МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
НАЦІОНАЛЬНИЙ АВІАЦІЙНИЙ УНІВЕРСИТЕТ
ФАКУЛЬТЕТ АРХІТЕКТУРИ, БУДІВНИЦТВА ТА ДИЗАЙНУ
КАФЕДРА КОМП'ЮТЕРНИХ ТЕХНОЛОГІЙ БУДІВНИЦТВА ТА РЕКОНСТРУКЦІЇ АЕРОПОРТІВ

ДОПУСТИТИ ДО ЗАХИСТУ

Завідувач випускової кафедри

_________ О.І. Лапенко

«_7_» ___06___ 2022 р.

# ДИПЛОМНА РОБОТА

## (ПОЯСНЮВАЛЬНА ЗАПИСКА)

**ВИПУСКНИКА ОСВІТНЬОГО СТУПЕНЯ БАКАЛАВР**

**ЗА СПЕЦІАЛЬНІСТЮ 192 «БУДІВНИЦТВО ТА ЦИВІЛЬНА ІНЖЕНЕРІЯ»**
**ОСВІТНЬО-ПРОФЕСІЙНА ПРОГРАМА**
**«ПРОМИСЛОВЕ І ЦИВІЛЬНЕ БУДІВНИЦТВО»**

**Тема:** **«Багатоквартирний житловий будинок в м. Охтирка Сумської області»**

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Київ 2022

НАЦІОНАЛЬНИЙ АВІАЦІЙНИЙ УНІВЕРСИТЕТ

Факультет архітектури, будівництва та дизайну
Кафедра комп'ютерних технологій будівництва та реконструкції аеропортів
Спеціальність: 192 «Будівництво та цивільна інженерія»
Освітньо-професійна програма: «Промислове і цивільне будівництво»

ЗАТВЕРДЖУЮ
Завідувач кафедри
__________ О.І. Лапенко
«13» 04 2022 р.

**ЗАВДАННЯ**
**на виконання дипломної роботи**

Туан Інур Міскін Мохамед Рамін Міскін
(П.І.Б. випускника)

1. Тема роботи «Багатоквартирний житловий будинок в м. Охтирка Сумської області»
затверджена наказом ректора від «13» квітня 2022р. № 379/ст.

2. Термін виконання роботи: з «23» травня 2022р. по «19» червня 2022р.

3. Вихідні дані роботи: житловий будинок різної поверховості з монолітним перекриттям, навантаження відповідно до ДБН В.1.2-2:2006 «Навантаження та впливи».

4. Зміст пояснювальної записки:
Вступ, аналітичний огляд, архітектурно-планувальна частина, розрахунково-конструктивна частина, технологічно-організаційна частина, висновки, список використаних джерел.

5. Перелік обов'язкового ілюстративного матеріалу: таблиці, рисунки, діаграми, графіки не менше 4-х креслень та 4-х слайдів:

-фасади, план типового поверху, експлікації

- креслення конструкції, специфікації елементів

-технологічно-організаційні схеми виконання основних будівельних процесів

6. Календарний план-графік

| № з/п | Завдання | Термін виконання | Підпис керівника |
|---|---|---|---|
| 1. | Аналітичний огляд | 13.05.22-14.05.22 | Гасій |
| 2. | Архітектурно-будівельний розділ | 16.05.22-20.05.22 | Гасій |
| 3. | Розрахунково-конструктивний розділ | 23.05.22-02.06.22 | Гасій |
| 4. | Технологічно-організаційна частина | 03.06.22-04.06.22 | Гасій |
| 5. | Вступ. Висновки. Список використаних джерел. | 06.06.22-07.06.22 | Гасій |
| 6. | Підготовка доповіді та презентації | 08.06.22-11.06.22 | Гасій |

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Керівник дипломної роботи: Гасій Гасій Г.М.

Завдання прийняв до виконання: ______ Туан Інур Міскін Мохамед

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# INTRODUCTION

The theme of the graduation project is a Multicompartment building in Okhtyrka city in the Sumy region. The residential building consists of two block – sections, five-story, and seven-story, interconnected at the level of 4.5 floors by verandas. The frame and ceilings of the block sections are designed in a monolithic version using the PERI universal formwork. Columns are made of monolithic reinforced concrete of class $B\,20$ with a section of $400 \times 400\,mm$. Ceilings and roofing – a monolithic, beamless reinforced concrete slab $180\,mm$ thick made of class $B\,20$ concrete supported by columns and walls. The elevator shaft is made of monolithic reinforced concrete with a wall thickness of $200\,mm$. Stair flights are monolithic $1200\,mm$ wide. Ventilation blocks – prefabricated reinforced concrete of individual design. Lintels – prefabricated reinforced concrete according to series $1.038.1 - 1$ and individual metal ones.

Spatial rigidity is ensured by a monolithic ceiling $180\,mm$ thick and monolithic walls $200\,mm$ thick.

The outer walls are designed as non-load-bearing enclosing structures with floor-by-floor support on floors. The structure of the outer walls is layered brickwork with insulation with $PSB - s$ polystyrene boards, calculated according to [28].

