveground and (b) underground structure parts. Lifting height of crane hook H_r, m is calculated using the formula:

$$H_r, = h_1 + h_2 + h_3 + h_4 \quad (26)$$

where, h_1 – the height of mounted structure from the crane base (taken equal to 0), m.

h_2 – the height of mounted element (1,5÷2 m).

h_3 – the height from the top level of the structure to the bottom of the cargo (0,5÷1 m).

h_4 – the height of lifting equipment (2÷4,5 m).

So H= 0+1.75+0.5+4=1.694

In certain cases, the amount of h_4 to be selected through the catalogs of lifting equipment in relation to the mounted elements.Crane working radius during construction of underground part L_u, m, is calculated using the formula:

$$L_u = a + c + B_p + 0,5, \quad (27)$$

where, c – slope construction, m.

$l_{1s.t}$ – length of a pit on top, m;

$l_{2s.t}$– width of a pit on top, m,

$$c = l_{1s.t.} - l_{2s.t} \quad (28)$$

C = (42.5-30.5)/2 = 6

where;B_p – the width of structure underground part (l_1 + (0,5 · 2)), m; 0,5 reserve zone width, m.

a – the distance from the crane rotation axis to the pit edge, m, is equal:

a =b/2 + 0,5 + $r1$

0.7/2 +0.5 +1.75 = 2.6

where,b – width of the crane track (5÷ 7), m;

0,5 – half the width of the sleeper or sleeper unit

r_1 – minimum allowable distance from the slope base to the sleeper structure, m, accepted per.

According to the basic characteristics of the directories or catalogs to be selected corresponding crane.Required carrying capacity of the crane is calculated using the formula:

$$Q_{cr} = (q_1 + q_2) \cdot К, \quad (29)$$

$$Q_{cr} = (435.8 + 0.6) \cdot 0.9=392.7$$

where, q_1 – maximum weight of the mounted element, t.

m_{b1} – bucket weight (annex.1, tab.18);

m_{c2} – concrete weight (2÷2,5) t/m^3.

q_1 = 435.8

q_2=0.6

$$q1=mb1+mc2 \quad (30)$$

where q_2– lifting equipment and tools weight (0,1÷0,15), t;

К– factor including the deviation of lifting device weight, taken equal 1,08÷1,12.So Q_{cr} = 392.7.

Required working radius is determined by the formula:

$$L_{cr}^{tr} = b/2+ a_1 + c, \quad (31)$$

$$L_{cr}^{tr}=0.7/2+1.75+26.6=28.7$$

where, b – width of the crane way (track), (5÷ 7), m;

a_1 – 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.

c – the distance from the gravity center the farthest from the crane mounted element to the protruding part of the crane (taken equal to the width of the structure – l_2) m.

So we have:

Lu = 2.6 +6+ 37 +0.5 = 46.1

Schemes determining the mounting characteristics of tower cranes and jib rail a) when mounting the aboveground parts

6.9 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[6].

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:

$$S=(Q/\cos\alpha)K \quad (32)$$

where, α – vertical deviation angle of the sling, no more than 45°;

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),So I have :

$$S = 0.6/\cos 75^o)1.33 = 5.6T = 3.08kg$$

Breaking strength in thesling branches is determined:

$$P=S\ S_f \quad (33)$$

where, S_f– safety factor, taken as S_f = 6– for slings with inventory lifters, S_f 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.

So P = 3.086 = 18.4

6.10 Design of concrete works

During the design of technology of foundations concreting should:-select the type of formwork, assign the size and determine the need for shuttering boards;-determine the method of formwork and reinforcement (manually or with a crane); so I choose manually choose the method of concrete mix supply in concrete units (vertical transport) and the type of vehicle for the delivery of concrete mix to the construction site (horizontal transport);We select horizontal transport.-choose the brand of vehicles, choose a set of machines, vehicles and equipment for the implementation of concrete works complex;-carry out technological schemes of concrete works.All decisions on the concrete foundation technology in the Course Project may be taken without the

Delivery of concrete to the construction site is carried out in specialized vehicles – mixer trucks Methods of concrete supply into the concrete blocks (in this case, the form of monolithic columnar foundation) are different[7]:

It is advisable to supply concrete mix with cranes at an average intensity of concrete works of up to 20 m3 per shift. The crane is also used simultaneously in the production of reinforcing and formwork.

When there is no time limit for concreting the basement. In this case, the intensity of laying a concrete mixture we take for a concrete pump 20 m3 / h.

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[10]:

$$M = M_e + \mathrm{E} \cdot \gamma_{dc}, t, \quad (34)$$

where, M_e – mass of the empty bunker, t;

E – hopper capacity, m^3;

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

Features of rotated bins and not rotated bins for feeding the concrete mix by valves are given in.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[11].

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.

So M=325+1.25·2.4=328

Features of rotated bins and not rotated bins for feeding the concrete mix by valves are given in. 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.

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.

7 Determination of work labor input and crew composition

The labor input of operations is calculated based on the ENiR on respective works (ENiR E–2, E–4, E–11, E–22, etc.), performed by equipment or manually. For manual processes in the column “operator” put a dash. Total labor costs and wages are obtained by multiplying the amount of work on the standards of time and rates. The calculation is presented in tabular form (tab. 10) in the calculation of labor costs, make it only by the accepted type[17].

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:

Table B.1 - Cost calculations of machine time, labor costs and salary

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.

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 [8].

The duration of the mechanized processes is determined by:

$$Pm = Nm.sh / n \cdot A, \quad (35)$$

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

$$N_{мс} = \frac{Q}{П_{см}}, \quad (36)$$

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

$P_{см}$ - changeable productivity of the unit, ha / shift.

Removal of top soil:

$$Pm=368/1*2*18662.4=3day$$

Soil xcavation in the trench and trench access to the pit:

$$Pm=87.86/1*2*200=3 \text{ days}$$

Formwork installation of columnar foundation manually;

$$Pm=11032.32/2*2*500= 5.5 \text{ days}$$

Concreting of raft foundation:

$$Pm=56.784/1*2*2280=6 \text{ days}$$

Backfilling:

$$Pm=2179.68/2*2*200=3 \text{ days}$$

Soil compaction:

$$Pm=7265/2*2*115=5 \text{ day}$$

Final land planning:

$$Pm=1540/2*2*200=2 \text{ days}$$

Duration of manual processes is determined by:

$$P\text{p}=Q/n\cdot A\text{m} \quad (37)$$

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

N – Number of workers per shift.

The construction of temporary fencing:

$$P\text{p}=441.6/2*10=2 \text{ days}$$

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

$$P\text{p}=246.01/2*5=2 \text{ days}$$

Excavation of soil underrun:

$$P\text{p}=19469.03/2*20=15 \text{ days}$$

Concrete preparation for foundations:

$$P\text{p}=692.12/2*10=3 \text{ days}$$

Reinforcement installation of columnar foundation manually:

$$P\text{p}=92008.16/2*20=23 \text{ days}$$

Formwork installation of columnar foundation manually :

$$P\text{p}=3971.64/2*20=9 \text{ days}$$

Concreting of columnar foundation:

$$P\text{p}=68.14/2*2=2 \text{ days}$$

Formwork removal of columnar foundation;

$$P\text{p}=420.02/2*10=9 \text{ days}$$

Foundation waterproofing:

$$P\text{p}=670566/2*20=17 \text{ days}$$

Final land planning;

$$P\text{p}=508.2/2*10=3 \text{ days}$$

Removal of temporary fencing;

$$P\text{p}=331.2/2*10=2 \text{ days}$$

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[9].

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

$$\text{K}u=nmax/nav, \quad (38)$$

Where, nmax– the maximum number of workers at the facility;

nav – the average number of workers:

$$nav = \Sigma Q / \, , \tag{39}$$

where, Q – total labor input (labor costs)

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

$$nav = \Sigma Q / Ptota$$

$$Кu = nmax / nav,$$

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[16].

8 Definition of scope of work

Based on the analysis of the architectural and planning solution of the buildingIt is necessary to calculate the amount of installation work in a tabular form (Table 1). To do this, set the size of the elements, to calculate the geometric volume and mass of each of them, to determine the required number of them as a separate sample floor (span), and in the building as a whole. When designing the production of stone works in the course project, it is advisable to calculate the volume of work in a tabular form (Table 2). After compiling the table by summing up determine the total volume of masonry. Further, depending on the type of structures and technology, the calculation of the volume of work, which is reduced to compilation of "Bulletin of work volumes[15].

Table 8 - Specification of monolithic reinforced concrete elements on the standard floor

Name of element	Mark of concrete	Sizes without Apertures, m			Volume of element ,m3	Sizes of apertures, m			Volume of apreture,m3	Number element in the floor	Volume of Concrete, m3	
		Length	Width	Height		Length	Width	Height			In one element	In whole floor
Raft foundation	M25	6	0.3	3	5.4	2	0.2	2	0.8	42	5.4	226.8

Table 9 - Bill of Quantities

Name of work	Unit of measurement	Amount		Calculation of volume of work
		To capture	In the whole building	
Brick wall	M3	28	252	7056

When calculating the amount of installation work should be considered as main installation processes, and accompanying auxiliary work (for example, welding joints of prefabricated elements, sealing joints, jointing).

The amount of work to seal joints with concrete between and the coatings are determined in meters of the seam. The number of seams with sufficient an exact degree of accuracy can be determined by the formula.

$$Lm = \Sigma p N / 2 \quad (40)$$

Where p - is the perimeter of one plate, m.

N - number of plates of this type, pcs.

To determine the amount of work on the electric weld joints length the seam is adopted depending on the type of building and the type of constructive elements. To determine the length of weld seams w / w structures in the course project can use the data, shown in[7].

Installation of the frame of a multi-storey building: installation of foundations; installation of columns; laying of crossbars; installation of floor slabs and coatings; installation of landings and marches; installation of external wall panels; electric welding of mounting joints; monolithic mounting joints; filling the joints of floor slabs and coatings; sealing and jointing of external seams of wall panels.

When compiling the “Bulletin of the scope of work” for brick buildings, it is necessary to take into account that masonry of walls is performed as a complex process, which includes the assembly of prefabricated structures, the arrangement and rearrangement of scaffolding and scaffolding, the supply of brick and mortar to the workplace. Amount of work on the masonry walls should be calculated separately for the inner and outer walls, partition walls thickness 1/4 and 1/2 bricks, the material, the thickness of the masonry walls pits and ducts.

The complexity of the masonry of the outer walls varies in the following types: simple - with complicated parts up to 10% of the wall area; walls of medium complexity - with complicated parts up to 20% of the wall area; particularly complex walls - with complicated parts that occupy more than 40% of the wall area. The complicated parts of the masonry include pilasters, cornices, girdles, bay windows, loggias, niches, etc. made of brick or various ceramic blocks. The volume of masonry walls is calculated by the formula.

$$V = (F - P) b \quad (41)$$

Where F - the area of the walls, m2.

P - the area of window and door openings along the outer contour of the boxes, m2.

bin - wall thickness, m.

The volume of mortar for masonry depends on the thickness and complexity of the walls and partitions. To calculate the volume of mortar when building brick external and internal walls, as well as various thicknesses of partitions, it is advisable to use the data given in the table .

$$V=(6804-768)=4992.6$$

When erecting monolithic structures, the main processes that form the bill of quantities are: installation, disassembly and rearrangement of formwork of walls, columns, ceilings; installation of reinforcing frames and grids; welding and knitting of joints of fittings; reception, supply and laying of concrete mix.

When calculating the volume of the device of monolithic structures, the formwork area is established as a result of determining the area of the side surfaces of

The choice of load-gripping devices and rigging equipment is made using reference literature and is formatted as [1].

During the design of monolithic buildings, in accordance with the chosen methods of erection, the choice of a crane for the installation of formwork and reinforcement is made, the choice of the formwork system with the compilation Table. 6 and schemes of layout of panels in enlarged formwork modules on a fragment of a wall, columns, overlapping, the equipment for submission, stacking and consolidation of a concrete mix is determined [2].

Table 10 - The sheet of load-gripping devices and rigging equipment

Name	Mark	Amount	Purpose
load-gripping devices (crane)	RDK-250	2	Lifting and assembling Prefabricated wall

Table 11 - Specification of formwork

Type of shield(formwork)	Size,mm		Number of shields(formwork)
	Length	width	
large panel formwork, (linear and universal boards)	3000	300	86*2=172

8.1 Calculation of the turnover of scaffolding and formwork

We define the formwork by the following formula[8]:

$$z = \frac{\sum_1^a m}{n-1+\frac{A*tb}{K}} \tag{42}$$

where $\sum_1^a m$ - total number of seizures on all tiers constructions.

n - the number of simple processes;

A - the number of shifts per day;

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

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

The required number of sets of formwork is determined from the expression: sets.

$$a = n + 1 + \frac{A \cdot t_б}{K}$$

$$z = \frac{20}{2 - 1 + \frac{2 \cdot 6}{1}} = 1.5$$

$$a = 2 + 1 + \frac{2 \cdot 6}{1} = 15$$

Table 12 - List of mechanisms, equipment and devices for transportation, laying and compaction of concrete mixture

Name (mark)	Appointment	Main parametrs	Required quantity
MAZ500	Dum truck	Transfereng 172 sheilds	2
Vibrator	Max volume: 7 m3 Max mass of concrete: 11910kg Model code: 3299	Compaction of concrete of foundation	8
RDK-250	Tower crane	Transferring material and prefabricated walls	2
ABN 581532	Concrete mixer	Receiving concrete mixing and supply it	1

8.2 Determination of labor volume and cost of exposure

The assignment of specific ways and means to carry out the bot allows you to specify the composition and scope of work and go to the their specific labor intensity on the projected facility. The labor intensity is calculated using the data in Table. 1 to 4 and norms of time for work in accordance with ENIR [3, 4].

The calculation is carried out in the form of "Statement of labor costs, machine time-costs and labor costs "(Table 8); when compiling a statement the composition of the workers' links according to the ENIR is determined.

Table 13 – The cost labor time and labor cost

Name of process	Unit of measurement	Volume of work	Rationale of ENIR	Rate of time	
				Workers	Driver
Concreting	M3	619.2		16	8

Table 14 - The cost labor time and labor cost

Labor input		Link composition to ENIR		Cost value	
Workers Person-hour	Driver-hour	Profession rank	Amount	Unit rate	Total cost
5000	5000	Low	10	5000	50000

9 Calculation of required parameters of mounting crane

The choice of the type of cranes depends on: the configuration and size of the structure; overall dimensions, degree of enlargement, mass, and location of the structures to be mounted; adopted method of installation[6].

Tower cranes. The choice of mounting crane is made by finding the three main characteristics: - the required capacity (mounting weight), height of the hook (installation height) and boom.

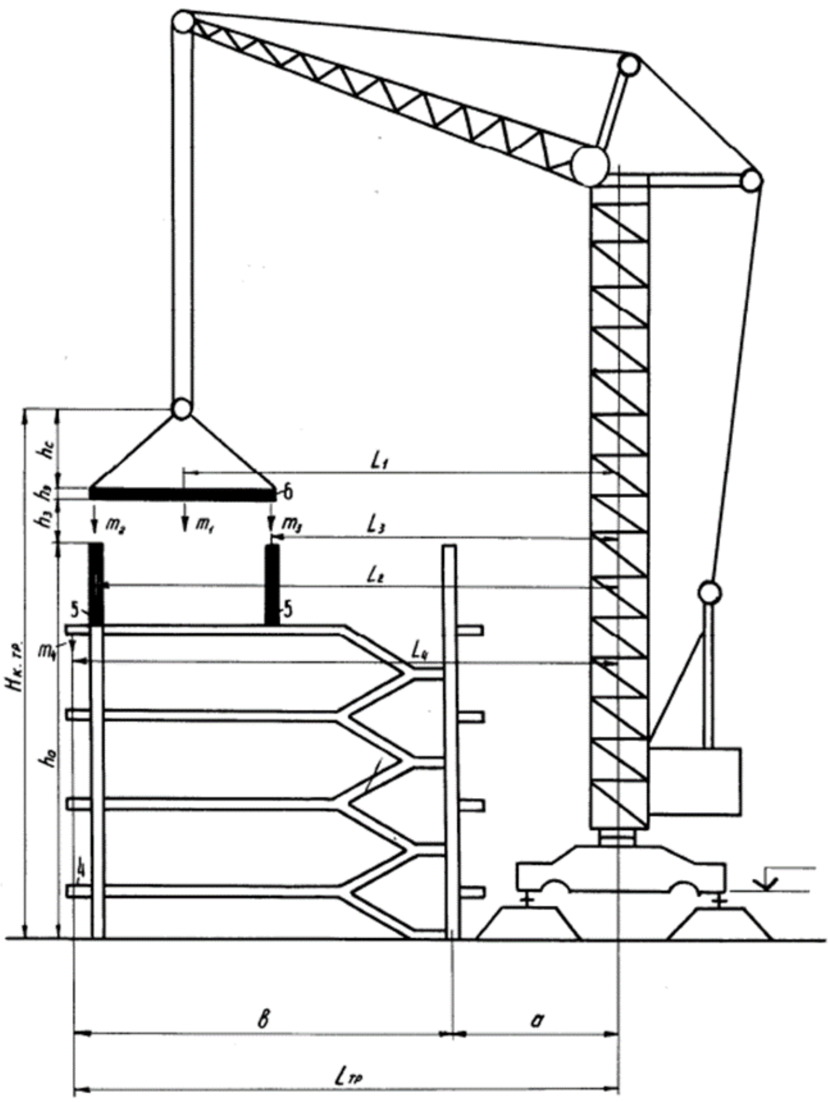

Figure 10 - Scheme for determining the parameters of tower cranes (RDK-250)

When assembling structures of multi-storey buildings with tower cranes, the required hook reach (m) is determined from the installation condition of the element farthest from the crane axis[9].

$$Ltp = a + b \tag{43}$$

Where a is the distance from the axis of rotation of the crane to the nearest wall of the building, providing the dimension for the lower part of the crane during its rotation, m;

b - distance from the wall closest to the crane to the center of gravity of the most distant element (or building width), m.

The required height of the hook H.tr (m) is determined from the condition of lifting the highest positioned element according.

The crane lifting capacity is taken according to the largest mounting mass of the element according to the formula (3), while checking that the required load moment corresponds to the load moment of the selected crane.

Required load moment Mtr is the largest product of the mounting weight of the element Qe and the corresponding hook reach L (m).

After determining the design parameters of the mounting cranes according to their technical characteristics, such machines are selected whose operating parameters satisfy the design ones, equal to them or slightly surpass them.

The type of mounting crane is selected in two stages. First accept technically acceptable options, and then, comparing the technical and economic indicators, choose the best option.Hook lifting height[8].

$$H = h0 + hzap + he + hp \quad (44)$$

Where h0 is the mark on which the structure is installed, m.

hzak - Height reserve - the minimum distance between the mounting level and the bottom of the mounted element (usually 0.4 ... 1.0 m), m;

he - Height (or thickness) of the element in the installation position, m.

hpr - Sling height in the working position from the top of the mounted element to the crane hook (laying of the slings from 1: 1 to 1: 2, height within 1 ... 4 m),

So H= 1+1+3+1.5=5.5

Departure of an arrow of the crane (crane hook)

$$L = a / 2 + b + c + 1 \quad (45)$$

Where a is the width of the crane runway, m;

b - Distance from the head of the crane runway nearest to the building to the building, m;

c - Building width, m;

1 m - The minimum stock for acceptance of the element without tightening, taking into account safe installation.