Monolithic concrete as a material for the construction of residential and public buildings has always attracted the attention of architects and builders. In the $1920s$, an attempt was made in our country to determine the area of rational use of monolithic concrete in the construction of buildings for various functional purposes. However, with the intensive development of prefabricated housing construction in the $1950s$, interest in monolithic housing construction decreased. Mainly due to the relatively high labor intensity of work at the construction site, especially at low temperatures, the low level of mechanization of processes, and the lack of qualified workers and engineering and technical workers. At the same time, foreign experience testifies to the significant advantages of monolithic housing construction, which include the rational use of material, labor and energy resources. Thus, in the USA, the level of use of monolithic and prefabricated concrete is 63% and 37%, respectively, in England – 68% and 32%, in France – 86% and 14%.

It should be noted that the complete opposition of monolithic housing construction to prefabricated and “brick” is unfair. Monolithic housing construction, unlike the prefabricated one, cannot be mass-produced. The main advantage of monolithic housing construction is its use for solving urban problems, for residential high-rise buildings of a point type, and extended buildings of any number of floors.

In general, monolithic housing construction is characterized by:

– more opportunities for solving various urban planning problems at lower costs of material and fuel and energy resources;

– fewer capital investments are required for the development of the production base, compared with prefabricated building systems;

– the less painful transition of construction organizations in the reorientation from industrial to residential construction;

– various possibilities of combinations with elements of prefabricated construction (balconies, stairs, external panels, three-dimensional block elements, etc.)

– the architectural and planning solution of the residential building was adopted taking into account the urban development situation.

– the residential courtyard includes the necessary elements of improvement: entrances to residential entrances, playgrounds and recreation areas, landscaping, and a utility site.

# CHAPTER 1. ANALYTICAL REVIEW

A Multicompartment building is a serious object in which the heating, water supply, ventilation, power supply, and sewerage systems are connected into a single whole [20, 15, 1]. The construction process is divided into several stages, which ultimately affect the time. Despite this, multi-storey buildings are increasingly being built using monolithic technology.

Any construction of any building using monolithic technology is a lengthy and painstaking procedure. Moreover, this applies not only to the construction work itself but also to the approval of the project and other paper documentation.

Consider the main stages of the construction of a monolithic high-rise building [13, 14, 22, 15, 6]:

– Perhaps the most difficult stage is not related to construction. First, you need to obtain a building permit and select a suitable site. Then comes a difficult period of coordinating controversial issues with the local administration (given the complexity of urban construction, this stage will take a huge amount of time and nerves);

– Geological and topological exploration is carried out on the allocated plot of land. It is necessary to correctly determine the type of soil and its composition, the depth of groundwater, the level of soil freezing, and other important indicators;

– An extremely important stage is the development of a multi-storey building project. It includes all the necessary construction documentation: material calculation, engineering systems, sections, floor plans, and final estimate. The project is the last paper document and after it, the stages of construction work begin;

– A breakdown of the site is being carried out and preparatory work for the preparation of the foundation will start. It is necessary to dig a pit and drive piles under the foundation. After that, the installation of the frame from the reinforcement begins (use a rod of rectangular or round section). During the construction of a multi-storey building using monolithic technology, the frame plays an important role - it gives the structure the necessary rigidity;

– Installation of removable formwork made of wooden panels, polystyrene foam, or plastic is in progress. You can use ready-made formwork. At the end of the assembly, a concrete solution is poured with further tamping (using deep vibrators). Now it remains to wait for the complete drying and hardening of the mixture, after which the formwork is dismantled. Various additives can be used to speed up the process. According to this principle, they build floor by floor;

– Insulation and finishing of the facade are carried out after the last layer of concrete has completely dried. It takes at least 28 days, and even more in wet and cold weather;

– In the final stage, the house is connected to all necessary communications. After that, the territory adjacent to the house is ennobled.

Monolithic high-rise buildings have obvious advantages over brick and panel counterparts. First of all, it is worth highlighting their reliability and compactness. An important component is external attractiveness. An insulated and plastered monolithic high-rise building looks much better than a panel or brick one [9, 6].

In addition, very often, when building a multi-storey building using monolithic technology, additional architectural techniques and elements are used: ledges, bay windows, curved walls, window openings with original geometry [22, 15, 6, 1].

One of the key benefits is durability. Thanks to special construction technology, the monolithic structure has fewer joints, which can significantly increase the service life. Such buildings can be built in seismically active areas.

Monolithic high-rise buildings are ideal as objects with a developed infrastructure. On the basement and first floors, there is the possibility of arranging retail outlets, sports facilities, parking lots, and other establishments.

The disadvantages include reasons that are not related to the operational characteristics of buildings. The main negative point is the likelihood of shifting the deadlines for the completion of the object.

This happens due to an incorrect calculation or when the weather conditions worsen. This includes the complexity of the work because not every company can master a monolithic structure.

Monolithic construction is one of the most promising technologies used in the construction of buildings and structures for various needs.

The process of monolithic construction itself looks like the construction of various structural elements from a mixture containing concrete and special formwork.

Formwork is an integral part of monolithic construction, as well as one of its features since it is due to formwork that the structure of the future building acquires strength, rigidity, and resistance to changes in the shape, size, and other properties of the concreted structure.

Even though the construction market is oversaturated with offers of various services from construction companies, only a few of them are engaged in monolithic construction, and even fewer are ready to offer high-quality services for the construction of a monolithic house.

This is because monolithic construction is an innovation in the construction of buildings that requires special knowledge and techniques that are not available to every construction organization. In particular, the construction of formwork, an indispensable part of a monolithic structure, requires special knowledge.

During the construction of monolithic buildings, fixed formwork made of expanded polystyrene is the most popular among construction companies.

These formworks have the form of a hollow polystyrene block, which consists of two panels interconnected by special bridges made of the same material or plastic.

Expanded polystyrene is lightweight and easy to install, which is why it has become very widespread.

As a rule, plasterboard sheets are most often chosen for interior decoration, which is glued directly to polystyrene. Or choose plaster materials that are applied to polystyrene foam.

Next, it is worth plastering the facade of the house or tiling it with tiled materials or hardly combustible panels.

Also in monolithic construction, collapsible formwork is used. Most often they are used in the construction of multistorey and administrative buildings. In this case, the design of the house can be done in 2 ways:

– construction with monolithic external walls and insulated façade;

– construction with monolithic walls and insulation inside the wall.

The first type of construction is used only in very large buildings, and the second – is in all other cases.

At the construction site, special forms are installed - formwork, which completely repeats the contour of the future structure or its element – walls, columns, etc. In the formwork (of the type provided for by the scheme), reinforcement is installed into which concrete is poured.

Today, several types of formwork are used in monolithic construction technology: panel and tunnel formwork.

Tunnel formwork allows you to immediately get whole blocks of apartments since you can simultaneously build both internal walls and ceilings of the height and width that you only need. After the construction is completed, it is only necessary to build the outer walls. True, such a house can hardly be called elite, since one apartment will occupy a maximum of $50 - 60$ square meters.

For the construction of shield formwork, it takes more time, but it is more mobile. With its help, you can build buildings without frame-type beams, which opens up a lot of different possibilities. For example, you can build a building with absolutely any facade and any number of floors, while it is possible to plan the apartments themselves in such a way that you can satisfy the customer as much as possible. So, buyers get a lot of options for a future apartment - whatever they want. You can buy an apartment without finishing and partitions at all and plan it yourself from “$A$” to “$Z$”. So, the customer can decide for himself how many rooms he will have, what kind of interior they will have and even how many levels.

Then a communication system is installed (and this is all the electrical wiring that fits into the walls and ceilings at the time of formation), and the insulation system.

For the construction of external walls, curtains, panels, and brick walls are used. It should be noted that monolithic brick construction makes it possible to provide monolithic houses with almost one hundred percent sound insulation.

At the beginning of any construction, to start building a house, following monolithic technology, the construction site is cleared and prepared for the construction of the building. The construction area is calculated based on the size of the building itself, as well as the area that needs to be allocated for the storage and delivery of building materials. A distinctive feature of monolithic construction is the fact that concrete for construction is prepared directly at the site of the construction of the building, which can significantly reduce the cost of preparing and delivering concrete, and as a result, save on the final cost of construction.

Next is the installation of the reinforcing cage. This stage is extremely important in monolithic construction technology, which allows you to build a highly economical house in the shortest possible time. Depending on the shape of the reinforcing cage, the shape of the future building is formed. The reinforcing frame gives the walls of the building additional reliability and strength.

Then the formwork is installed. After preparing the territory and installing the reinforcing cage, the construction is approaching the stage of erecting special panel structures, into which concrete will be poured a little later.

Concrete is being poured. For the construction of the house, an ordinary concrete mixture is used, which is responsible for the formation of the walls of the future building.

heating of concrete. This need arises only when construction takes place in the winter season so that the concrete hardens better. However, if the construction takes place in the summer, then the need for this procedure is no longer necessary.

Curing. Removing formwork. For the concrete to harden, it is left for several days. After the concrete has hardened, the formwork is removed and the construction is approaching the finish line.

Exterior decoration of the house. This stage is considered the final stage of construction. Since concrete has high insulation performance, monolithic buildings do not require additional work on laying hydro, heat, and sound insulating materials. There is also no need to level the walls, so all finishing work tends to only perform facing work. To finish the facade of a monolithic building, you can use any known decorative materials that are only used today for outdoor finishing work. Most often, as a rule, panel-facing materials, facing bricks, decorative plaster, and many others are used. Here, architects can give free rein to their innovations and at the same time take into account the taste preferences of the customer as much as possible.

The requirements for the construction of monolithic buildings are of the same kind as for the usual ones. These requirements and norms are enshrined in the relevant government documents and project specifications.

# CHAPTER 2. ARCHITECTURAL DESIGN

## 2.1. General information

The architectural and planning solution of the residential building was adopted taking into account the urban development situation. The residential building consists of two block – sections, five-story, and seven-story, interconnected at the level of 4.5 floors by verandas.