L= 6/2+1.75+24=28.75

Required crane capacity

$$Q = q1 + q2 \quad (46)$$

Where q_1 - is the maximum mass of the lifted load, t.

Q_1- Traverse mass or other construction device, t.

q_2 - Lifting equipment and tools weight (0,1÷0,15), t.

$$Q_{cr} = (435.8 + 0.6) =436.4$$

$$q_1 = 435.8$$

$$q_2=0.6$$

The cost of installation of units of production according to the formula.

$$Ced = Cmk/P0 \quad (47)$$

Where C mk - The cost of installation of the entire volume of building structures.

P 0 - The total volume of mounted designs, t; m3.

Ced= 714.4/800 =0.893

The duration of the complex process (specialized stream) of installation of structures is determined by the schedules of the work, or from the laws of in-line production.

The duration of the specialized stream of installation of structures of a multi-storey building is found from the following expression.

$$T = Nmk + \sum Ti +Tb \quad (48)$$

Where N - is the number of floors.

m - The number of captures.

K - the rhythm of the flow.

T - The duration of technological auxiliary processes, for the implementation of which it is necessary to interrupt the leading process - installation of structures T and - the duration of the technological support processes carried out after the installation of building structures[11].

T= 9*1*1+5+2=16

The complexity of the unit of installation of prefabricated structures, man-h / t or man-h / m, is determined by the formula,

$$Q = Qmk/P0 \quad (49)$$

Where Q m k - the total complexity of installation of prefabricated structures, man-hours;

P 0 - the total volume of mounted structures, t; m3.

Q= 330/226.8 = 1.45

The production of workers per shift, t or m3, is

$$B= P0*tc/Qmkh \quad (50)$$

Where tc - the duration of the shift, h

B= 800*8/330*9=237.03

Production of cranes per shift, t or m3,

$$Bk=P0/Ty \quad (51)$$

Where Ty - the duration of installation of structures, shifts. "

Bk=800/8=100

The economic efficiency of the adopted version of the installation work can be determined by the difference in the costs:

$$Э= (C1-C2) +E(K1-K2) \quad (52)$$

Where Ci — C2 is the difference in the cost of a unit of work of the compared options,E is the normative efficiency coefficient,

Ki — K2 is the difference in specific capital investments for the compared options.

Э= 20.4+9.5*1.2=31.8

Specific capital investments for mounting cranes are determined by the formula.

$$K= \sum \frac{Sj}{Ndj*qmj} \quad (53)$$

Where Sj - the estimated cost of the crane the directive number of changes in crane operation per year;

Mj - the volume of work performed by the crane per shift, t or m3.

K= ∑Sj/(Ndj*qmj) = 34.8

Table 15 - Technical and economic indicators

Indicators	Value indicators for options	Relative value for variant %
The given unit of cost m3	0.893	0.00893
Specific labor input m3	1.45	0.0145
Duration of work shifts	16	0.16
Total	18.1	0.18.1

Table 16 - Costing labor, machine time and wages

Name of process	Unit of measurement	Volume of work	Rationale of ENIR	Rate of time	
				Workers	Driver
Concreting	M3	619.2		16	8

Table 17 - Costing labor, machine time and wages

Labor input		Link composition to ENIR		Cost value	
Workers Person-hour	Driver-hour	Profession rank	Amount	Unit rate	Total cost
5000	5000	Low	10	5000	50000

Section 5. Schedule of work. The schedule of work is compiled using the data of costing labor.

The duration of manual processes is determined by dividing the labor costs (person-h) by the accepted composition of the link (person). The duration of mechanized processes is determined by dividing the cost of machine time (mash.-h) by the number of leading machines on the capture. Schedule

sets from the conditions of an 8-hour working day using machines and mechanisms not less than two shifts.

When constructing the schedule, it is necessary to take into account the time of technological breaks associated with the set of concrete strength before demolition and subsequent loading. The form of the schedule is given in table. 12.

10 Determination of the composition of the integrated team

The number of workers in the integrated brigade will be determined by the formula[17]:

$$N = \frac{Q}{K \cdot m \cdot p} \tag{54}$$

Where Q - labor intensity of this type of work on the stage, people;
K - cyclic change module; m - number of seizures on the tier;
p - percentage of overfulfillment of the norms of working-out.

$$N = \frac{Q}{K \cdot m \cdot p} = 22.2$$

Table 18 - Statement of need for tools, equipment and fixtures

Name (mark)	Appointment	Main parametrs	Required quantity
MAZ500	Dum truck	TRANSFERENG 172 sheilds	2
Vibrator	Max volume: 7 m3 Max mass of concrete: 11910kg Model code: 3299	Compaction of concrete of foundation	8
Tower crane	RDK-250	Transferring material and prefabricated walls	2
Concrete mixer	ABN 581532	Receiving concrete mixing and supply it	1

Table 19 - Statement of need for materials, semi-finished products and structures

Name of material		mark	quantity	total
1		2	3	4
concrete		M25	5.4	232.2
Brick		M3	23	252.2

Table 20 - Quality control of work

Name of the processes to be controlled	Subject of control	Instrument and method of control	Frequency of control	Responsible for control	Technical criteria for quality control
1	2	3	4	5	6
Manual installation of reinforcement and frames	Reinforcing	Visually control	Controlling in every grip	Site engineer	According to technical criteria the quality of work is 97% perfect and 3% failure
Construction of scaffolding supporting formwork	Creating support for formwork	Visually control	Every plat and joints are controlled	Site engineer	The scaffolding 100% fitted correctly
Installation of formwork for wall	Formwork installation	Controlled by level instrument and inspection	The sizes of wall are controlled in every formwork	Site engineer	The formworks are fitted 98% correct
Formwork dismantling of walls	Removing of formwork	Visually control	Formworks are removed simultaneously	Site engineer	Removed 95% correct
Installation of formwork for slab	Installation of formwork	Controlled by level instrument and inspection	Formworks are installed in zero angle level and every floor	Site engineer	The formworks are fitted 98% correct
Formwork dismantling of slab	Removing of formwork	Visually control	Formworks are removed simultaneously	Site engineer	Removed 97% correct
Preparation of concrete	Concrete preparation	Sampling with jar	Controlled in every mixing period	Site engineer	According to technical criteria the quality of concrete is 96% perfect and 4% failure
Concrete delivery by concrete pumps	Delivery of concrete	Concrete pump	Controlled in every delivery period	Site engineer	97% correct delivery
Laying concrete mixture in the structure	Concreting pouring	Concrete pump and vibrator	Concrete pouring controlled periodically	Site engineer	97% correct pouring

11 Safety measures

In the production of reinforced concrete works, it is necessary to strictly comply with the requirements of SNiP 1-85-2001 "Occupational Health and Safety in Construction" and observe certain rules:

- Workers must be provided with safe access to the work.
- Guardrails must be put in place as work progresses.
- Access ladders must be properly erected tied and project at least 1 metre above the landing platform.
- Ladders or an access scaffold must be used for access.
- Equipment must be in good order before use.

The formwork used for the erection of monolithic reinforced concrete structures must be manufactured and applied in accordance with the PPR approved in accordance with the established procedure.

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

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

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

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

When cranes are working, people are not allowed to stay in the zone of operation. Do not carry the load over workers.

It is forbidden to swing a suspended cargo and leave it without supervision, as well as to conduct installation with a wind of more than 6 points.

It is prohibited to operate the boom crane directly under the wires of operating power lines of any voltage.

The descent of workers into the pit or trench is allowed only on the stairs.

If cracks or trenches appear in the slopes of the trench, which threaten the collapse, it is necessary to fix the walls or reduce the steepness of the slope before the work begins.

Welding transformers and lighting fixtures must only be connected to an electrician on duty.

For a temporary power grid on a construction site, an insulated wire should be used and suspended on reliable supports at a height of at least 2.5 m above the workplace, 3 m above the aisles and 5 m above the thoroughfares. At an altitude of at least 2.5 m from the ground, the electrical wires must be enclosed in cords or boxes.

Welding transformer housings and welded products are grounded in accordance with SNiP 1-85-2001 n 6.15.

Welding transformers are only included in the network with the use of closed types[18].

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

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

Workers with electric vibrators are allowed to work only after medical conclusion. Medical re-examination is carried out regularly and on time.

Concrete workers are provided with overalls, including shoes and vibration-proof dielectric gloves.

The vibrator housings are reliably grounded, and the wires feeding the vibrators are enclosed in rubber pins.

When compacting the concrete mix, the electric vibrator must not be moved by current-carrying hoses, and at the end it must be switched off.

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

Prior to the commencement of excavation work at the locations of existing underground utilities, measures for safe working conditions should be developed and agreed with the organizations operating these utilities, and the location of the underground utilities in the area is indicated by appropriate signs or inscriptions.

Excavation work in the area of existing underground utilities should be carried out under the direct supervision of the superintendent or foreman, and in the security zone of live cables or an existing gas pipeline, in addition, under the supervision of electric or gas facilities.If explosive materials are discovered, excavation work in these places should be stopped immediately before obtaining permission from the relevant authorities[9].

Before starting excavation work in areas with possible pathogenic contamination of the soil (landfill, cattle burial grounds, cemeteries, etc.), permission of the State Sanitary Inspection is required.

Excavations and trenches developed on the streets, driveways, in the yards of populated areas, as well as places where people or vehicles are moving, must be fenced with a protective fence, taking into account the requirements of GOST 23407-78. It is necessary to install warning signs and signs on the fence, and at night time - signal lighting. The places for people to pass through the trenches should be equipped with transitional bridges illuminated at night.

Soil extracted from the pit or trench should be placed at a distance of at least 0.5 m from the edge of the recess.

Digging in pits and trenches is not permitted. Boulders and stones, as well as peeling soil found on the slopes, must be removed. Digging pits and trenches with vertical walls without fastenings in non-rocky and unfrozen soils above the groundwater level and in the absence of underground structures near it is allowed to a depth of not more than, m:

1,0 - in bulk, sandy and coarse soil;

1.25 - in sandy loam;

1.50 - in loams and clays.

Digging pits and trenches with slopes without fastenings in non-rocky soils above the groundwater level (taking into account capillary rise) or in soils drained using artificial water reduction is allowed at the depth of excavation and the steepness of the slopes according to Table. 4.

The steepness of the slopes of the recesses with a depth of more than 5 m in all cases and a depth of less than 5 m under hydrogeological conditions and soil types not provided for in clause 9.10 and table. 4 should be installed by the project.

If it is impossible to use inventory fastenings of the walls of foundation pits or trenches, fastenings made according to individual projects approved in the established order should be used.When installing the fasteners, their upper part should protrude at least 15 cm above the edge of the recess.It is necessary to install fasteners in the direction from top to bottom as the excavation is developed to a depth of not more than 0.5 m.

Disassembly of the fasteners should be made in the direction from the bottom up as the backfilling of the recess.The development of trenches with vertical walls without fastening by rotary and trench excavators in cohesive soils (loams, clays) is allowed to a depth of not more than 3 m. In places where workers are required to stay, trenches or slopes should be fixed.

Work in pits and trenches with slopes that have undergone wetting is allowed only after a thorough inspection by the manufacturer (master) of the condition of the slopes and the collapse of unstable soil in places where “peaks” or cracks (delaminations) are found.

11.1 Concrete and reinforced concrete work

The formwork used for the construction of monolithic reinforced concrete structures must be manufactured and applied in accordance with the work design approved in the established manner.When installing formwork elements in several tiers, each subsequent tier should be installed only after the lower tier has been fixed.

Placing equipment and materials on the formwork that is not provided for by the work project, as well as the presence of people not directly involved in the production of work on the formwork flooring, is not allowed.The dismantling of the formwork should be carried out (after the concrete reaches the specified strength) with the permission of the manufacturer, and especially critical structures (according to the list established by the project) - with the permission of the chief engineer.Harvesting and processing of valves must be carried out in specially designed and suitably equipped places[19].

When performing work on the preparation of valves, it is necessary:enclose places intended for unwinding coils (coils) and straightening reinforcement;

when cutting reinforcing rods by machine tools into segments of less than 0.3 m in length, use devices that prevent their expansion;to protect the workplace when processing reinforcing bars that protrude beyond the dimensions of the workbench, and for bilateral workbenches, in addition, divide the workbench in the middle with a longitudinal metal safety net at least 1 m high;fold the prepared reinforcement in specially designated places;

Cover with shields the end parts of the reinforcing rods in places of common passages having a width of less than 1 m.

When performing work on tensioning the reinforcement, it is necessary: to install protective barriers at least 1.8 m high in places of passage of workers; equip devices for tensioning valves with an alarm that is activated when the drive of the tensioner is turned on; prevent people from staying at a distance closer than 1 m from reinforcing bars heated by electric current.

The descent of workers into chambers heated by steam is allowed after turning off the steam supply, as well as cooling the chamber and the materials and products inside it to 40 ° C.When preparing a concrete mixture using chemical additives, measures must be taken to prevent skin burns and eye damage to workers.

Bins (buckets) for concrete mix must meet GOST 21807. Moving a loaded or empty hopper is allowed only with the shutter closed.

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

During cleaning (testing, purging) of concrete pipelines with compressed air, workers not directly involved in these operations should be removed from the concrete piping by a distance of at least 10 m.Every day before starting to lay concrete in the formwork, it is necessary to check the condition of the packaging, formwork and screed. Detected malfunctions should be rectified immediately.

11.2 Installation work

At the site (capture), where installation work is being carried out, it is not allowed to carry out other work and to find unauthorized persons.When erecting buildings and structures, it is forbidden to perform work related to finding people in one section (grab, section) on floors (tiers) over which moving, installing and temporarily securing prefabricated structures or equipment are carried out.

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

Ways of slinging structural elements and equipment should ensure their supply to the installation site in a position close to the design[20].

It is forbidden to lift prefabricated reinforced concrete structures that do not have mounting loops or marks that ensure their correct slinging and installation.Cleaning of structural elements to be mounted from dirt and ice should be done before they rise.

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

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

People are not allowed to stay on structural elements and equipment during their lifting or moving.During breaks in the work, it is not allowed to leave the raised structural elements and equipment on weight.

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

Elements of structures or equipment installed in the design position must be fixed so that their stability and geometric immutability are ensured.Distribution of structural elements and equipment installed in the design position should be made after their permanent or temporary reliable fixation. It is not allowed to move installed elements of structures or equipment after their distribution, with the exception of cases justified by PPR.

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

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

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

During the installation of structures, buildings or structures, installers must be on previously installed and securely fixed structures or scaffolds.Installation of flights of stairs and platforms of buildings (structures), as well as cargo-passenger building lifts (elevators) should be carried out simultaneously with the installation of building structures. On mounted staircases, fences should be installed immediately.

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

When dismantling structures and equipment, the requirements for installation work should be followed.Simultaneous dismantling of structures or dismantling of equipment in two or more tiers along one vertical is not allowed.

CONCLUSION

The main purpose of architecture has always been to create the living environment necessary for human existence, the nature and the comfort of which was determined by the level of development of society, its culture, achievements of science and technology. Extension relevance the construction of Wedding Palaces is due to a number of features social development. These include: an increase in the population in cities, an increase in its cultural level, civil responsibility and material security. The diploma work consists of the following sections: architectural construction, design and construction, construction technology production, economic part.

In the architectural and construction section, decisions on the general plan are justified object, according to the space-planning and constructive solution, according to engineering equipment. In this section, heat engineering calculation of external walls and covering slabs. In the design and construction section, the design scheme of one block, compiled a collection of loads and determined the forces in the supporting structures with using the PC "Lira-Sapr 2016".

In the section of construction production technology, methods are defined construction production, a construction plan has been developed, as well as a calendar schedule. The accepted work methods provide for a comprehensive mechanization and use of high-performance construction machines, ensuring high quality of work and labor safety, flow and uninterrupted construction process. The rationality of the choice of methods of production of work, complex mechanization, technological sequence and the relationship of individual types of work are reflected by technical and economic indicators. The construction master plan was developed in compliance with the requirements of Eurocode.

The economy section includes the data of the consolidated estimate calculation construction costs. This project is designed for the convenience and comfort of our children and youths. An effective school facility is responsive to the changing programs of educational delivery, and at a minimum should provide a physical environment that is comfortable, safe, secure, accessible, well illuminated, well ventilated, and aesthetically pleasing. The school facility consists of not only the physical structure and the variety of building systems, such as mechanical, plumbing, electrical and power, telecommunications, security, and fire suppression systems.

LIST OF USED LITERATURE

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3 SN RK 2.02-01-2014 "Fire safety of buildings and structures." 4 SN RK 2 04-02-2011 “Protection against noise”.
5 SN RK 2.04-01-2011 "Natural and artificial lighting."
6 SP RK 5.01-102-2013 “Foundations of buildings and structures”.
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14 Lyashenko T.A. Guidelines for the implementation of the course project - Tikhoretsk: FSBEI HPE RGUPS, 2016 - 52 p.
15 Dzhumagaliev T.K., Kalpenova Z.D. The technology of construction of the underground part of buildings and structures. The task and guidelines for the implementation of the course project in the discipline "Technology of building production-1" for full-time and part-time students of specialties 5B072900 - Construction" and 5B042000 - "Architecture". - Almaty: KazGASA , 2013 - 45 p.
16 ENiR E2-1 "Earthworks".
17 ENiR E4-1 “Installation of prefabricated and installation of monolithic reinforced concrete structures”.
18 Technology of building production: a manual for students of specialties 1-70 02 01 "Industrial and civil construction", 1-70 02 02 "Expertise and property management" specialties 1-27 01 01-17 "Economics and organization of production (construction)" / S.N. Leonovich , V.N. Chernoivan . - Minks :BNTU, 2015 .-- 505 s.
19 NTP RK 01-01-3.1 (4.1) -2012 “Loads and impacts on buildings. Snow load. Wind impacts. " 20 SN RK 1.03-05-2011 “Labor protection and safety measures in construction”.20 NTP RK 02-01-1.1-2011 “Design of concrete and reinforced concrete structures made of heavy concrete without prestressing reinforcement”.

Appendex A

IMPORTANT. Geometrically unstable system at node 57986 along direction UZ with residual 100% (0 applied against -90.1717 obtained). Restraint is imposed.

IMPORTANT. Geometrically unstable system at node 30501 along direction UX with residual 100% (0 applied against 72.8023 obtained). Restraint is imposed.

IMPORTANT. Geometrically unstable system at node 30312 along direction UX with residual 100% (0 applied against 72.731 obtained). Restraint is imposed.

IMPORTANT. Geometrically unstable system at node 57986 along direction UY with residual 100% (0 applied against 63.2714 obtained). Restraint is imposed.

IMPORTANT. Geometrically unstable system at node 57986 along direction UX with residual 100% (0 applied against 26.9003 obtained). Restraint is imposed.

IMPORTANT. Geometrically unstable system at node 4744 along direction UZ with residual 100% (0 applied against -11.8713 obtained). Restraint is imposed.

IMPORTANT. Geometrically unstable system at node 4744 along direction UY with residual 100% (0 applied against 8.75726 obtained). Restraint is imposed.

IMPORTANT. Geometrically unstable system at node 4735 along direction UZ with residual 100% (0 applied against 6.23351 obtained). Restraint is imposed.