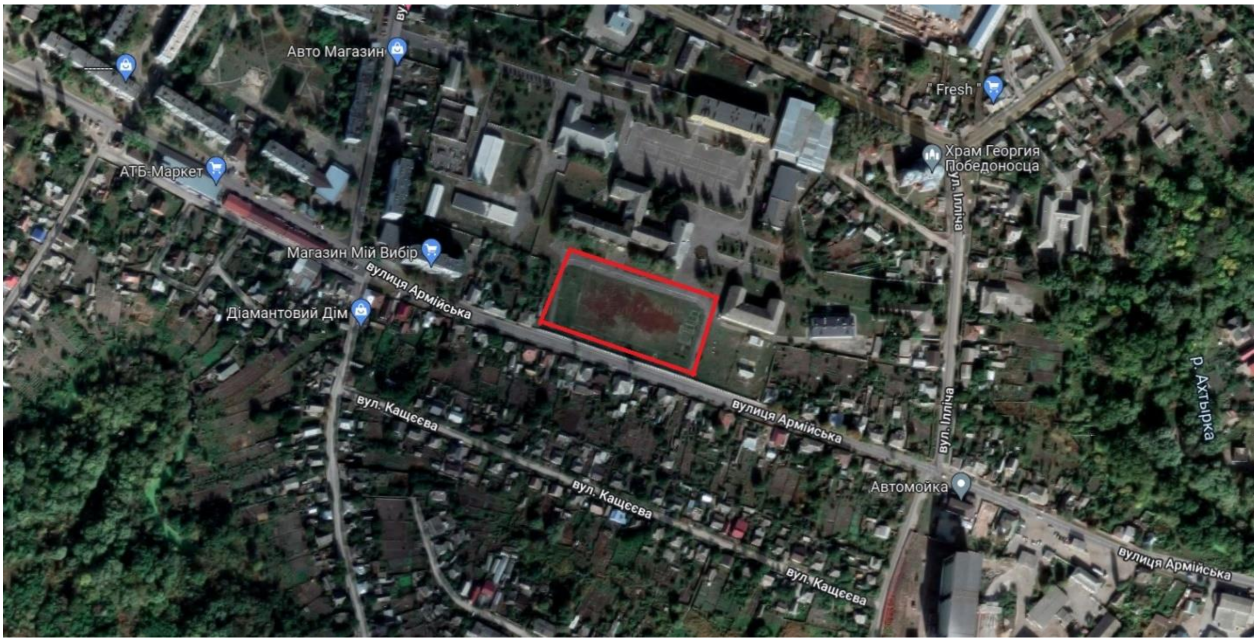


Fig. 2.1. Situational layout

In the residential block section, a passenger-and-freight elevator with a carrying capacity of $500\,kg$, and a staircase with a march width of $1.2\,m$ were designed. The normative height of a residential building is less than $26\,m$.

The insolation of apartments follows [32].

The first floor is designed to accommodate families with disabilities. In addition, part of the first floor, in axes $1-3$, is occupied by built-in public facilities.

The frame and ceilings of the block sections are designed in a monolithic version using the PERI universal formwork. Columns are made of monolithic reinforced concrete of class $B\ 20$ with a section of $400 \times 400\ mm$. Ceilings and roofing – a monolithic, beamless reinforced concrete slab $180\ mm$ thick made of class $B\ 20$ concrete supported by columns and walls. The elevator shaft is made of monolithic reinforced concrete with a wall thickness of $200\ mm$. Stair flights are monolithic $1.2\ m$ wide. Ventilation blocks – prefabricated reinforced concrete of individual design. Lintels – prefabricated reinforced concrete according to series $1.038.1 - 1$ and individual metal ones.

Spatial rigidity is ensured by a monolithic ceiling $180\ mm$ thick and monolithic walls $200\ mm$ thick.

The outer walls are designed as non-load-bearing enclosing structures with floor-by-floor support on floors. The structure of the outer walls is layered brickwork with insulation with $PSB - S$ polystyrene boards, calculated according to stage $II$, amend. 3 to [28]. Insulation – plates of polystyrene foam $PSB - C$ [33] a thickness of $150\ mm\ \gamma = 40\ kg/m^3$.

The brickwork of the inner layer of hollow brick follows [38] $1400\ kg/m^3$ on mortar $M - 50$, $250\ mm$ thick. The outer layer of face brick follows [38] $1400\ kg/m^3$ on the mortar $M - 50$, $120\ mm$ thick with jointing. In areas of masonry for sheathing and plastering, the outer layer of hollow brick follows [38] $1400\ kg/m^3$ on the mortar $M - 50$, $120\ mm$ thick without jointing.

Loggia fencing is made of bricks with face brick cladding and concrete white facade slabs.

Internal inter-apartment walls made of bricks follow [38] $1400\ kg/m^3$ on the mortar $M - 50$ and monolithic reinforced concrete. Intra-apartment partitions made of double gypsum-fiber sheets on a metal frame manufactured by $Uralgips\ KNAUF$. Partitions of bathrooms and kitchens along the front of the installation of equipment from solid clay follow [38] $1400\ kg/m^3$ on the mortar $M - 50$.

The window blocks are made of wood with triple glazing. Socle made of clay solid brick follows [38] 1400 $kg/m^3$ on the mortar $M-50$. The following engineering support systems are provided in the residential building: water supply, sewerage, heat supply, electricity supply, and garbage chute. Ventilation from kitchens and bathrooms is natural, through ventilation blocks. There is a container area for collecting garbage near the residential building.