IMPORTANT. Geometrically unstable system at node 4735 along direction UX with residual 100% (0 applied against -6.19246 obtained). Restraint is imposed.

IMPORTANT. Geometrically unstable system at node 25204 along direction UZ with residual 100% (0 applied against 6.1782 obtained). Restraint is imposed.

IMPORTANT. Only 10 messages about geometrical unstability with max residual are displayed. Altogether such messages 2472. Unstability is found in directions X, Y, Z, UX, UY, UZ

Nodes with unknowns that cause geometrically unstable system are coloured red on the model

IMPORTANT. Residual of solution at node 62805 along direction Y. Residual 100% (0.000258745 applied against -0.000182295 obtained)

IMPORTANT. Residual of solution at node 46637 along direction UZ. Residual 100% (0 applied against 2.13768e-005 obtained)

IMPORTANT. Residual of solution at node 46769 along direction UZ. Residual 100% (0 applied against 2.09648e-005 obtained)

IMPORTANT. Residual of solution at node 52218 along direction UY. Residual 100% (0 applied against -2.01369e-005 obtained)

IMPORTANT. Residual of solution at node 57813 along direction UZ. Residual 100% (0 applied against 2.00072e-005 obtained)

IMPORTANT. Residual of solution at node 57803 along direction UZ. Residual 100% (0 applied against -1.91187e-005 obtained)

IMPORTANT. Residual of solution at node 52217 along direction UY. Residual 100% (0 applied against -1.83415e-005 obtained)

IMPORTANT. Residual of solution at node 52297 along direction UY. Residual 100% (0 applied against -1.64699e-005 obtained)

IMPORTANT. Residual of solution at node 35899 along direction UZ. Residual 100% (0 applied against 1.60778e-005 obtained)

IMPORTANT. Residual of solution at node 52199 along direction UY. Residual 100% (0 applied against -1.5511e-005 obtained)

IMPORTANT. Only 10 max residuals are displayed. Altogether residuals 424. Residuals are found along directions X, Y, UX, UY, UZ

IMPORTANT. Buckling at node 62797 along direction Y.

Nodes with buckling are coloured red on the model

18:44 Calculating natural vibrations

18:44 Iteration No.1

18:44 Iteration No.2

0 shapes obtained (among them 0 in specified range)

18:44 Iteration No.3

4 shapes obtained (among them 4 in specified range)

18:44 Iteration No.4

4 shapes obtained (among them 4 in specified range)

18:44 Iteration No.5

5 shapes obtained (among them 5 in specified range)

18:44 Iteration No.6

9 shapes obtained (among them 8 in specified range)

18:44 Iteration No.7

10 shapes obtained (among them 9 in specified range)

18:44 Iteration No.8

12 shapes obtained (among them 11 in specified range)

18:44 Iteration No.9

14 shapes obtained (among them 13 in specified range)

18:44 Iteration No.10

16 shapes obtained (among them 15 in specified range)

18:44 Iteration No.11

19 shapes obtained (among them 18 in specified range)

18:44 Iteration No.12

21 shapes obtained (among them 20 in specified range)

18:45 Iteration No.13

23 shapes obtained (among them 22 in specified range)

18:45 Iteration No.14

25 shapes obtained (among them 24 in specified range)

18:45 Iteration No.15

27 shapes obtained (among them 26 in specified range)

18:45 Generating vectors of dynamic loads

18:45 Calculating unknowns

Generating results

18:45 Generating topology

18:45 Generating displacements

18:45 Calculating and generating forces in elements

18:45 Calculating and generating reactions in elements
18:45 Calculating and generating force diagrams in bars
18:45 Calculating and generating deflection diagrams in bars
18:45 Generating mode shapes
Total nodal loads on main model:
Load case 1 PX=-1.5043e-008 PY=-3.09253e-013 PZ=14513.7 PUX=0.361682 PUY=0.0121076 PUZ=-9.94983e-008
Load case 2 PX=0 PY=0 PZ=2070.37 PUX=0.115605 PUY=0.00585516 PUZ=0
Load case 3 PX=0 PY=0 PZ=5982.43 PUX=-1.27321 PUY=3.47377 PUZ=0
Load case 4 PX=2.83146 PY=-0.341916 PZ=8.96722e-019 PUX=-0.00585164 PUY=-0.0236127 PUZ=0.0330911
Load case 5 PX=0 PY=0 PZ=1828.56 PUX=0.120837 PUY=0.00879186 PUZ=0
Load case 6 PX=0 PY=0 PZ=115.122 PUX=-0.0050445 PUY=-0.00225471 PUZ=0
Load case 7 PX=-69.5267 PY=-69.2115 PZ=0 PUX=1.11716e-015 PUY=-3.05311e-015 PUZ=-1.40998e-014
Load case 8 PX=0 PY=31.144 PZ=0 PUX=0 PUY=0 PUZ=-6.09235e-015
Load case 9-2 PX=-22.2864 PY=-0.00983165 PZ=0.493104 PUX=0 PUY=0 PUZ=0
Load case 9-11 PX=-41.1481 PY=18.3205 PZ=-21.5256 PUX=0 PUY=0 PUZ=0
Load case 9-14 PX=-72.4633 PY=14.5839 PZ=7.18143 PUX=0 PUY=0 PUZ=0
Load case 9-26 PX=-29.962 PY=16.2277 PZ=26.5893 PUX=0 PUY=0 PUZ=0
Load case 10-4 PX=0.0993707 PY=-21.2129 PZ=3.63272 PUX=0 PUY=0 PUZ=0
Load case 10-5 PX=-11.7082 PY=-63.5845 PZ=0.736908 PUX=0 PUY=0 PUZ=0
Load case 11-6 PX=18.0319 PY=-9.7213 PZ=-54.8203 PUX=0 PUY=0 PUZ=0
Analysis protocol
Date: 18.03.2021
GenuineIntel   Intel(R) Core(TM) i5-10300H CPU @ 2.50GHz   8 threads
Microsoft Windows 10 ENG 64-bit. Build 19042
Available RAM = 11185524224
19:30 Reading input data from file C:\Users\Public\Documents\LIRA SAPR\LIRA SAPR 2016 NonCommercial\Data\Mustafa deploma.txt
19:30 Carrying out a check of input data for the main model
Number of nodes = 62808 (among them = 62088 nodes that are not deleted)

Number of elements = 61009 (among them = 61009 elements that are not deleted)

MAIN MODEL

19:30 Optimizing order of unknowns

Number of unknowns = 303795

STATIC ANALYSIS

19:31 Generating stiffness matrix

19:31 Generating load vectors

19:31 Decomposing stiffness matrix

19:31 Calculating unknowns

19:31 Checking solution

IMPORTANT. For load case ?1, total residual error 5.47566%

IMPORTANT. For load case ?2, total residual error 0.00201227%

IMPORTANT. For load case ?5, total residual error 0.00217163%

IMPORTANT. For load case ?6, total residual error 0.00670354%

IMPORTANT. For load case ?7, total residual error 40.5818%

IMPORTANT. For load case ?8, total residual error 79.6639%

IMPORTANT. Geometrically unstable system at node 57986 along direction UZ with max residual 100% (0.512057 applied against -40.5077 obtained) in load case 7. Restraint is imposed.

IMPORTANT. Geometrically unstable system at node 4740 along direction UZ with max residual 100% (0 applied against 4.54839 obtained) in load case 7. Restraint is imposed.

IMPORTANT. Geometrically unstable system at node 4760 along direction UZ with max residual 100% (-2.22045e-016 applied against -4.54839 obtained) in load case 7. Restraint is imposed.

IMPORTANT. Geometrically unstable system at node 57986 along direction UY with max residual 100% (2.5026 applied against -618.224 obtained) in load case 1. Restraint is imposed.

IMPORTANT. Geometrically unstable system at node 57986 along direction Y with max residual 100% (0.11625 applied against -2.06125 obtained) in load case 7. Restraint is imposed.

IMPORTANT. Geometrically unstable system at node 57986 along direction UX with max residual 100% (1.22142 applied against -262.685 obtained) in load case 1. Restraint is imposed.

IMPORTANT. Geometrically unstable system at node 4735 along direction Y with max residual 100% (0.42625 applied against -1.27875 obtained) in load case 7. Restraint is imposed.

IMPORTANT. Geometrically unstable system at node 57986 along direction X with max residual 100% (0.3295 applied against -1.1203 obtained) in load case 7. Restraint is imposed.

IMPORTANT. Geometrically unstable system at node 4735 along direction UZ with max residual 100% (-0.0500521 applied against 1.1512 obtained) in load case 7. Restraint is imposed.

IMPORTANT. Geometrically unstable system at node 4760 along direction Y with max residual 100% (0.389375 applied against -0.77875 obtained) in load case 7. Restraint is imposed.

IMPORTANT. Only 10 messages about geometrical unstability with max residual are displayed. Altogether such messages 889. Unstability is found in directions X, Y, Z, UX, UY, UZ

Nodes with unknowns that cause geometrically unstable system are coloured red on the model

IMPORTANT. Residual of solution at node 52234 along direction X. Max residual 100% (0 applied against -5.79804e-005 obtained) in load case 1

IMPORTANT. Residual of solution at node 57581 along direction X. Max residual 100% (0 applied against 4.60148e-005 obtained) in load case 1

IMPORTANT. Residual of solution at node 46772 along direction X. Max residual 100% (0 applied against 4.55768e-005 obtained) in load case 1

IMPORTANT. Residual of solution at node 52241 along direction X. Max residual 100% (0 applied against -4.48227e-005 obtained) in load case 1

IMPORTANT. Residual of solution at node 46651 along direction X. Max residual 100% (0 applied against -4.38272e-005 obtained) in load case 1

IMPORTANT. Residual of solution at node 46840 along direction Y. Max residual 100% (0 applied against -4.3001e-005 obtained) in load case 1

IMPORTANT. Residual of solution at node 52228 along direction X. Max residual 100% (0 applied against -4.21205e-005 obtained) in load case 1

IMPORTANT. Residual of solution at node 57721 along direction Y. Max residual 100% (0 applied against 4.16636e-005 obtained) in load case 1

IMPORTANT. Residual of solution at node 57727 along direction Y. Max residual 100% (0 applied against -4.07472e-005 obtained) in load case 1

IMPORTANT. Residual of solution at node 30399 along direction X. Max residual 100% (0 applied against -4.01735e-005 obtained) in load case 1

IMPORTANT. Only 10 max residuals are displayed. Altogether residuals 276. Residuals are found along directions X, Y

IMPORTANT. Buckling at node 62797 along direction Y.

Nodes with buckling are coloured red on the model

DYNAMIC ANALYSIS

19:31 Generating mass matrix for dynamic load case No.9

19:31 Generating mass matrix for dynamic load case No.10

19:31 Generating mass matrix for dynamic load case No.11

Calculating natural vibrations for dynamic load cases No.No.9 10 11

Total masses: mX=1954.79 mY=1954.79 mZ=2358.49 mUX=0 mUY=0 mUZ=0

19:31 Conducting a check of model suitability for calculation of natural vibrations with such mass application. The check is made by applying masses as static loads.

IMPORTANT. Total residual error 4.47631%

IMPORTANT. Geometrically unstable system at node 57986 along direction UZ with residual 100% (0 applied against -90.1717 obtained). Restraint is imposed.

IMPORTANT. Geometrically unstable system at node 30501 along direction UX with residual 100% (0 applied against 72.8023 obtained). Restraint is imposed.

IMPORTANT. Geometrically unstable system at node 30312 along direction UX with residual 100% (0 applied against 72.731 obtained). Restraint is imposed.

IMPORTANT. Geometrically unstable system at node 57986 along direction UY with residual 100% (0 applied against 63.2714 obtained). Restraint is imposed.

IMPORTANT. Geometrically unstable system at node 57986 along direction UX with residual 100% (0 applied against 26.9003 obtained). Restraint is imposed.

IMPORTANT. Geometrically unstable system at node 4744 along direction UZ with residual 100% (0 applied against -11.8713 obtained). Restraint is imposed.

IMPORTANT. Geometrically unstable system at node 4744 along direction UY with residual 100% (0 applied against 8.75726 obtained). Restraint is imposed.

IMPORTANT. Geometrically unstable system at node 4735 along direction UZ with residual 100% (0 applied against 6.23351 obtained). Restraint is imposed.

IMPORTANT. Geometrically unstable system at node 4735 along direction UX with residual 100% (0 applied against -6.19246 obtained). Restraint is imposed.

IMPORTANT. Geometrically unstable system at node 25204 along direction UZ with residual 100% (0 applied against 6.1782 obtained). Restraint is imposed.

IMPORTANT. Only 10 messages about geometrical unstability with max residual are displayed. Altogether such messages 2472. Unstability is found in directions X, Y, Z, UX, UY, UZ

Nodes with unknowns that cause geometrically unstable system are coloured red on the model

IMPORTANT. Residual of solution at node 62805 along direction Y. Residual 100% (0.000258745 applied against -0.000452766 obtained)

IMPORTANT. Residual of solution at node 57803 along direction UY. Residual 100% (0 applied against 2.34361e-005 obtained)

IMPORTANT. Residual of solution at node 52281 along direction UZ. Residual 100% (0 applied against 2.29288e-005 obtained)

IMPORTANT. Residual of solution at node 52287 along direction UZ. Residual 100% (0 applied against 2.03899e-005 obtained)

IMPORTANT. Residual of solution at node 57716 along direction UY. Residual 100% (0 applied against 1.99814e-005 obtained)

IMPORTANT. Residual of solution at node 30350 along direction UZ. Residual 100% (0 applied against 1.9714e-005 obtained)

IMPORTANT. Residual of solution at node 46774 along direction UZ. Residual 100% (0 applied against 1.95433e-005 obtained)

IMPORTANT. Residual of solution at node 46842 along direction UZ. Residual 100% (0 applied against 1.90305e-005 obtained)

IMPORTANT. Residual of solution at node 52203 along direction UY. Residual 100% (0 applied against 1.81573e-005 obtained)

IMPORTANT. Residual of solution at node 52267 along direction UY. Residual 100% (0 applied against -1.74185e-005 obtained)

IMPORTANT. Only 10 max residuals are displayed. Altogether residuals 404. Residuals are found along directions X, Y, UY, UZ

IMPORTANT. Buckling at node 62797 along direction Y.

Nodes with buckling are coloured red on the model

19:31 Calculating natural vibrations

19:31 Iteration No.1

19:31 Iteration No.2

0 shapes obtained (among them 0 in specified range)

19:31 Iteration No.3

4 shapes obtained (among them 4 in specified range)

19:31 Iteration No.4

4 shapes obtained (among them 4 in specified range)

19:31 Iteration No.5

5 shapes obtained (among them 5 in specified range)

19:31 Iteration No.6

9 shapes obtained (among them 8 in specified range)

19:31 Iteration No.7

10 shapes obtained (among them 9 in specified range)

19:31 Iteration No.8

12 shapes obtained (among them 11 in specified range)

19:31 Iteration No.9

14 shapes obtained (among them 13 in specified range)

19:31 Iteration No.10

16 shapes obtained (among them 15 in specified range)

19:31 Iteration No.11

19 shapes obtained (among them 18 in specified range)

19:31 Iteration No.12

21 shapes obtained (among them 20 in specified range)

19:31 Iteration No.13

23 shapes obtained (among them 22 in specified range)

19:31 Iteration No.14

25 shapes obtained (among them 24 in specified range)

19:31 Iteration No.15

27 shapes obtained (among them 26 in specified range)

19:31 Generating vectors of dynamic loads

19:31 Calculating unknowns

Generating results

19:31 Generating topology

19:31 Generating displacements

19:31 Calculating and generating forces in elements

19:31 Calculating and generating reactions in elements

19:31 Calculating and generating force diagrams in bars

19:31 Calculating and generating deflection diagrams in bars

19:32 Generating mode shapes

Total nodal loads on main model:

Load case 1 PX=-1.5043e-008 PY=-3.09253e-013 PZ=14513.7 PUX=0.361682 PUY=0.0121076 PUZ=-9.94983e-008

Load case 2 PX=0 PY=0 PZ=2070.37 PUX=0.115605 PUY=0.00585516 PUZ=0

Load case 3 PX=0 PY=0 PZ=5982.43 PUX=-1.27321 PUY=3.47377 PUZ=0

Load case 4 PX=2.83146 PY=-0.341916 PZ=8.96722e-019 PUX=-0.00585164 PUY=-0.0236127 PUZ=0.0330911

Load case 5 PX=0 PY=0 PZ=1828.56 PUX=0.120837 PUY=0.00879186 PUZ=0

Load case 6 PX=0 PY=0 PZ=115.122 PUX=-0.0050445 PUY=-0.00225471 PUZ=0

Load case 7 PX=-69.5267 PY=-69.2115 PZ=0 PUX=1.11716e-015 PUY=-3.05311e-015 PUZ=-1.40998e-014