## 2.2. Initial data and general part.

| | |
|---|---|
| Building-climatic zone | 1 $V$ |
| Estimated outdoor temperature | 25 $°C$ |
| Normative weight of snow cover | 1.5 $kPa$ |
| Standard wind pressure | 0.3 $kPa$ |
| Estimated freezing depth | 2.0 $m$ |
| Degree of fire resistance | $II$ |
| Level of responsibility | $II$ |
| Durability category | $II$ |

## 2.3. Space planning

Residential area:

| | |
|---|---|
| Area of apartments | 3189.69 $m^2$ |
| The total area of apartments | 3372.27 $m^2$ |
| Residential building area | 4576.90 $m^2$ |
| Building volume | 18520.00 $m^3$ |
| Including underground | 2500.00 $m^3$ |
| Building area | 922.8 $m^2$ |

Built-in premises (Office):

| | |
|---|---|
| Total area | 260.36 $m^2$ |
| Usable area | 225.74 $m^2$ |
| Estimated area | 187.68 $m^2$ |
| Building volume | 933.20 $m^3$ |

## 2.4. Thermal engineering characteristics of external enclosing structures

Basic initial data. Construction area: the humidity zone of the construction area is normal; relative humidity indoors – 30%, humid mode – normal; design temperature of the internal air: $+27°C$ (accepted following the design standards for the relevant buildings and structures); operating conditions of the building envelope – $B$; calculated winter outdoor air temperature of a cold five-day period with a security $of$ 0.92 – 30°C.

Optimum thermal resistance. We determine the required resistance to heat transfer, based on sanitary and comfortable conditions:

$$R_o^{тр} = \frac{n(t_в - t_н)}{\Delta t_н * \alpha_в} = 1{,}64\left(м^2 * °C / Вт\right) \quad (2.1)$$

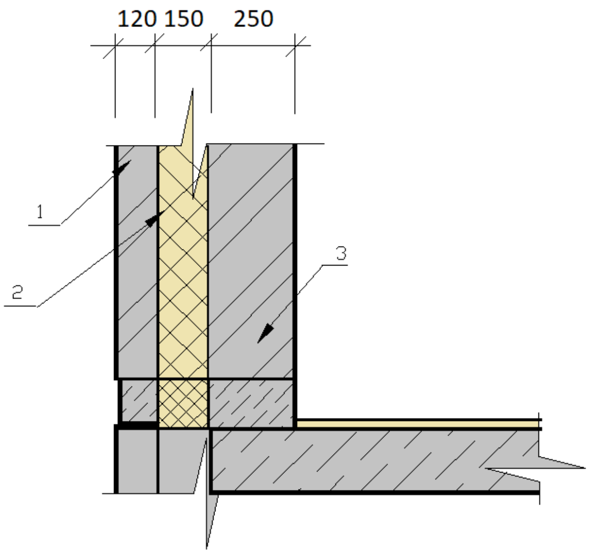


Fig. 2.2. The section fencing:

1 –The outer layer of face brick on the mortar $M - 50, 120\ mm$ thick with jointing; 2 – Insulation - plates made of polystyrene foam $PSB - S$ with a thickness of $150\ mm\ \gamma = 40\ kg/m^3$; 3 – Brickwork of the inner layer of hollow brick on mortar $M - 50, 250\ mm$ thick.

To obtain resistance to heat transfer, based on the condition of energy saving, we determine the degree-day of the heating period $R_0^{тр}$ = 3,57 (м2 * ˚С/Вт).

We determine the resistance to heat transfer of the fence:

$$R_0 = R_в + \sum_{i=1}^{4} \frac{\delta_i}{\lambda_i} + R_н = 4{,}26\left(м^2 \times °C / Bm\right) \quad (2.2)$$

The optimum thermal resistance of the insulation. We determine the optimal thermal resistance of the insulation, taking into account capital costs and operating costs for heating is $1{,}69\ м^2 \times °C/W$, where:

– a coefficient taking into account the ratio of the thermal resistance of the insulation to the resistance to heat transfer of the fence, equal to 0.85;

– a coefficient taking into account heat losses due to infiltration of outdoor air, taken equal to 1.05;

– a coefficient taking into account the change in the cost of thermal energy for the future, we accept – 1.3.

If $R$ for need < $R$ for real, then this means that the economically feasible resistance to heat transfer simultaneously satisfies sanitary and hygienic requirements, and the calculation ends there.

Thermal calculation of the floor structure.

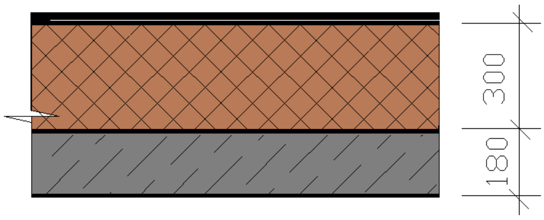


Fig. 2.3. The section of floor

We find the required heat transfer resistance of the fence, which eliminates the occurrence of condensate on the inner surface of the fence and provides comfortable conditions:

$$R_0^{mp} = 0,9 \times (22-(-35)) / (3,0\times8,7) = 1,97\ м^2 \qquad (2.3)$$

We find the minimum reduced resistance to heat transfer, based on the conditions of energy saving 2.85 $m^2$°C$/W$. We determine the resistance to heat transfer of the fence at 5.34 $m^2°C/W$. Comparing the result, we see that the fence meets the requirements of [28].

## 2.5. Characteristics of the main structural elements

### 2.5.1. Exterior finish.

The plinth of the outer walls should be faced with split concrete stones $SKTs - 1R - 1T$ made of heavy concrete, size $400 \times 100 \times 200$ of the company $LLP$ "$DEDOGOR$", the seams should be sinking by $20\,mm$. Lay the corner stones with the smooth side facing out.