Load case 8 PX=0 PY=31.144 PZ=0 PUX=0 PUY=0 PUZ=-6.09235e-015

Load case 9-2 PX=-22.2856 PY=-0.00971644 PZ=0.493066 PUX=0 PUY=0 PUZ=0

Load case 9-11 PX=-40.9315 PY=18.255 PZ=-21.4743 PUX=0 PUY=0 PUZ=0

Load case 9-14 PX=-72.2812 PY=14.5883 PZ=7.12315 PUX=0 PUY=0 PUZ=0

Load case 9-26 PX=-30.0158 PY=16.2705 PZ=26.5959 PUX=0 PUY=0 PUZ=0

Load case 10-4 PX=0.0988784 PY=-21.2122 PZ=3.6326 PUX=0 PUY=0 PUZ=0

Load case 10-5 PX=-11.6404 PY=-63.8497 PZ=0.661744 PUX=0 PUY=0 PUZ=0

Load case 11-6 PX=17.981 PY=-9.68571 PZ=-54.7656 PUX=0 PUY=0 PUZ=0

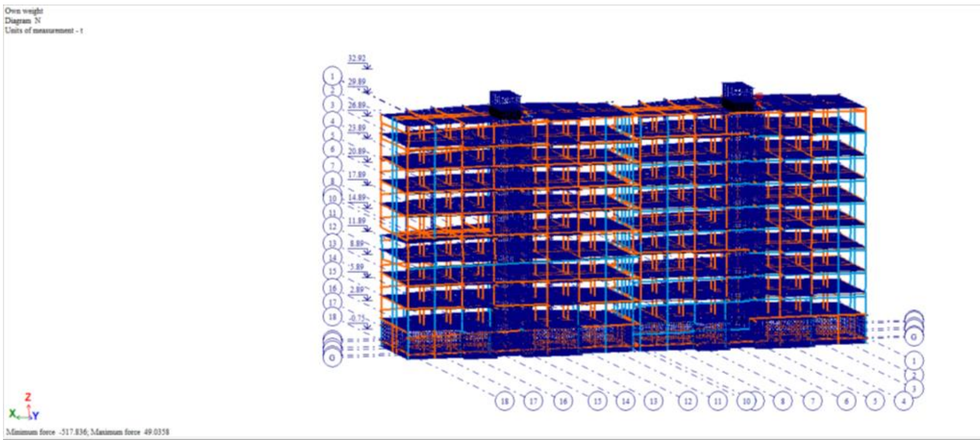


Figure A.1 - Axial force diagram N

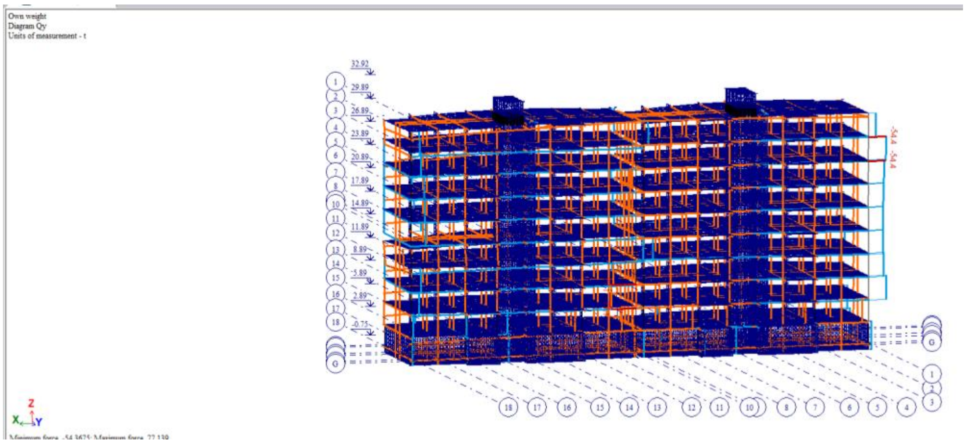


Figure A.2 - Shear force diagram Qy

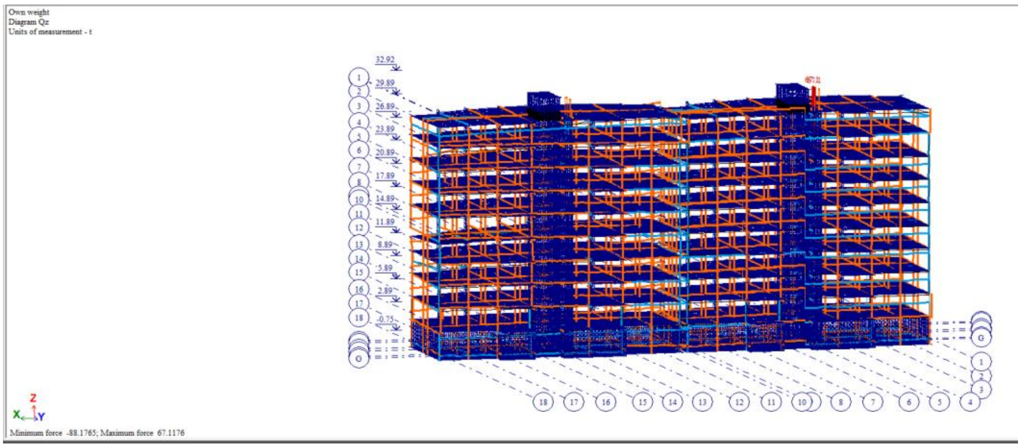


Figure A.3 - Shear force diagram Qz

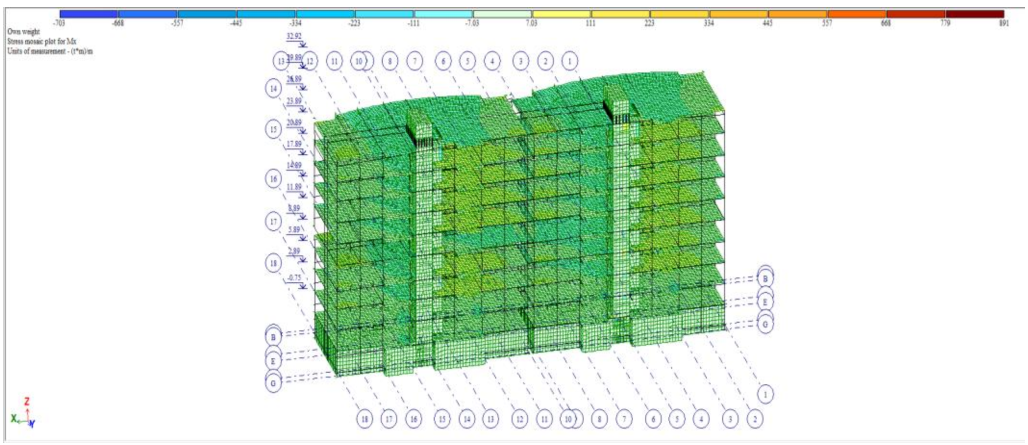


Figure A.4 - Stress Mx

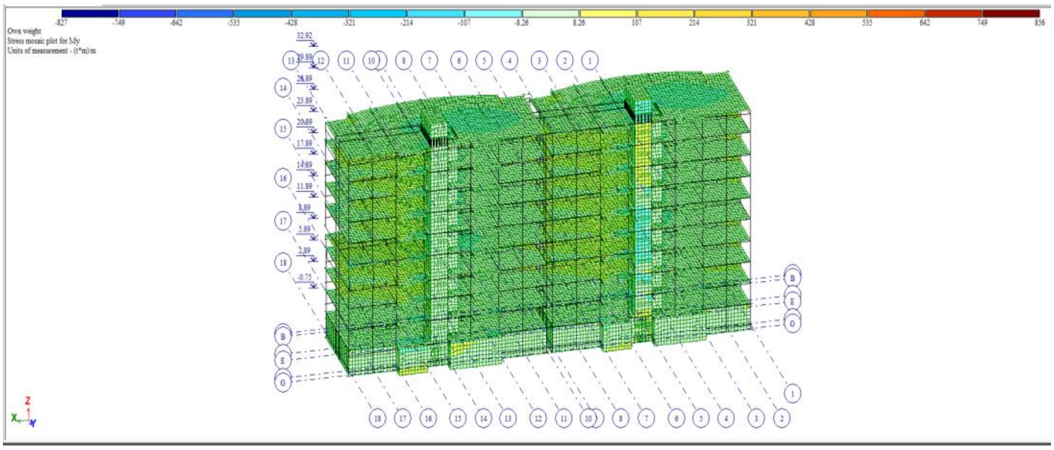


Figure A.5 - Stress My

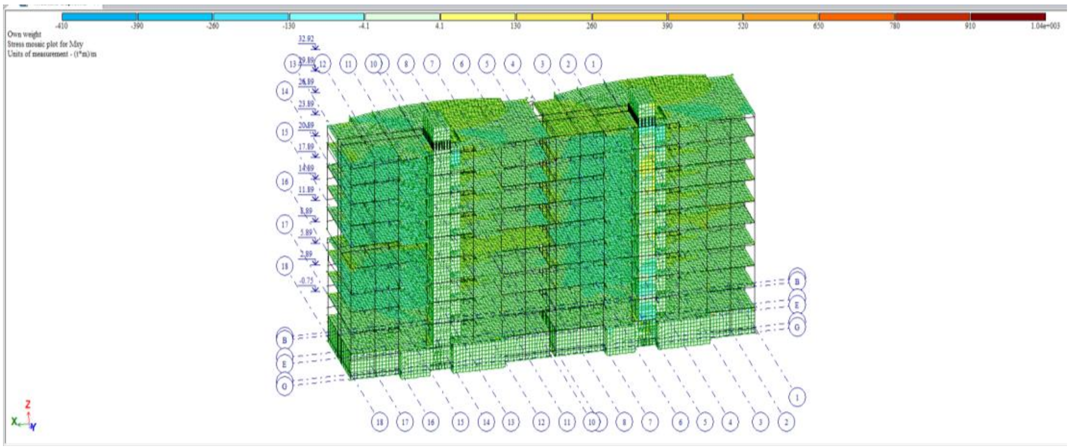


Figure A.6 - Stress Mxy

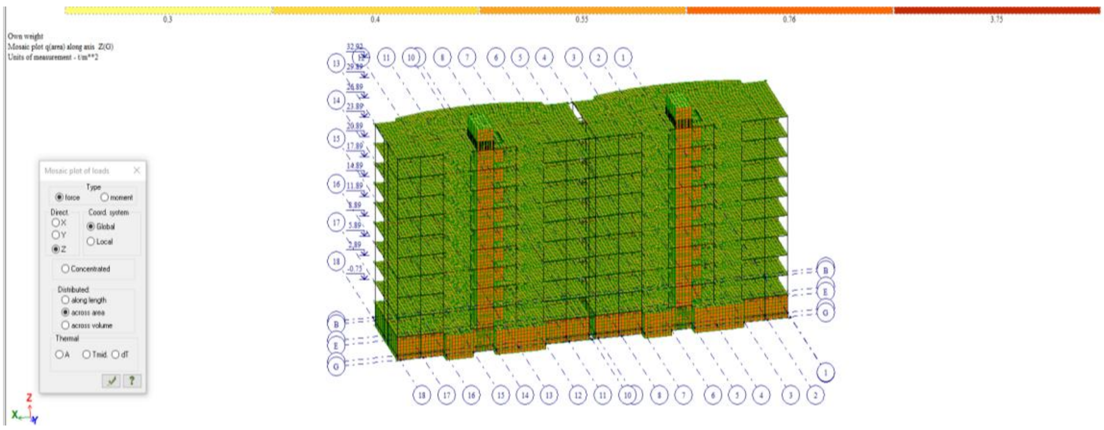


Figure A.7 - Dead wiegth diagram

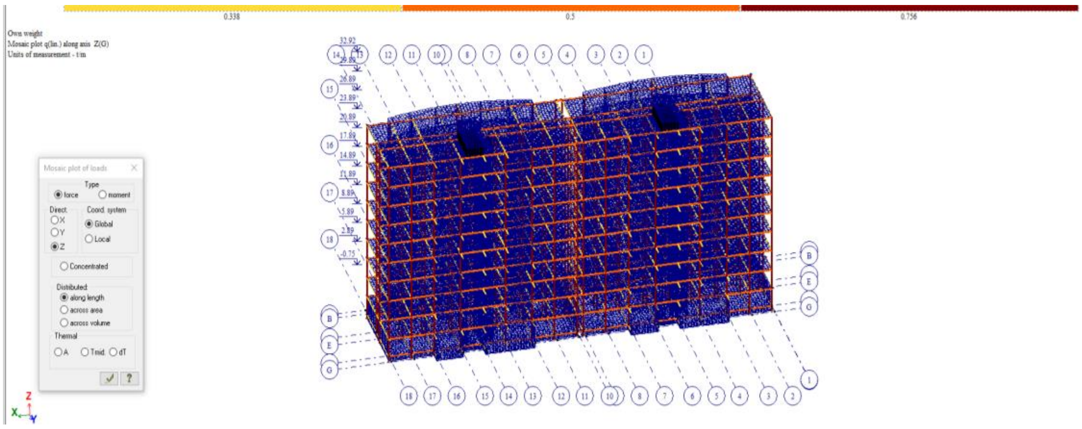


Figure A.8 - Self-weight of rods The floor structure is established according to table

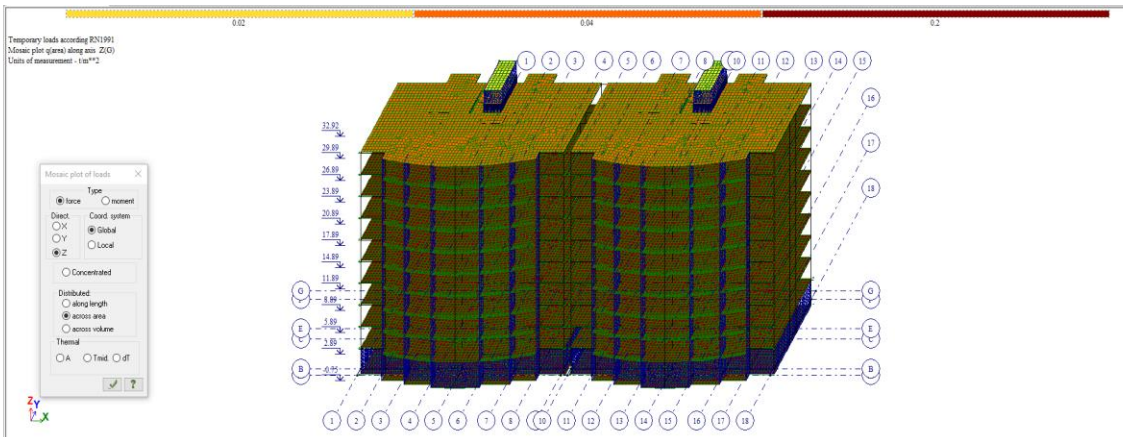


Figure A.9 - Temporary load design

Appendex B

Table B.1 - Cost calculations of machine time, labor costs and salary

Name of processes	**Justification (ENIR, No., table, point)**	**Unit of measure**	**Volume of work**	**Standard time**	**Quotation, u.e.**	**Labor costs**	**Salary**				
				Working h–h.	**Drivers of m–cm.**	**Working**	**Drivers**	**Working, h–d**	**Drivers of m–cm.**	**Working**	**Drivers**
2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
The construction of temporary fencing		10m	156	1,2	–	1,3	–	187.2	–		–
Removal of top soil		1000 m2	2730.7	–	0.56	–	0.6	–	564,82	–	917.4
Soil excavation in the trench and trench access to the pit		100 m2	958.2	2.8	3.56	1.48	1.7	2682.9	312,78	3970.9	5798
Excavation of soil underrun		m3	2160	1.64	–	0.54	–	3542.4	–	1912.8	–
Concrete preparation for foundations		m3	0.321	0.79	–	0.49	–	0.25	–	0.1225	–
Reinforcement installation of strip foundation manually		т	7092	22,17	–	15	–	131202	–	18368 28	–
Formwork installation of		m2	1241.8	0,36	0,12	0,35	0,17	459.4	1323,88	59.77	18.62

strip foundation manually											
Concreting of strip foundation		m3	70.92	1,2	0,89	0,34	0,31	62.4	50,54	13.7	10.6
Formwork removal of strip foundation		m2	1241.8	0,31	–	0,08	–	235.9	–	110.8	18.6
Foundation waterproofing		100m2	300	10	–	7,15	–	3000	–	21450	-
Backfilling		m2	167.5	–	0,39	–	1,58	–	850,08	–	103.17
Soil compaction		100 m2	334	–	0,92	–	0,26	–	6683,8	–	79.8.8
Final land planning		100 m2	1860	0,33	0,49	1,58	1,65	615.7	754,6	972..8	1508.5
Removal of temporary fencing		10m	200	0,90	–	1,05	–	180	–	189	–

Estimated calculation of the cost of construction in the amount of 19Row 7Column **1334707.12650815** thousand tenge

Including refundable amounts: 15Row7Column **1858.459977** thousand tenge

Value added tax 18Row7Column **143004.334983016** thousand tenge

ESTIMATE CALCULATION OF THE COST OF CONSTRUCTION

Compiled in 2001

P / p No.	No. of estimates and calculations	Name of chapters, objects, works and costs	Estimated cost, thousand tenge			Total, thousand tenge
			construction and installation works	equipment, furniture and inventory	other costs	
1	2	3	4	5	6	7
1	1	School	329339	-	-	329339
2		**Total = 1 line**	329339	-	-	**329339**
3		Costs of preparatory work on the construction site 1.1% * 2 line 7 column	3622.729	-	-	3622.729
4		Main construction objects buildings and structures 15% * 3r7c	543.40935	-	-	543.40935
5		**Total = 3 lines**	3622.729	-	**-**	**3622.729**
6		**Total 2s + 5s**	332961.729	-	**-**	**332961.729**
7		Additional costs during the performance of work in the winter 1.2% * 6r7c	3995.540748	-	**-**	3995.540748
8		Seniority costs 1% * 6r7c			3329.61729	3329.61729
9		Costs for additional vacations 0.4% * 6r7c			1331.846916	1331.846916
10		**Total 7r + 8r + 9r**	**3995.540748**		**4661.464206**	**8657.004954**
11		**Total 6r + 10r**	336957.269748		4661.464206	341618.733954
12		Including refundable amounts = 4r	543.40935		-	543.40935

13		**Total according to the estimated calculation in base prices 2001 = 11r**	336957.269748		4661.464206	341618.733954
14		Total estimated at current prices in 2020. 13r * 3.42	1152393.86253816		15942.20758452	1168336.07012268
15		Including refundable amounts in current prices 12r7c * 3.42	1858.459977			1858.459977
16		Taxes, fees, mandatory payments, 2% * 14r7c			23366.7214024536	23366.7214024536
17		Estimated cost at the current price level 14r + 16c	1152393.86253816		39308.9289869736	1191702.79152513
18		VAT (12%) * 17r7c			143004.334983016	143004.334983016
19		Construction cost 17r + 18c	1152393.86253816		182313.26396999	1334707.12650815

Construction site name -		Residential building in Shymkent								
Object name -		Residential building in Shymkent								
		LOCAL ESTIMATE								
		(Local estimate calculation)								
Base:										
			Estimated cost						329339	thousand tenge
			Standard labor intensity						1176	person-h
			Estimated wages						11301	thousand tenge
Compiled in 2001										
N p / p	Code and item number of the standard	Name of works and costs, unit of measure	Number	Unit cost, tenge		Total cost, tenge		Overheads	Labor costs, man-hours, construction workers	
				Total	Expl. machines	Total	Expl. machines			
				Salary of construction workers	incl. Salary of drivers	Salary of construction workers	incl. Salary of drivers	tenge	workers serving machines	
								%	for one.	Total
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
		<u>SECTION 1 Equipment</u>								
1	**Ts0110-350-23**	Layout of areas from soils of 2 group mechanized way	**2**	**953.00**	**9.20**	**1200**	**18**	**868**	**2.00**	**8**

				953.00	4.50	950	9	101	0.03	0.06 /
2	SPRICE	Cutting off the vegetation layer	one	63564.15	-	8564	-	-	0.03	-
				-	-	-	-	-	0.03	-
3	SPRICE	Development of soil of 3 groups from 1408.86 loading on dump trucks excavators with bucket with a capacity of 0.65 m3	one	13451.32	-	1835	-	-	0.03	-
				-	-	-	-	-	0.03	-
4	SPRICE	Development of soil of 3 groups in 801.82 excavator dump Dragline or Reverse shovel "with a bucket capacity 0.65 m3	10	11202.96	-	152030	-	-	0.03	-
				-	-	-	-	-	0.03	-
5	SPRICE	Transportation of soil	eight	13634.30	-	129074	-	-	0.03	-
				-	-	-	-	-	0.03	-
6	Ts0110-669-3	Layout of the bottom of the pit	21	11235.00	1.60	40880	34	17690	0.03	405
				11235.00	-	19656	-	90	0.03	-
7	SPRICE	Manual soil finishing software package (version 4.2.3)	10	1835.77	-	18358	-	-	0.03	-
				-	-	-	-	-	0.03	-
8	SPRICE	Concrete device preparation	10	11236.00	-	12328	-	-	0.03	-
				-	-	-	-	-	0.03	-
9	SPRICE	Device w / concrete foundations	one	14850.57	-	14851	-	-	0.03	-
				-	-	-	-	-	0.03	-