Exterior walls to be faced with facing bricks with jointing. Walls of bay windows should be lined with white plates "$Fast - A$", as an option, facing with beige plates is possible. The walls of the first floor of the built-in premises are decorative high-quality stone plaster with rustication and trapezoidal rustication. Rusts are made using planed wooden slats. Plaster walls of entrances without rustication.

The composition of the stone mixture in% by weight:

| | |
|---|---|
| White Portland cement (M-400) | 20 |
| Lime dough | 5 |
| A crumb of white limestone with a particle size of $0.6-5\ mm$ | 75 |

Inclusions of other colors up to 2 % are allowed. The composition of the plaster and the technology for the production of plaster work according to the builder's guide or similar but more recent editions.

The paint rust throughout the building is white.

Windows – oil painting for two times white. Balcony glazing - oil painting for two times light gray. Entrance doors - finishing with weatherproof varnish.

Decorative screens of the attic and the roof of the entrance canopies should be made of metal tiles, dark green by Monterrey.

Around the building, make a concrete pavement with a width of $700\ mm$ from the concrete of class $B$ 7.5 on a crushed stone base.

As finishing options, it is possible to change the color of the window blocks from white and light gray to light green. It is also possible to replace white plaster with plaster imitating granite.

### 2.5.2. Interior decoration.

Residential premises. Ceilings in living rooms, corridors, kitchens, bathrooms, and bathrooms of apartments, as well as in entrance vestibules, elevator lobbies, stairwells, and switchboard rooms: are grouted with adhesive whitewash. The ceilings in the garbage chamber are grouted with oil paint twice. Ceilings in the machine room of the elevator – lime whitewash.

Walls and partitions in living rooms - on plaster, pasting with wallpaper of improved quality follow [36]. Walls in kitchens and bathrooms are executed up to a height of $1400\ mm$ – on plaster, oil painting two times; above – on plaster, glue whitewash. Walls in bathrooms – up to a height of $2100\ mm$

– glazed tiles, higher on plaster, adhesive whitewash. Walls in entrance vestibules, elevator lobbies, stairwells, and switchboards, are made up to a height of 1400 $mm$ – on plaster, oil painting, and above - on plaster, painting with water-based paints. In the waste chamber, the walls are covered with ceramic tiles to the full height. In the engine room – on plaster, oil painting.

Above the kitchen equipment - facing with glazed tiles with elevation 0.800 to mark 1,400 including side walls at the stove and sink.

Paint the trunk of the garbage chute with oil paint twice.

Offices. In rooms: 101, 102, 103, and 104 – the ceilings are finished with grout, and improved adhesive whitewash. In the same premises, the walls are finished - on plaster, a finishing layer of mineral chips on an acrylic binder. In rooms: 105, 106, 107, and 108 – c eilings are finished with grout, and improved adhesive whitewash. In the same rooms, the walls are finished - on plaster with VA color. In-room 109 – the ceilings are finished with grout and adhesive whitewash. Walls up to a height of 2100 $mm$ – with glazed tiles, and above – on plaster with adhesive whitewash.

### 2.5.3. Floors.

Residential premises. In living rooms, kitchens, corridors of apartments, and pantries on the ground floors: – polyvinyl chloride linoleum on a heat and sound insulating base on Bustilat glue, on a leveling layer of polymer cement and cement-sand screed $M$ 150 (20 $mm$) using polystyrene concrete (40 $mm$).

Bathrooms, first floor bathrooms, garbage chambers, el. switchboard rooms, cleaner's room: – ceramic tiles on a cement-sand screed $M$ 150 (20 $mm$) using concrete polystyrene (40 $mm$).

In living rooms, kitchens, corridors of apartments, storage rooms on floors $2-7$: – linoleum on Bustilat glue, on a leveling layer of polymer cement and cement-sand screed $M$ 150 (20 $mm$) using polystyrene concrete (40 $mm$).

Bathrooms, bathrooms, vestibules of garbage chambers on floors $2-7$: – ceramic tiles on a cement-sand screed $M$ 150 (20 $mm$) using polystyrene concrete (40 $mm$).

Loggias of the 1st floor: tongue-and-groove boards [35] 28 $mm$ thick, along the logs of the section $120 \times 80$ $mm$.

Loggias $2-7$ floors: cement-sand mortar screed $M$ 150 (20 $mm$) painted with oil paint.

In elevator halls, common corridors of the 1st floor: – Mosaic concrete of class $B$ 15 (30 $mm$) over a screed of cement-sand mortar $M$ 150 (20 $mm$) and porous mortar $M$ 50 (90 $mm$).

On the entrance porches: – "$Belaton$" $stove\ F.$ 7.8. on cement-sand mortar $M$ 150 (100 $mm$).

In elevator halls, common corridors of $2-7$ floors: – Concrete of mosaic composition of class $B$ 15 (30 $mm$) on a screed of cement-sand mortar $M$ 150 (20 $mm$).

Offices. In rooms - ceramic granite "$CARRARA$" is on the leveling layer of cement-sand screed $M$ 150 (40 $mm$) and using polystyrene concrete (40 $mm$).

In rooms 105, 106, 107, 108: – polyvinyl chloride linoleum on a heat-sound insulating on the Bustilat glue, along with the leveling layer of polymer cement and cement-sand screed $M$ 150 (20 $mm$) using concrete polystyrene (40 $mm$).

In-room 109: – ceramic tiles on cement-sand screed $M$ 150 (20 $mm$) using concrete polystyrene (40 $mm$).

Office entrance porch: Belton stove on cement-sand mortar $M$ 150 (100 $mm$).

Lay 1 layer of glassine or polyethylene film over the insulation with an overlap of 150 $mm$.

The ramp should be polished until 50 % of the aggregate is exposed.

The floor in the garbage chamber should be made with a slope to the ladder.

In all rooms, install a wooden plinth $PL-1$. Paint the skirting board in the same color as the flooring.

Perform floors after installing pipes for electrical wiring and installing partitions.

### 2.5.4. Key decisions to ensure the living conditions of people with disabilities.

The project provides for measures to allow access for disabled people, and people with disorders of the musculoskeletal system to apartments in a residential building and a store. For this purpose, ramps are designed at the entrance. There is an elevator to reach the floors of the residential building. Entrance door leaves have a width of more than 900 $mm$.

### 2.5.5. Fire prevention measures.

In each apartment on the network of household and drinking water supply, a separate tap is provided for connecting a fire hose (sleeve) for intra-apartment fire extinguishing at an early stage [21]. As fire warning devices in the apartments, autonomous detectors of the type are installed, which have built-in sound devices.

The normalized height of a residential building is up to 26 $m$.

The degree of fire resistance of the building is $II$.

Functional fire hazard class $F$ 1.3.

# CHAPTER 3. STRUCTURAL DESIGN

## 3.1. General part and load collection

The calculation includes a multicompartment building, a 7-story building. Columns are made of monolithic reinforced concrete of class $B20$ with a section of $400 \times 400\,mm$. Ceilings and roofing – a monolithic, beamless reinforced concrete slab $180\,mm$ thick made of class $B\,20$ concrete supported by columns and walls. The elevator shaft is made of monolithic reinforced concrete with a wall thickness of $200\,mm$. Stair flights are monolithic $1200\,mm$ wide. Ventilation blocks – prefabricated reinforced concrete of individual design.

Lintels – prefabricated reinforced concrete according to series $1.038.1-1$ and individual metal ones. Spatial rigidity is ensured by a monolithic ceiling $180\,mm$ thick and monolithic walls $200\,mm$ thick. The outer walls are designed as non-load-bearing enclosing structures with floor-by-floor support on the ceilings. The structural diagram of the building is shown in Figure 3.1., The diagram of deformations under the influence of loads is shown in Figure 3.2.

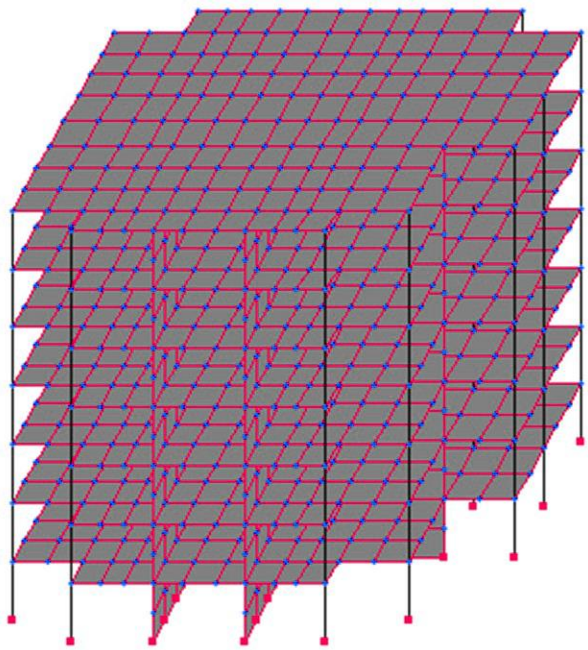

Fig. 3.1. Structural scheme of the building

*Table 3.1*

**Collection of loads**

| Name | Normative load kPa | Reliability factor | Design load kPa |
|---|---|---|---|
| **Constant** | | | |
| Monolithic ceiling t=180 mm | 4.50 | 1.1 | 4.95 |
| Screed linoleum floors | 0.20 | 1.3 | 0.26 |
| Partitions | 0.30 | 1.1 | 0.33 |
| Total | 5.00 | | 5.54 |
| **Temporary** | | | |
| load | 1.50 | 1.3 | 1.95 |
| snowy | 1.00 | 1.4 | 1.40 |
| Coefficient k | Standard load kN/m | Coefficient reliability | Estimated load kN/m |
| **wind** | | | |
| II - wind region, terrain type B | | | |
| 1st floor h= 4.1 0.50 | 0.63 | 1.4 | 0.88 |
| 2nd floor h= 7.1 0.56 | 0.71 | 1.4 | 0.99 |
| 3rd floor h= 10.1 0.65 | 0.82 | 1.4 | 1.15 |
| 4th floor h= 13.1 0.71 | 0.90 | 1.4 | 1.26 |
| 5th floor h= 16.1 0.77 | 0.97 | 1.4 | 1.36 |
| 6th floor h= 19.1 0.83 | 1.05 | 1.4 | 1.47 |
| 7th floor h= 22.1 0.88 | 1.10 | 1.4 | 1.55 |