10	**Ts0110-345-4**	Frames and flat meshes: Rev. and ribbed steel ext. 9 class A-III, d 14 mm SN RK 8	**one**	**7207.00**	**148.00**	**9207**	**148**	**6674**	**0.03**	**48**
				6570.00	**38.30**	**6570**	**38**	**101**	**0.03**	**0**
11	**SPRICE**	Reinforced concrete device	**one**	**10817.27**	**-**	**10817**	**-**	**-**	**0.03**	**-**
				-	**-**	**-**	**-**	**-**	**0.03**	**-**
12	**SPRICE**	Frames and flat meshes: Rev. and ribbed steel ext. 9 class A-III, d 12 mm	**one**	**4882.00**	**-**	**8828**	**-**	**-**	**0.03**	**-**
				-	**-**	**-**	**-**	**-**	**0.03**	**-**
13	**SPRICE**	Waterproofing horizontal cement with liquid glass walls, foundations	**one**	**4566.00**	**-**	**25830**	**-**	**-**	**0.03**	**-**
				-	**-**	**-**	**-**	**-**	**0.03**	**-**
14	**SPRICE**	Backfilling of soil	**one**	**20830.27**	**-**	**40830**	**-**	**-**	**0.03**	**-**
				-	**-**	**-**	**-**	**-**	**0.03**	**-**
15	**SPRICE**	Soil compaction, group 1,2 pneumatic rammers	**one**	**37034.64**	**-**	**37035**	**-**	**-**	**0.03**	**-**
				-	**-**	**-**	**-**	**-**	**0.03**	**-**
		TOTAL SECTION 1 DIRECT COSTS	**Tenge**			**511666**	**200**	**25232**		**461**
			Tenge			**27176**	**47**			**-**
	The cost of installation work -		Tenge			**511666**				
	Materials -		Tenge							
	Total salary -		Tenge			**27223**				
	The cost of materials and structures -		Tenge							
		Overhead costs -	Tenge			**25232**				
		Normative labor intensity in N.R. -	person-h							**23**
		Estimated wages in N.R. -	Tenge				**3785**			
		Irregular and unforeseen costs -	Tenge			**32214**				

	TOTAL, the cost of installation work -		Tenge			504685				
		Standard labor intensity -	person-h							484
		Estimated salary -	Tenge				31008			
		TOTAL SECTION 1	Tenge			504685				
		Standard labor intensity -	person-h							484
		Estimated salary -	Tenge				31008			
SECTION 2 Materials										
16	**Ts0108-148-1**	Laying of basement slab	**92**	**27.70**	**2.10**	**6548**	**793**	**1765**	**0.10**	**8**
				19.70	**0.50**	**2021**	**86**	**95**	**-**	**-**
17	**SPRICE**	Laying of external walls	**72**	**52.62**		**9788**	**-**	**-**	**-**	**-**
				-	**-**	**-**	**-**	**-**	**-**	**-**
18	**SPRICE**	Bricks and ceramic stones Rev. and single additional issue 10	**twenty**	**47.24**		**15444**	**-**	**-**	**-**	**-**
				-	**-**	**-**	**-**	**-**	**-**	**-**
19	**SPRICE**	Laying of partitions	**2**	**50.53**		**901**	**-**	**-**	**-**	**-**
				-	**-**	**-**	**-**	**-**	**-**	**-**
20	**SPRICE**	Installation of partitions from	**36**	**4.48**		**961**	**-**	**-**	**-**	**-**
				-	**-**	**-**	**-**	**-**	**-**	**-**
21	**Ts0111-108-7**	Staircase device	**600**	**132.92**		**99752**	**-**	**one**	**0.59**	**854**
				105.75		**73840**	**-**	**90**	**-**	**-**
22	**SPRICE**	Installation of lift shafts with weight more than 2.5 t	**600**	**50.23**		**30138**	**-**	**-**	**-**	**-**
				-	**-**	**-**	**-**	**-**	**-**	**-**

23	Ts0111-108-9	Arrangement of balcony slabs	20	399.77		8999	-	one	1.90	48
				344.25		8858	-	90	-	-
24	SPRICE	Beamless device slabs up to 220mm	20	103.15		4063	-	-	-	-
				-	-	-	-	-	-	-
25	SPRICE	Frames and flat meshes:	1200	1.49	0.00	2235	-	-	-	-
				-	-	-	-	-	-	-
26	Ts0108-148-1	Reinforcement blanks, not Rev. and assembled into frames and meshes additional item 9 smooth steel class A-I, d 6	900	27.70	2.10	24930	2345	17271	0.10	100
				19.70	0.50	17730	850	95	-	
27	SPRICE	Three-layer pitched roofs	900	41.56		37404	-	-	-	-
				-	-	-	-	-	-	-
28	Ts0108-409-1	Installation of window blocks from PVC profiles	450	108.60	48.90	48870		16929	0.22	100
				39.60	12.20	17820		95	0.07	41
29	SPRICE	Single-leaf window blocks with paired shutters OS 9-9	300	9.87		4961	-	-	-	-
				-	-	-	-	-	-	-
30	SPRICE	Installation of door blocks from PVC profiles in external and internal stone openings walls	150	17.34	-	3509	-	-	-	-
				-	-	-	-	-	-	-
31	SPRICE	Door blocks	four	8429.18	-	33716	-	-	-	-
				-	-	-	-	-	-	-
32	S143001-1	Glazing of windows	0.5	-	-	-	-	-	-	-

				-	-	-	-	-	-	-
33	**E0101-14-1**	Plaster, simple surfaces with lime mortar for stone and concrete walls	**37.5**	**12.48**	**12.48**	**945**	**465**	**118**	**-**	**-**
				-	**3.24**	**-**	**122**	**97**	**0.01**	**0.375 /**
		TOTAL SECTION 2 DIRECT COSTS	**Tenge**			**350000520**	**3138**	**36085**		**1120**
			Tenge			**107697**	**1058**			
	The cost of installation work -		Tenge			**350000520**				
	Materials -		Tenge							
	Total salary -		Tenge			**108755**				
	The cost of materials and structures -		Tenge							
		Overhead costs -	Tenge			**360085**				
		Normative labor intensity in N.R. -	person-h							**56**
		Estimated wages in N.R. -	Tenge				**54013**			
		Irregular and unforeseen costs -	Tenge			**21021636**				
	TOTAL, the cost of installation work -		Tenge			**329338969**				
		Standard labor intensity -	person-h							**1176**
		Estimated salary -	Tenge				**11300728**			
		TOTAL SECTION 2	Tenge			**329338969**				
		Standard labor intensity -	person-h							**1176**
		Estimated salary -	Tenge				**11300728**			
		TOTAL DIRECT COSTS BY ESTIMATE:	**Tenge**			**350512187**	**3138**			**737**
			Tenge			**134873**	**1105**			
		The cost of materials and structures -				**22421006**				
	Recalculation of totals into prices as of June 1, 2021									

	Total direct costs				**350000520**				
	Overheads	**#REF!**							
	Irregular and unforeseen costs				**329338969**				
	TOTAL in prices as of 01.01.2001	**3293389.688128**	**332632358.50**						
	Total with the cost of seniority	**1317355.8752512**	**330656324.69**						
	Total with the cost of additional leave	**11308446.3043314**							
	Total at current prices as of 06/14/2018	**226168.926086627**	**11534615.23**						
	Total with taxes, fees and obligations. payments	**12 %**	**1384153.83**						
	Value Added Tax (VAT)				**12918769**				
	Total with value added tax (VAT)								

Object estimation

Residential building

Estimated cost	**329339**	thousand tenge
Standard labor intensity	**1.176**	thousand people hour
Estimated salary	**11301**	thousand tenge

Compiled in 2001

P / p No.	No. of estimates and calculations	Name of works and costs	Estimated cost, thousand tenge				Normative labor intensity, thousand people hour	Estimated salary, thousand tenge	Indicators of a unit cost, thousand tenge
			construction and installation works	equipment, furniture and inventory	other costs	Total			
one	2	3	four	five	6	7	eight	nine	10
	one	Installation work	329339			329339	1.176	11301	
		Total	329339			329339	1.176	11301	

Form 4rs
ABC-4

Construction site name - Residential building in Shymkent

RESOURCE ESTIMATE

Object name - Residential building in Shymkent

Base:

Compiled in 2001 Tenge

P / p No.	ABC resource code and attribute	Resource cipher	Name of resources, equipment, structures, products and parts	unit of measurement	Number of units	Estimated unit price	Sale price per unit	Transport costs per unit	Cost (Total)
						justification	justification	Total	
one	2	3	four	five	6	7	eight	nine	10
			LABOR RESOURCES						
1	1		Labor costs of construction workers	man-h	737	182.98	-	-	1304773
						-	-	-	
2	3		Labor costs of machinists	man-h	0.06	173.25	-	-	8850
						-	-	-	
			TOTAL	**Tenge**				-	**1304773**
			CONSTRUCTION MACHINES AND MECHANISMS						
						OPERATION OF MACHINES		**Salary of the Engineers**	
3			Construction machines and mechanisms	machine-h		2083	-	8850	

						-	-		1000933
			TOTAL	**Tenge**					
			BUILDING MATERIALS AND STRUCTURES						
4	6300 M	S143001-1	Concrete	m3	0.5	- -	- -	- -	35999-
5		SPRICE	Reinforcement blanks, not assembled into frames and meshes smooth steel class A-I d 10 mm	PC	one	63564.15 -	- -	- -	63564
6		SPRICE	Reinforcement blanks, not assembled into frames and meshes smooth smooth steel class A-I, d = 6 mm	PC	four	8429.18 -	- -	- -	262155927.18
7		SPRICE	heavy concrete, class B25 / M-300 / m3	m	150	207.34 -	- -	- -	31101
8		SPRICE	Heavy concrete class B3,5 / M-50 / m3	m	300	19.87 -	- -	- -	5961
9		SPRICE	Heavy concrete, class B7,5 / M-100 / m3	m	900	410.56 -	- -	- -	369504
10		SPRICE	Heavy concrete, class B12.5	PC	1200	10.49 -	- -	- -	12588
11		SPRICE	Heavy concrete, class B15 / M-200 / m3 198.8892	m	twenty	103.15 -	- -	- -	2063
12		SPRICE	Gravel for construction works m3	m	600	500.23 -	- -	- -	300138
13		SPRICE	Bricks and ceramic stones	PC	36	104.48 -	- -	- -	3761.28
14		SPRICE	masonry	PC	2	50.53 -	- -	- -	101.06
15		SPRICE	Sand	m	twenty	470.24 -	- -	- -	9404.8

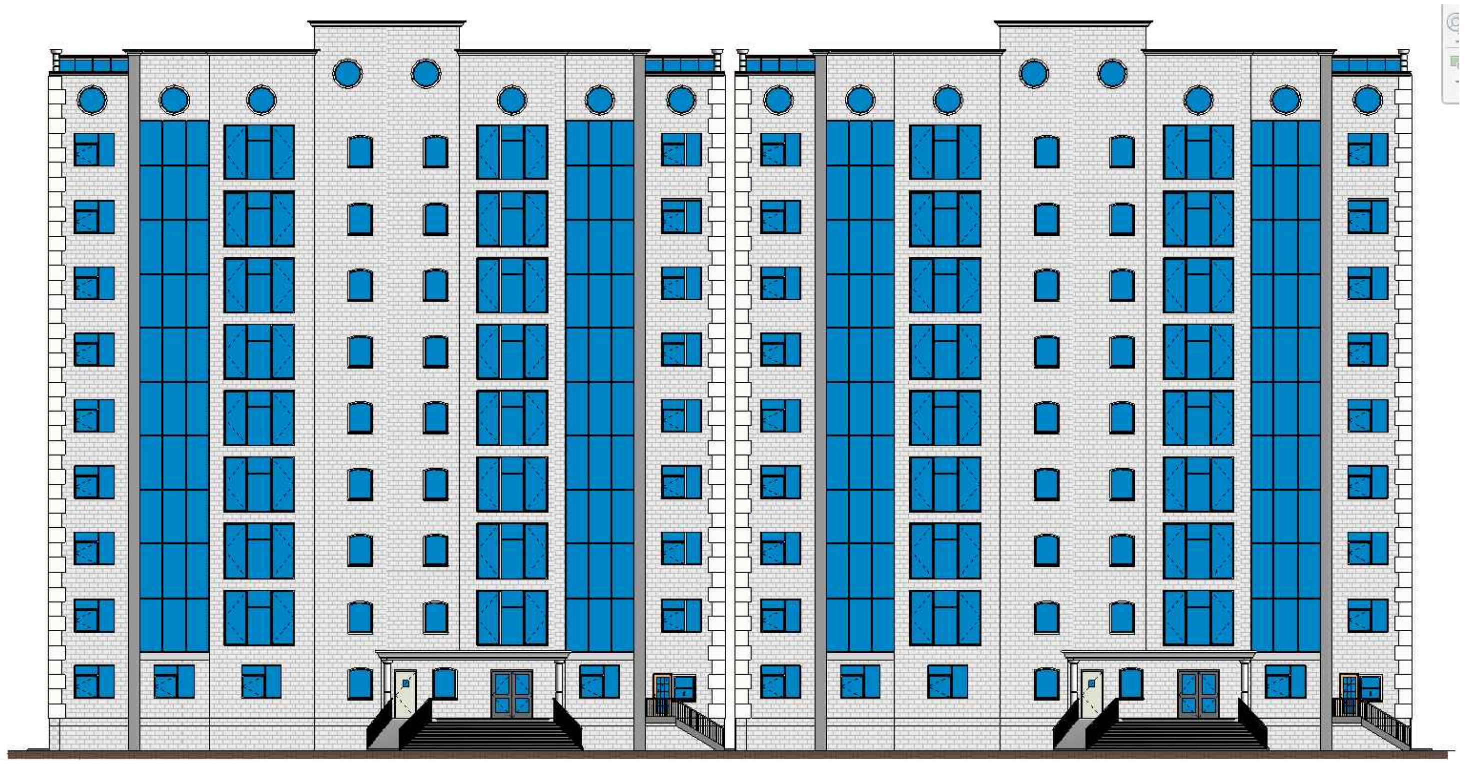
16		SPRICE	Dry mixes: putties cement-based leveling	m	72	92.62	-	-	6668.64
						-	-	-	
17		SPRICE	Dry mixes for installation drywall sheets	PC	one	37034.64	-	-	37035
						-	-	-	
18		SPRICE	Ready masonry mortar, heavy m3	PC	one	20830.27	-	-	20830
						-	-	-	
19		SPRICE	Heavy masonry mortar cement M-100	PC	one	2538.38	-	-	2538
						-	-	-	
20		SPRICE	Heavy masonry mortar cement-lime M-25	PC	one	2882.21	-	-	2882
						-	-	-	
21		SPRICE	Heavy masonry mortar cement-lime M-50	PC	one	10817.27	-	-	10817
						-	-	-	
22		SPRICE	Heavy finishing solution cement 1: 3	PC	one	14850.57	-	-	14851
						-	-	-	
23		SPRICE	Heavy finishing solution cement-lime 1: 1: 6	PC	10	9320.83	-	-	93208.3
						-	-	-	
24		SPRICE	Heavy finishing mortar lime 1: 2.5	PC	10	1935.77	-	-	19357.7
						-	-	-	
25		SPRICE	Crushed stone from natural stone for m3 construction works (ST RK 946-92), M-1000 fractions over 40mm	PC	eight	136304.3	-	-	1090434.4
						-	-	-	
26		SPRICE	Frames and flat meshes: steel t smooth class A-I, d = 10 mm	PC	10	11202.96	-	-	112029.6
						-	-	-	
27		SPRICE	Ceramic facade tiles m2	PC	one	13451.32	-	-	13451
						-	-	-	
			TOTAL	**Tenge**				-	**264378215.96**

Made up Hashimi S.M.

Facade south view

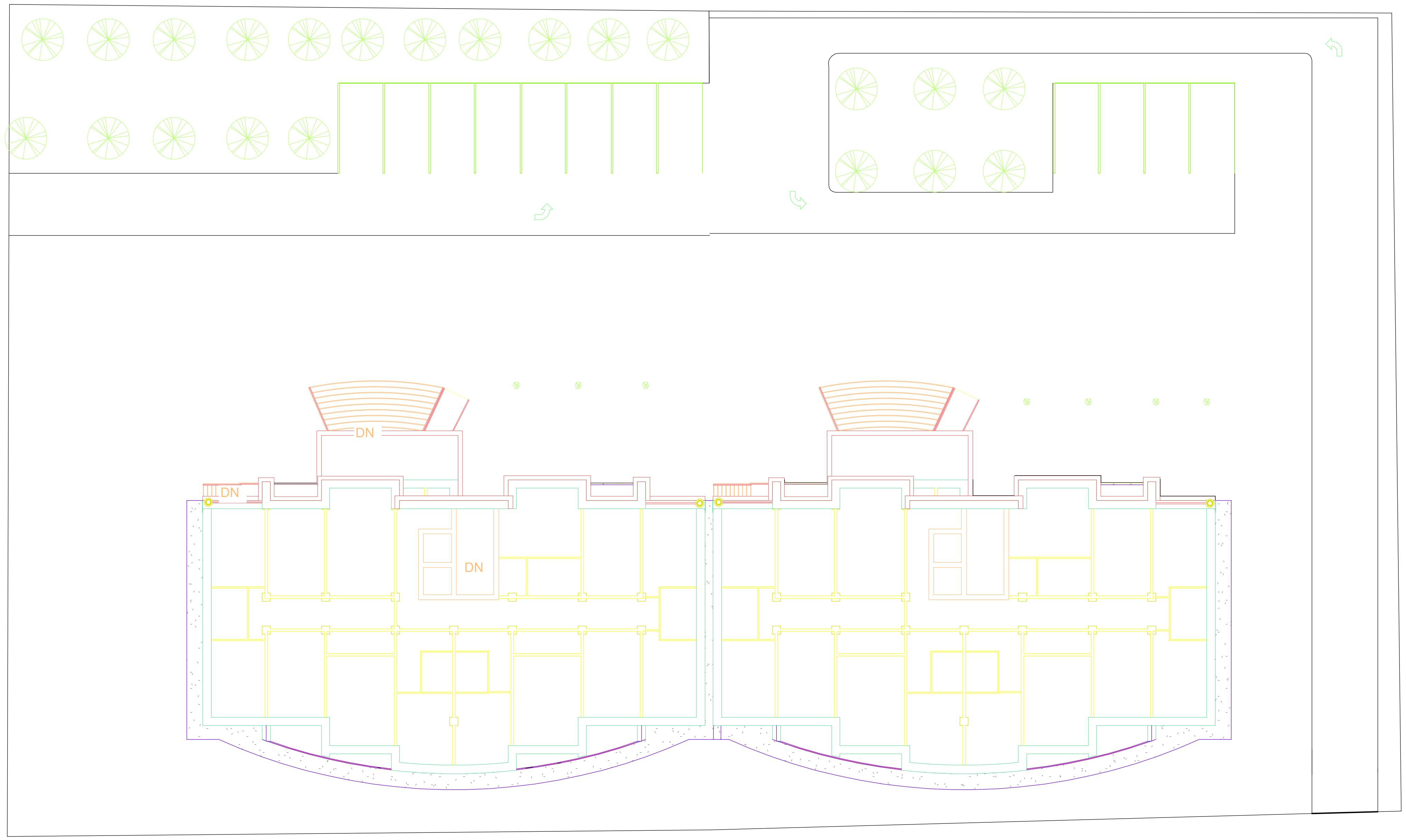
Facade 3d view

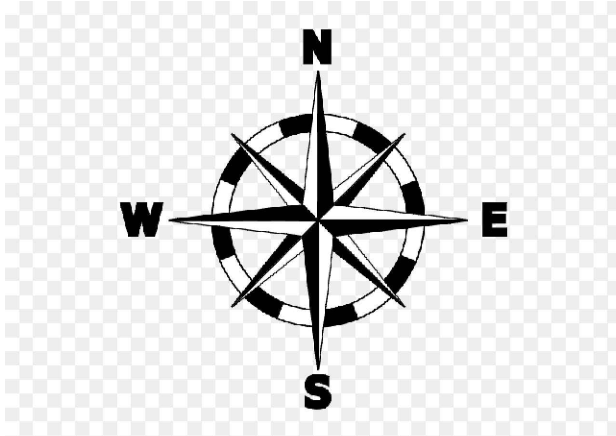
Facade north view



					KazNITU-5B072900-Civil Engeneering-Stb-08.03.2021-DP			
					Residential building based on monolithic modular technology in Shymkent			
Chan	Num.par.List	№doc	Sign	Date				
Head of Dep		Kozyukova.N.V			Architectural part	stage	list	lists
Consultant		Kozyukova.N.V				DP	1	10
Supervisor		Dostanova .S.H						
Controller		Bek .A.A			Facade	Construction and building materials departmen		
Created		Hashimi.S.M						

General plan





N	Chan.	unit	Quantity
1	Construction volume	M3	31027
2	Land area	M2	2856
3	construction site total area	M2	1156
4	Working Area of construction site	M2	1006.5

Chan	Num.par.List	№doc	Sign	Date
Head of Dep		Kozyukova.N.V		
Consultant		Kozyukova.N.V		
Supervisor		Dostanova .S.H		
Controller		Bek .A.A		
Created		Hashimi.S.M		

KazNITU-5B072900-Civil Engeneering-Stb-08.03.2021-DP

Residential building based on monolithic modular technology in Shymkent

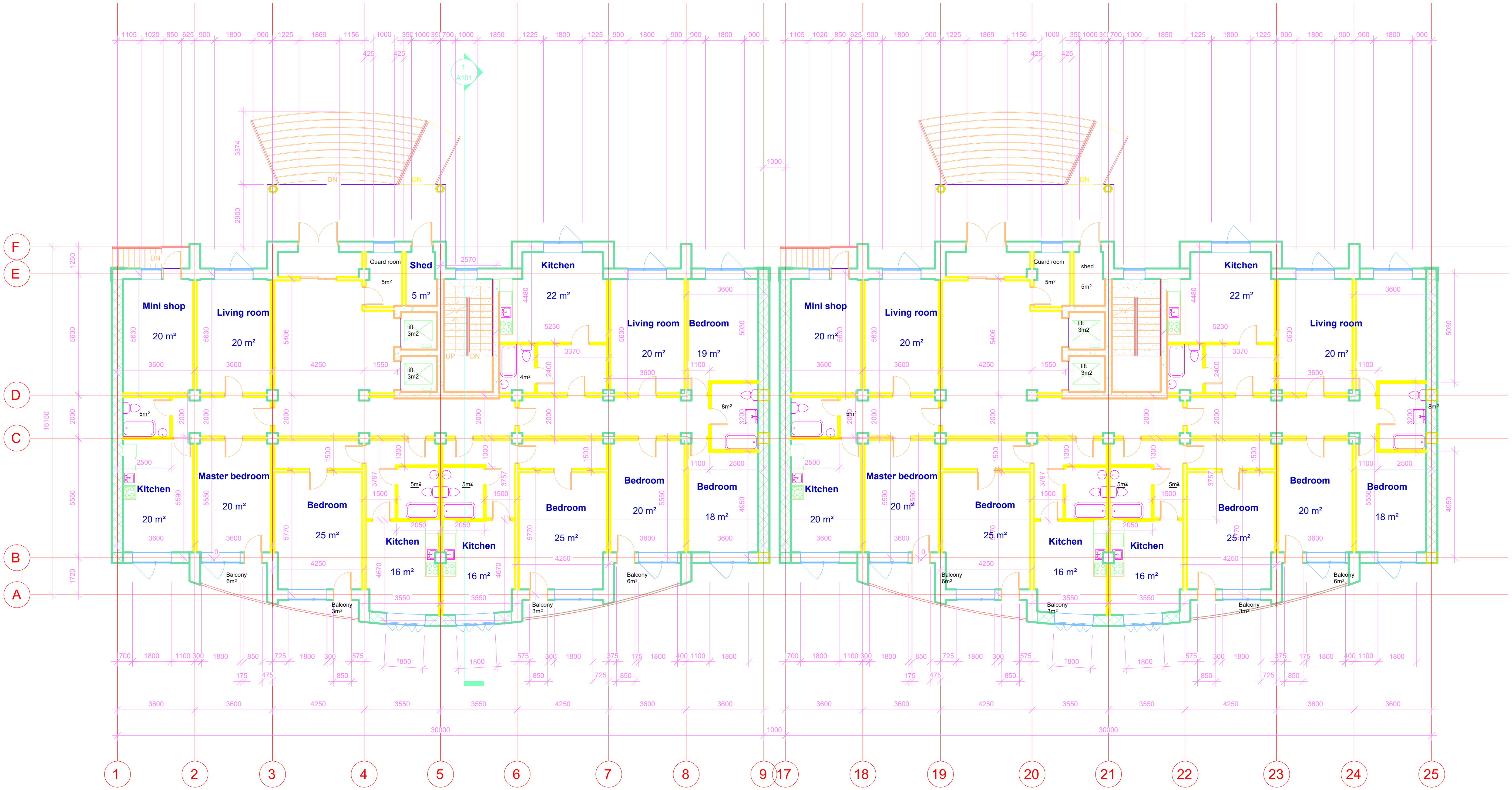
Architectural part

stage	list	lists
DP	2	10

Facade

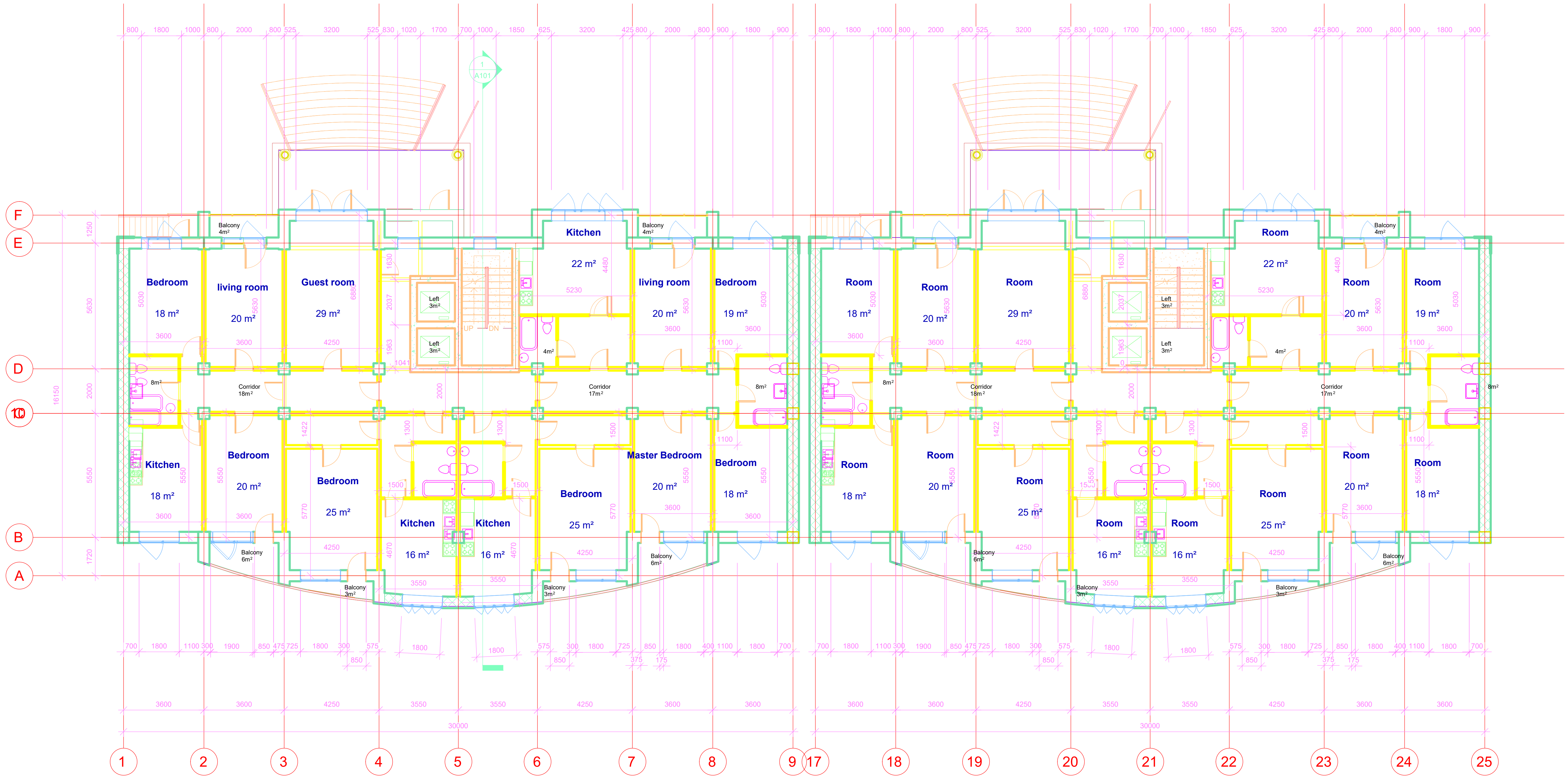
Construction and building materials departmen

First floor plan

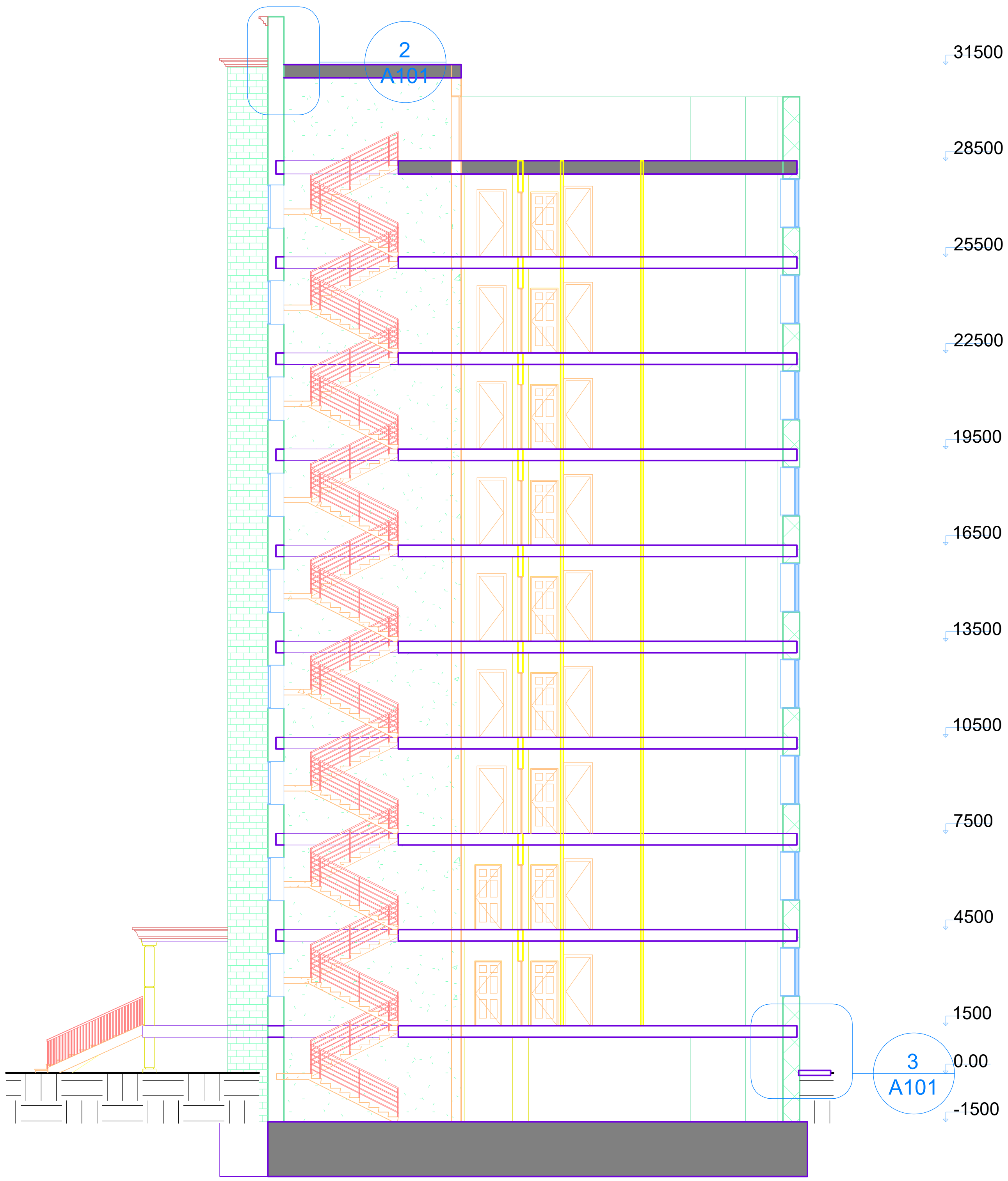


					KazNITU-5B072900-Civil Engeneering-Stb-08.03.2021-DP
					Residential building based on monolithic modular technology in Shymkent
Chan	Num.par.List	№doc	Sign	Date	
Head of Dep		Kozyukova.N.V			Architectural part — stage: DP; list: 3; lists: 10
Consultant		Kozyukova.N.V			
Supervisor		Dostanova .S.H			
Controller		Bek .A.A			Floor scheme — Construction and building materials departmen
Created		Hashimi.S.M			

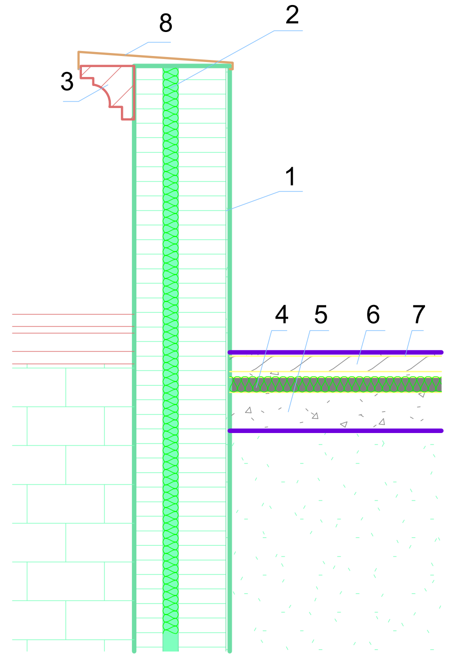
Typical floor plan

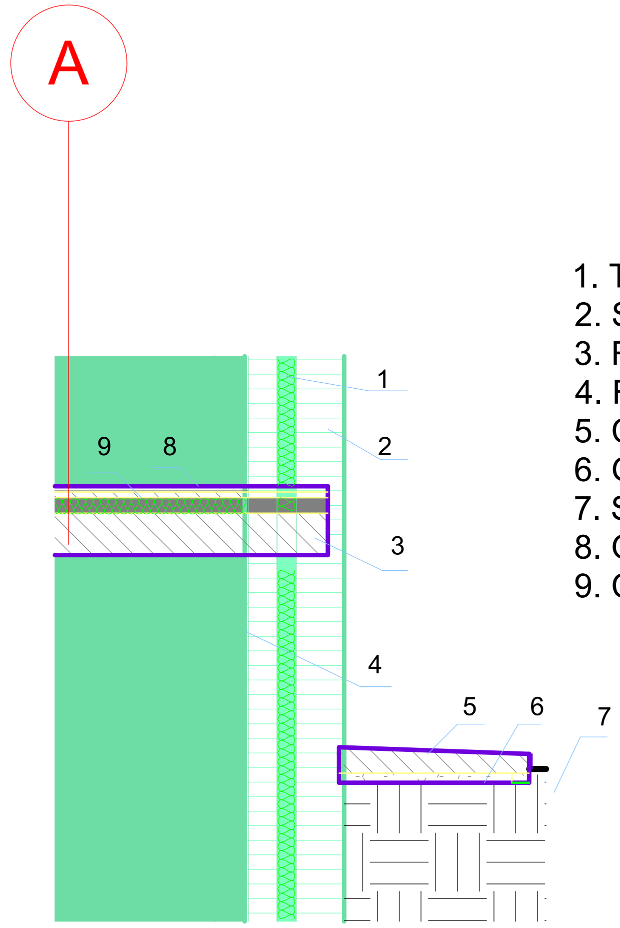


					KazNITU-5B072900-Civil Engeneering-Stb-08.03.2021-DP
Chan	Num.par.List	№doc	Sign	Date	Residential building based on monolithic modular technology in Shymkent
Head of Dep		Kozyukova.N.V			Architectural part — stage: DP; list: 4; lists: 10
Consultant		Kozyukova.N.V			
Supervisor		Dostanova .S.H			
Controller		Bek .A.A			Floor scheme — Construction and building materials departmen
Created		Hashimi.S.M			



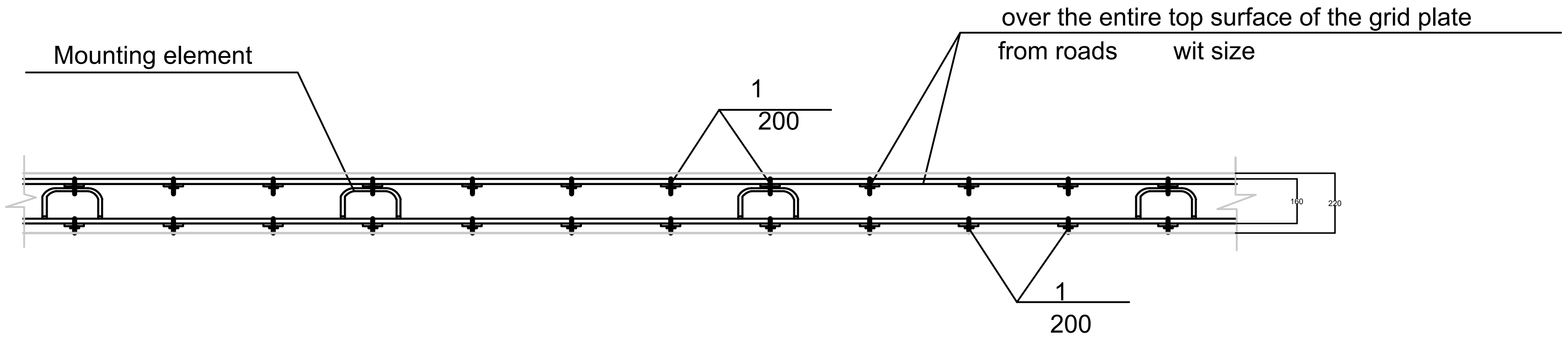
1. Concrete block masonry
2. Thermal & sound insulation (polystyrene)
3. Gypsum
4. Thermal & sound insulation (polystyrene)
5. Reinforced concrete
6. Asphalt shingle
7. roofing
8. Alimuniom

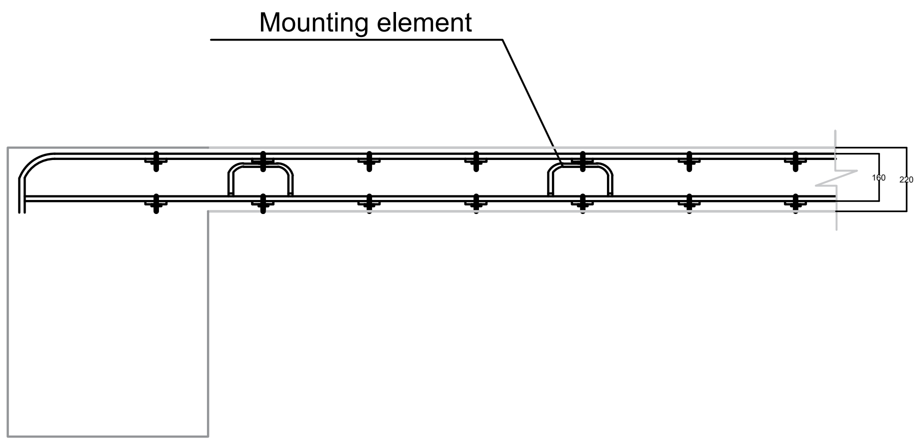




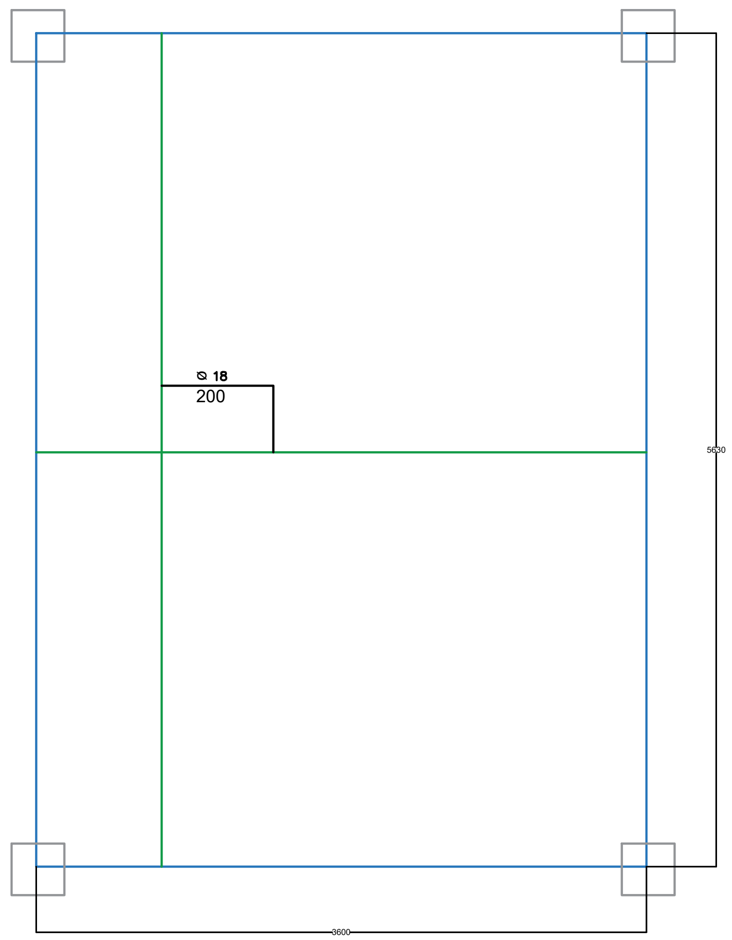
1. Thermal and sound indulation(polystyrene)
2. Structure 1 (concrete block CMU light)
3. Reinforced concrete slab
4. Finish work gypsum
5. Concrete sand/cement
6. Gravel
7. Soil
8. Oak floor
9. Concrete cement/ sand

					KazNITU-5B072900-Civil Engeneering-Stb-08.03.2021-DP			
Chan	Num.par.List	Nºdoc	Sign	Date	Residential building based on monolithic modular technology in Shymkent			
Head of Dep		Kozyukova.N.V			Architectural part	stage	list	lists
Consultant		Kozyukova.N.V				DP	5	10
Supervisor		Dostanova .S.H						
Controller		Bek .A.A			Section and nodes	Construction and building materials departmen		
Created		Hashimi.S.M						

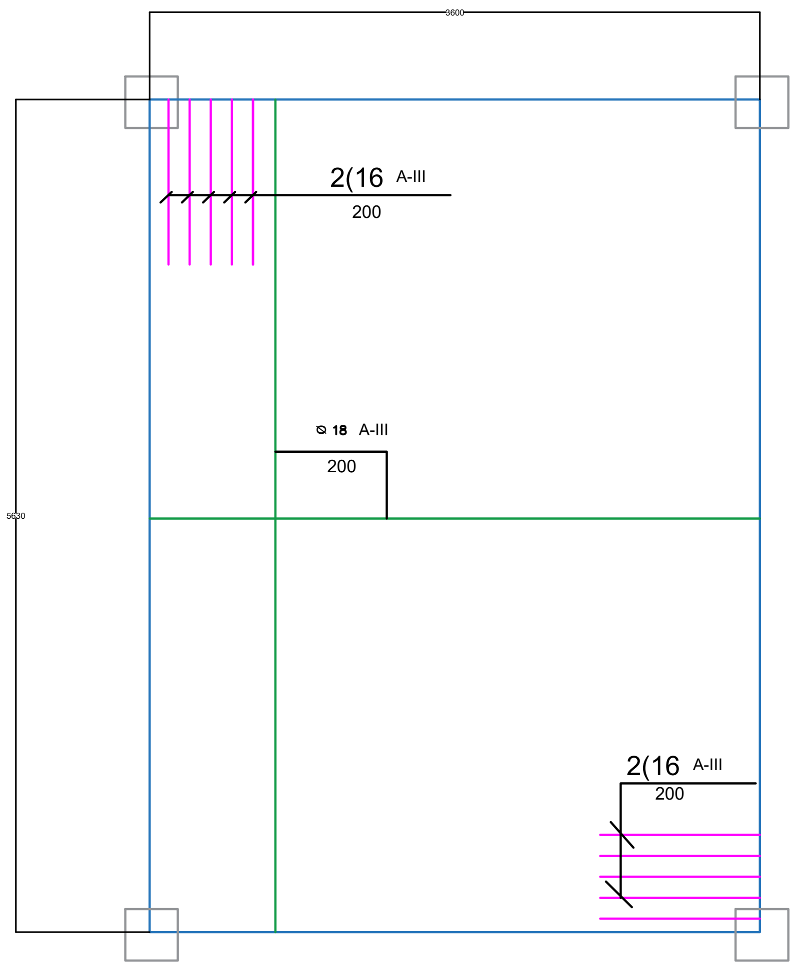




Scheme of floor slab on the lower edge



Scheme of floor slab on the upper edge



Specification of element

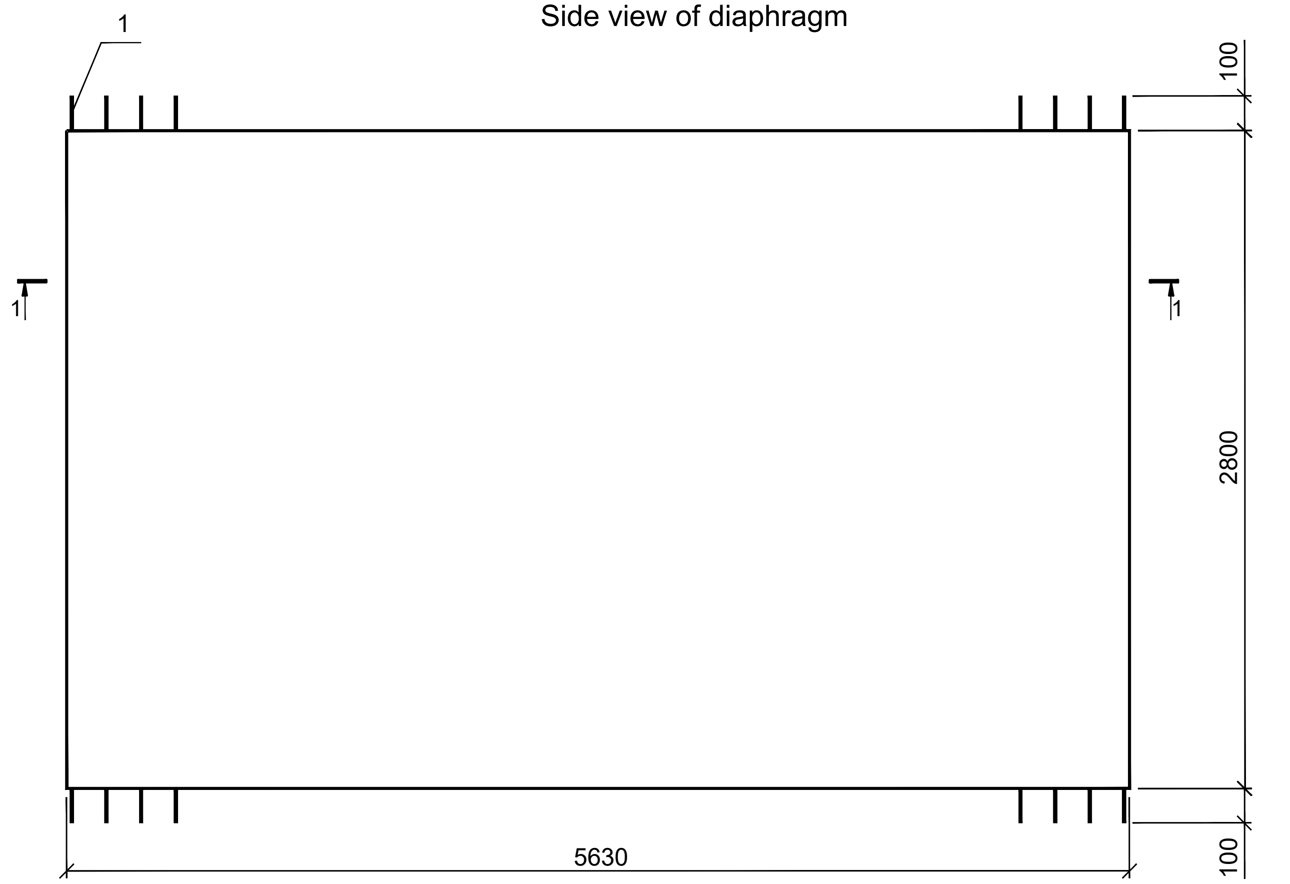
N	Designation	Name		Qty	Mass	Note
		Floor slab Pm1				
1	GOST 5781-82	⌀18 A-III	MP	3082	0.888	2736.82
2*	GOST 5781-82	⌀14 A-III	L=1290	206	0.80	164.80
3*	GOST 5781-82	⌀12 A-I	L=295	1726	0.12	207.12
		Materials				
		Concrete B25		23.3		

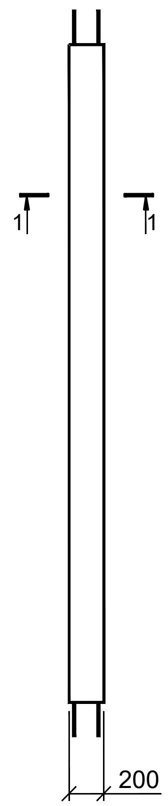
Statement of steel consumption per element kg

Mark	Reinforcement product						Total
	Rebar class			Rebar class			
	A-I			A-III			
	GOST 5781-82						
	⌀12		Total	⌀18	⌀16	Total	
Pm1	204.1		204.1	2736	164.8	2901	308.74

Chan	Num.par.List	№doc	Sign	Date	KazNITU-5B072900-Civil Engeneering-Stb-08.03.2021-DP
					Residential building based on monolithic modular technology in Shymkent
Head of Dep		Kozyukova.N.V			Calculation and design part
Consultant		Kozyukova.N.V			stage: DP; list: 6; lists: 10
Supervisor		Dostanova .S.H			
Controller		Bek .A.A			Slab design
Created		Hashimi.S.M			Construction and building materials departmen

Side view of diaphragm





Material specification

Name	Quantity
Assembly unit	
Frame Kp-1	1

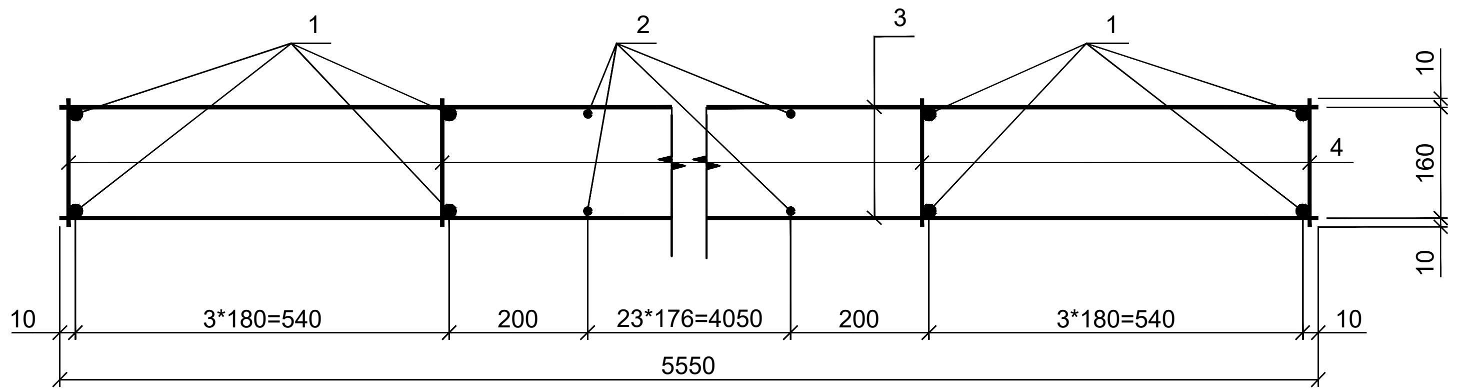
Specification of reinforcement

Mark product	N.	Diameter,	length N. мм	numb.	mass. kg.	mass of product, kg
Kp-1	1	Ø16S500	4000	16	1,58	102
	2	Ø8S240	4000	52	0,395	83
	3	Ø6S240	6100	18	0,222	25
	4	Ø6S240	180	36	0,222	1,5

steel consumption

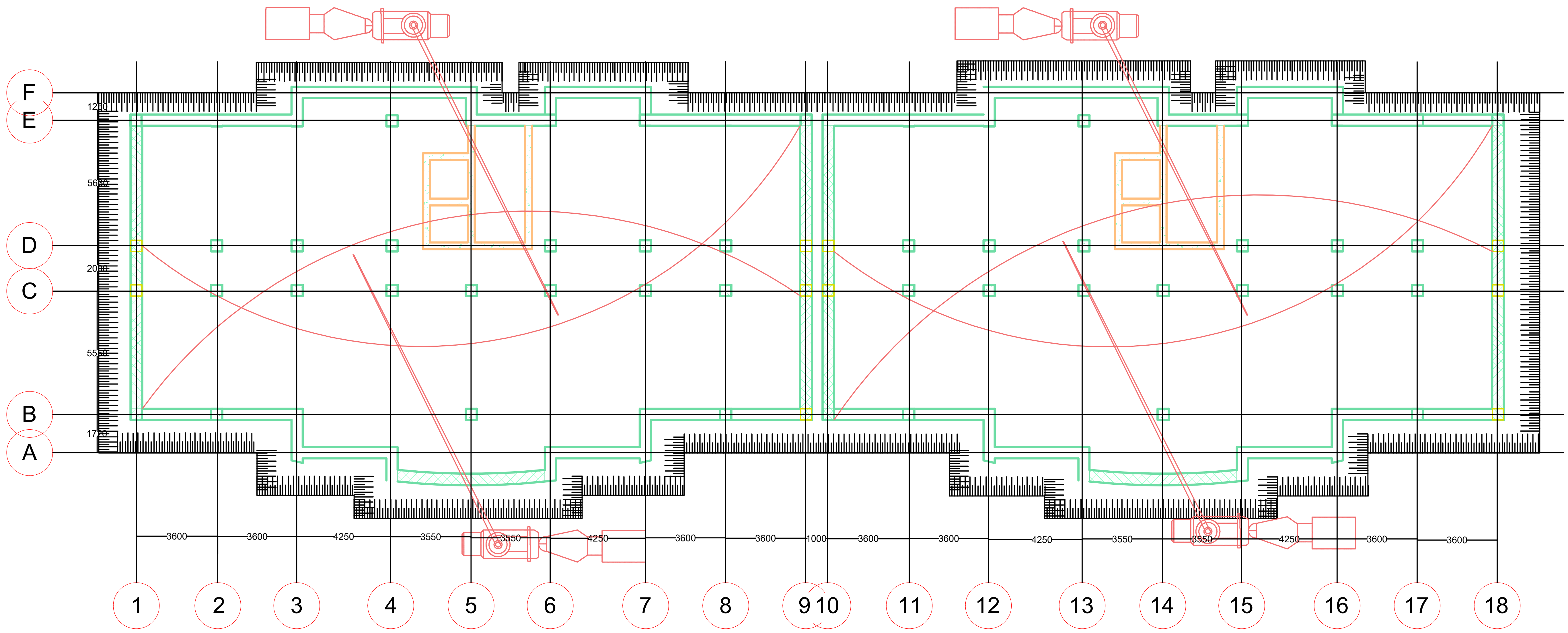
Mark of items	Reinforcement product			
	class of rebar			
	S500	S240		
	GOST 5781-82			total
	Ø16	Ø8	Ø6	
J-1	102	83	26,5	211,5

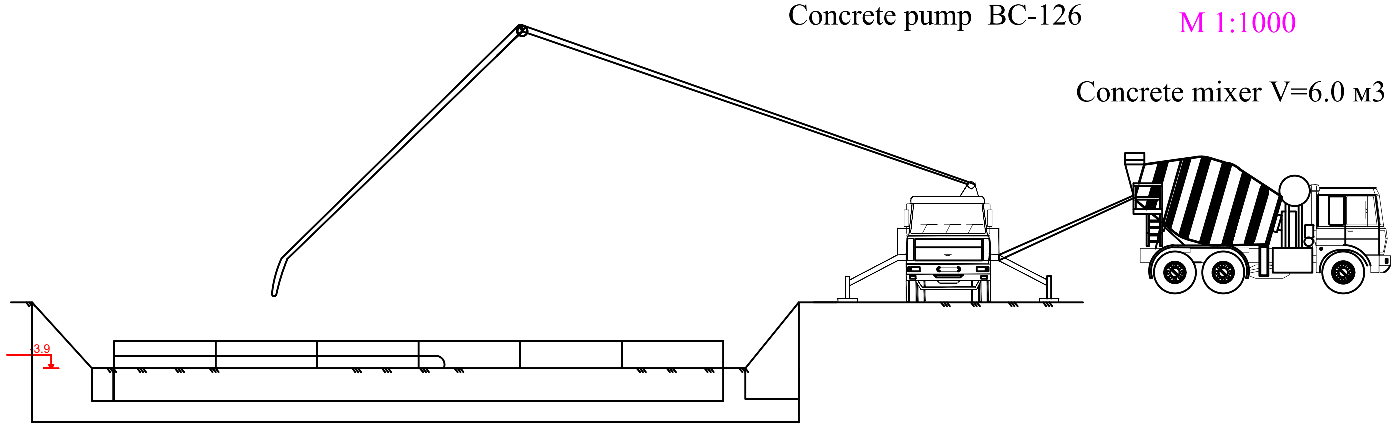
Frame Kp-1



Chan	Num.par.List	№doc	Sign	Date	KazNITU-5B072900-Civil Engeneering-Stb-08.03.2021-DP	
					Residential building based on monolithic modular technology in Shymkent	
Head of Dep		Kozyukova.N.V			Calculation and design part	stage: DP; list: 7; lists: 10
Consultant		Kozyukova.N.V				
Supervisor		Dostanova .S.H				
Controller		Bek .A.A			Diaphragm design	Construction and building materials departmen
Created		Hashimi.S.M				

Working raduis of concrete pump





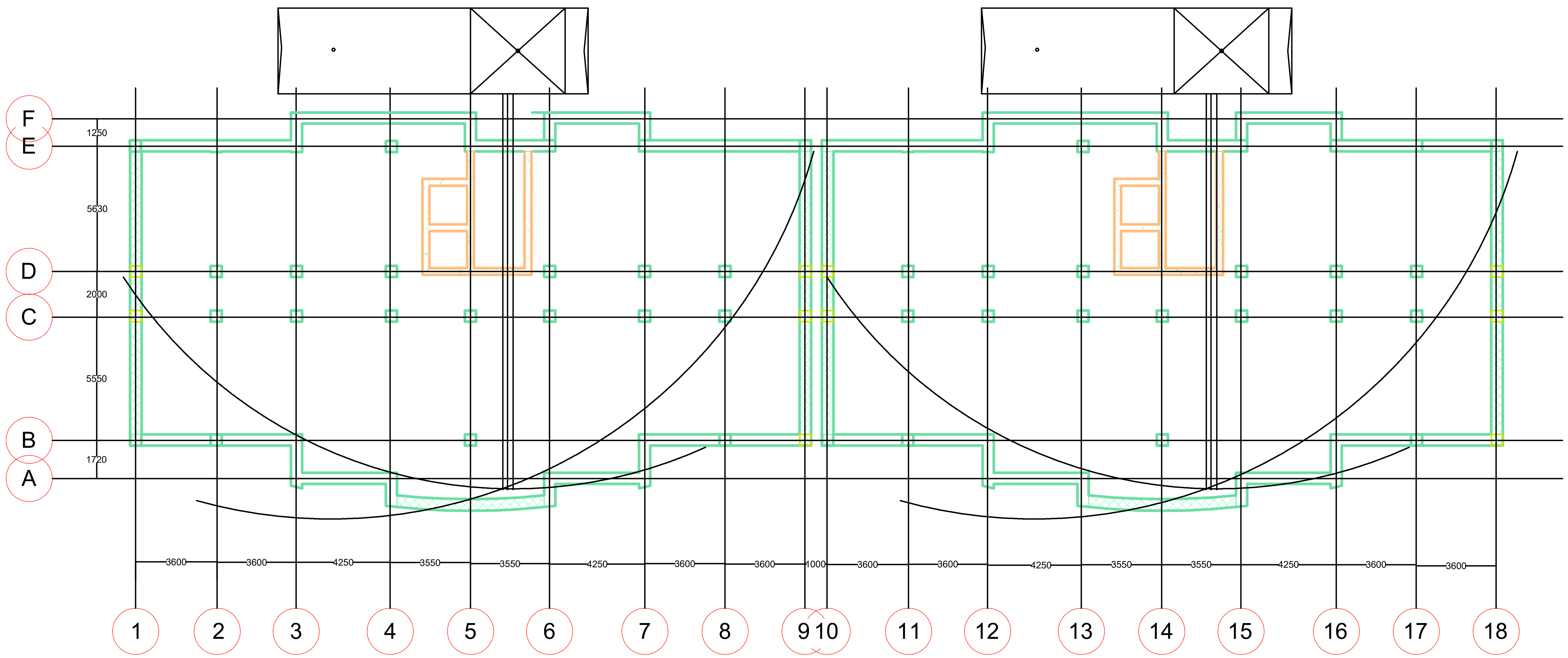
Concrete pump BC-126

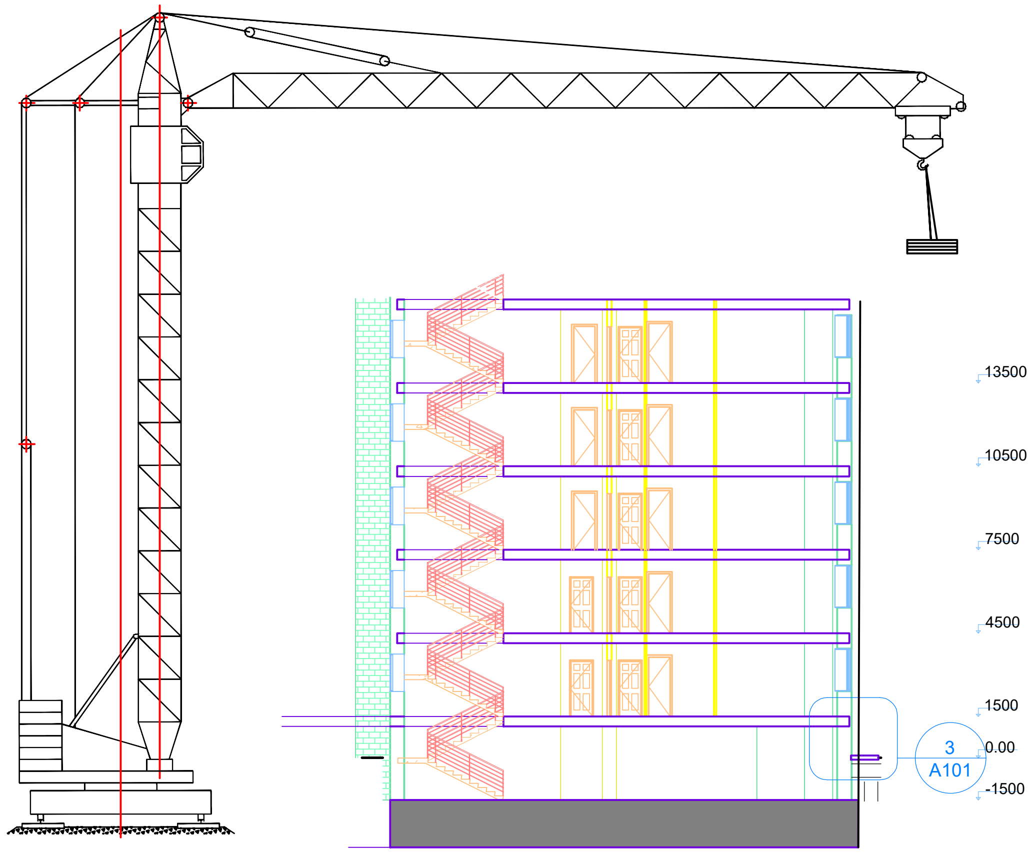
M 1:1000

Concrete mixer V=6.0 м3

					KazNITU-5B072900-Civil Engeneering-Stb-08.03.2021-DP		
					Residential building based on monolithic modular technology in Shymkent		
Chan	Num.par.List	№doc	Sign	Date			
Head of Dep		Kozyukova.N.V			Technological part	stage	list / lists
Consultant		Kozyukova.N.V				DP	8 / 10
Supervisor		Dostanova .S.H					
Controller		Bek .A.A			Concreting	Construction and building materials departmen	
Created		Hashimi.S.M					

Working radius of crane





Chan	Num.par.List	№doc	Sign	Date
Head of Dep		Kozyukova.N.V		
Consultant		Kozyukova.N.V		
Supervisor		Dostanova .S.H		
Controller		Bek .A.A		
Created		Hashimi.S.M		

KazNITU-5B072900-Civil Engeneering-Stb-08.03.2021-DP			
Residential building based on monolithic modular technology in Shymkent			
Technological part	stage	list	lists
	DP	9	10
Overhead working	Construction and building materials departmen		

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names
1		Soil preparation	3 days	Mon 4/19/21	Wed 4/21/21		construction manager,Excavator 1,Excavator 2,machine[1],staff 4 ,staff 5,staff 6 ,staff 9
2		Manual preparation of the bottom	3 days	Wed 4/21/21	Fri 4/23/21		machine[1],site Engineer,Staff 1,staff 2,staff 4
3		Instalation of foundation reinforcement	7 days	Thu 4/29/21	Fri 5/7/21		construction manager
4		**Installation of formwork**	**15.5 days**	**Fri 5/7/21**	**Fri 5/28/21**		**construction manager,project manager**
5		Installation of formwork of faoundation	5.5 days	Fri 5/7/21	Fri 5/14/21		,formwork[1],supervisor 1 site Engineer,supervisor 1,PM 1,Staff 1,staff 2
6		Formwork installation of	10 days	Mon 5/17/21	Fri 5/28/21		staff A,staff B,staff c,staff D
7		Installation of scaffolds	6 days	Thu 5/20/21	Thu 5/27/21		staff E,staff F
8		Laying concrete	6 days	Thu 6/3/21	Thu 6/10/21	14	site Engineer,supervisor 1
9		Installation of reinforcement of slabs	8 days	Fri 6/11/21	Tue 6/22/21	8	construction manager,site Engineer,staff F,supervisor 1
10		concreting	6 days	Tue 5/25/21	Tue 6/1/21		site Engineer,concrete[1],supervisor 2
11		**Removing of formwork**	**13 days**	**Tue 5/25/21**	**Thu 6/10/21**		**site Engineer,supervisor 2**
12		Removing of formorks of foundation	4 days	Tue 5/25/21	Fri 5/28/21		staff E,staff F,staff D,staff g,staff L
13		Removing of formorks of slabs	4 days	Mon 6/7/21	Thu 6/10/21		staff c,staff o,supervisor 1
14		Preparation of concrete	6 days	Wed 5/26/21	Wed 6/2/21	15	staff F,supervisor 1
15		Concrete delivery by concrete pumps	6 days	Tue 5/18/21	Tue 5/25/21		staff F,machine[1],concrete[1],PM 1,Staff 1,staff 2,supervisor 1
16		Preparation and dilivary of concrete for slab	6 days	Tue 5/25/21	Tue 6/1/21		staff F,staff g,staff h,staff L,supervisor 1,TESTTER 1
17		Preparation of masonry	22 days	Thu 6/10/21	Fri 7/9/21		concrete[1],machine[1],PM 1,supervisor 1,TESTTER 1
18		Exterior walls, balconies	30 days	Fri 7/9/21	Thu 8/19/21		Crane 1,PM 1,staff 5,staff 6 ,staff 9 ,staff 10,staff
19		Laying partiontion	17 days	Thu 8/19/21	Fri 9/10/21		q,staff r,steel,supervisor
20		Construction of the roofs	26 days	Fri 9/10/21	Fri 10/15/21		concrete[1],construction manager,Crane 1,Staff
21		Filling the gaps	25 days	Fri 10/15/21	Thu 11/18/21		staff 8 , staff 7 ,Gap filler,supervisor 1
22		plastering work	67 days	Thu 11/18/21	Fri 2/18/22		staff 9 ,staff B,staff D,staff g,staff h,supervisor 1
23		Painting works	21 days	Fri 2/18/22	Fri 3/18/22		paint[1],staff 10,staff p,staff w,staff x,steel,supervisor 1
24		General works	41 days	Fri 3/18/22	Fri 5/13/22		staff 8 ,staff F,staff h,supervisor 3
25		Wall clading	16 days	Fri 5/13/22	Fri 6/3/22		staff 9 ,staff c,staff g,supervisor 3
26		Floor structure	29 days	Fri 6/3/22	Wed 7/13/22		staff A,staff g,staff o,supervisor 1
27		Facad finishing	38 days	Wed 7/13/22	Fri 9/2/22		staff 8 , staff 7 ,Architect,staff x,supervisor 1
28		Installation of elevators	10 days	Fri 9/2/22	Thu 9/15/22		staff 10,staff B,staff c,staff D,steel,supervisor 1
29		Other works	23 days	Tue 9/13/22	Thu 10/13/22		Staff A,staff F,staff h,staff m,supervisor 2,supervisor 3
30		Plumbing works	18 days	Thu 10/13/22	Mon 11/7/22		Plumber 1,plumber 2,plumber 3,plumber 4,plumber 5 ,plumber 6 ,staff A,staff E,staff h,staff o
31		Ventilation	11 days	Mon 11/7/22	Mon 11/21/22		plumber 3,plumber 5 ,site Engineer,staff D,staff h
32		Electrical installation	8 days	Mon 11/21/22	Wed 11/30/22		Elitrician,staff 5,staff c,staff E
33		Weak power lines	7 days	Wed 11/30/22	Thu 12/8/22		staff F,staff o,staff p,steel
34		Landscaping	7 days	Thu 12/8/22	Fri 12/16/22		Architect,staff D,staff p,supervisor 3
35		Handing over the project	5 days	Fri 12/16/22	Thu 12/22/22		project manager

Project: Project1
Date: Tue 5/18/21

Task		Project Summary		Manual Task		Start-only		Deadline	
Split		Inactive Task		Duration-only		Finish-only		Progress	
Milestone		Inactive Milestone		Manual Summary Rollup		External Tasks		Manual Progress	
Summary		Inactive Summary		Manual Summary		External Milestone			

In the production of reinforced concrete works, it is necessary to strictly comply with the requirements of SNiP 1-85-2001 "Occupational Health and Safety in Construction" and observe certain rules:

Workers must be provided with safe access to the work.

Guardrails must be put in place as work progresses.

Access ladders must be properly erected tied and project at least 1 metre above the landing platform.

Ladders or an access scaffold must be used for access.

Equipment must be in good order before use.

The formwork used for the erection of monolithic reinforced concrete structures must be manufactured and applied in accordance with the PPR approved in accordance with the established procedure.

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

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

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

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

When cranes are working, people are not allowed to stay in the zone of operation. Do not carry the load over workers.

It is forbidden to swing a suspended cargo and leave it without supervision, as well as to conduct installation with a wind of more than 6 points.

It is prohibited to operate the boom crane directly under the wires of operating power lines of any voltage.

The descent of workers into the pit or trench is allowed only on the stairs.

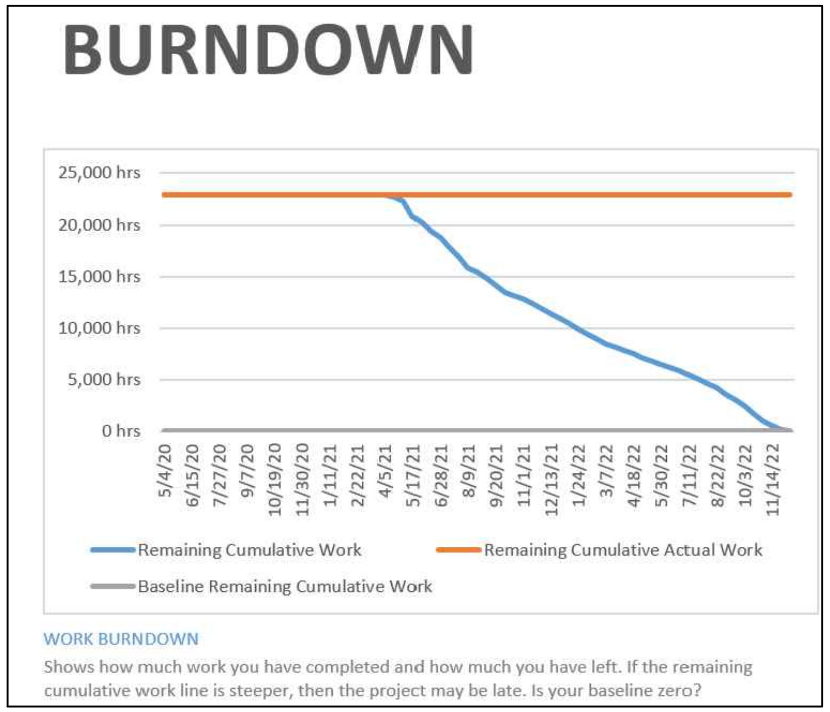
If cracks or trenches appear in the slopes of the trench, which threaten the collapse, it is necessary to fix the walls or reduce the steepness of the slope before the work begins.

Welding transformers and lighting fixtures must only be connected to an electrician on duty.

For a temporary power grid on a construction site, an insulated wire should be used and suspended on reliable supports at a height of at least 2.5 m above the workplace, 3 m above the aisles and 5 m above the thoroughfares. At an altitude of at least 2.5 m from the ground, the electrical wires must be enclosed in cords or boxes.

Welding transformer housings and welded products are grounded in accordance with SNiP 1-85-2001 n 6.15.

Welding transformers are only included in the network with the use of closed types.



					KazNITU-5B072900-Civil Engeneering-Stb-08.03.2021-DP			
					Residential building based on monolithic modular technology in Shymkent			
Chan	Num.par.List	№doc	Sign	Date				
Head of Dep		Kozykova.N.V			Technological part	stage	list	lists
Consultant		Kozykova.N.V				DP	10	10
Supervisor		Dostanova .S.H						
Controller		Bek .A.A			General work schedule	Construction and building materials departmen		
Created		Hashimi.S.M						

МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ РЕСПУБЛИКИ КАЗАХСТАН
СӘТБАЕВ УНИВЕРСИТЕТІ

RESPONSE

OF THE SUPERVISOR
for the graduation project

Hashimi Sayed Mustafa
5B072900-Civil Engineering

Topic: «Residental buiding based on prefabricated modular technology in Shymkent»

Student Hashimi S.M. during the training showed good preparation, professional literacy and erudition.

Hashimi S.M. completed her thesis in full and literacy for further work in this specialty.

All sections are made at a good level and fully meet the requirements for the thesis. An analytical review of the selected design of the building of a residential building, taking into account the climatic conditions, is carried out. The architectural-planning and structural sections were developed in accordance with the issued task. According to the given task, the diaphragm and plate structures were calculated, as well as the technological map for concrete work. The technical and economic review and construction production technology have been developed at a good level.

The thesis is completed at a good level and meets the requirements for bachelor's theses. Hashimi S.M. deserves a high score of 90 points.

Supervisor
Master of technical sciences, 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: ХАШИМИ Саид Мустафа

Название: Residential building based on prefabricated modular technology in Shymkent

Координатор:Надежда Козюкова

Коэффициент подобия 1:3.4

Коэффициент подобия 2:1.1

Замена букв:110

Интервалы:0

Микропробелы:6

Белые знаки: 0

После анализа Отчета подобия констатирую следующее:

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

Обоснование:

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Дата *Подпись Научного руководителя*

Протокол анализа Отчета подобия

заведующего кафедрой / начальника структурного подразделения

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

Автор: ХАШИМИ Саид Мустафа

Название: Residential building based on prefabricated modular technology in Shymkent

Координатор: Надежда Козюкова

Коэффициент подобия 1:3.4

Коэффициент подобия 2:1.1

Замена букв:110

Интервалы:0

Микропробелы:6

Белые знаки:0

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

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

Обоснование:

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Дата *Подпись заведующего кафедрой /*

начальника структурного подразделения

Окончательное решение в отношении допуска к защите, включая обоснование:

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Дата *Подпись заведующего кафедрой /*

начальника структурного подразделения