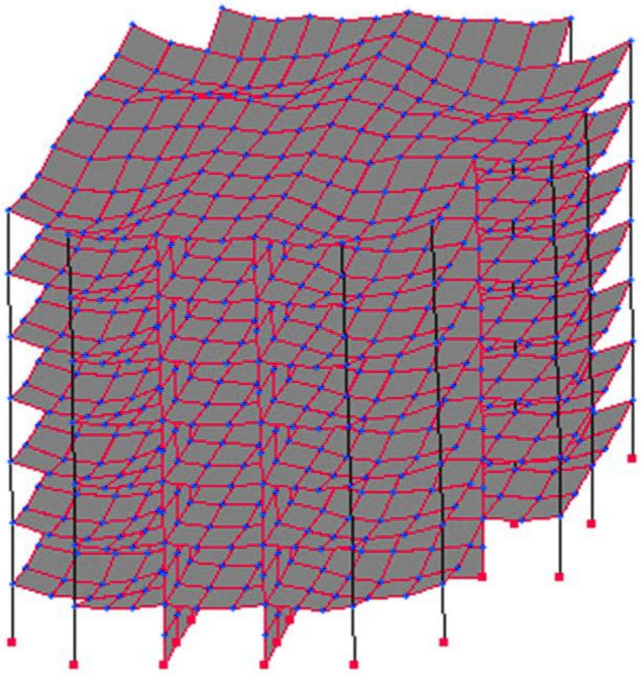

Fig. 3.2. Deformed circuit

We calculate the compiled scheme from the resulting load case. The obtained values are rendered by the program into separate isofield schemes (shown below).

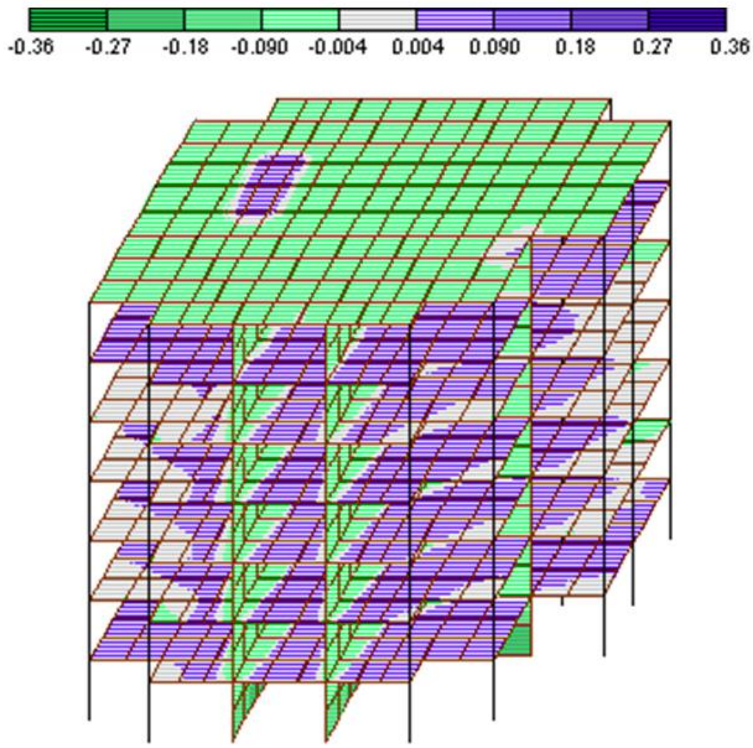


Fig. 3.3. Stresses $Nx$

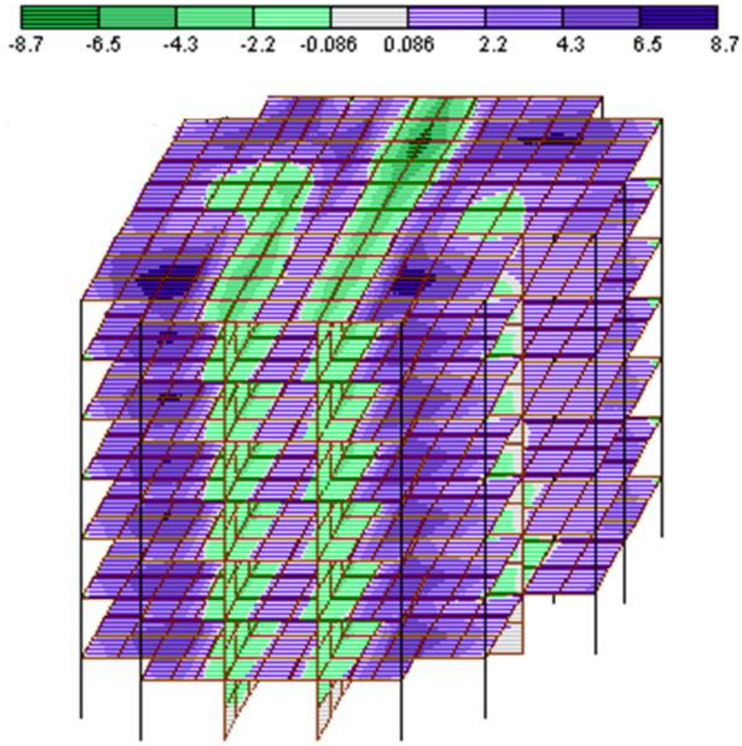


Fig. 3.4. Stresses $Mx$

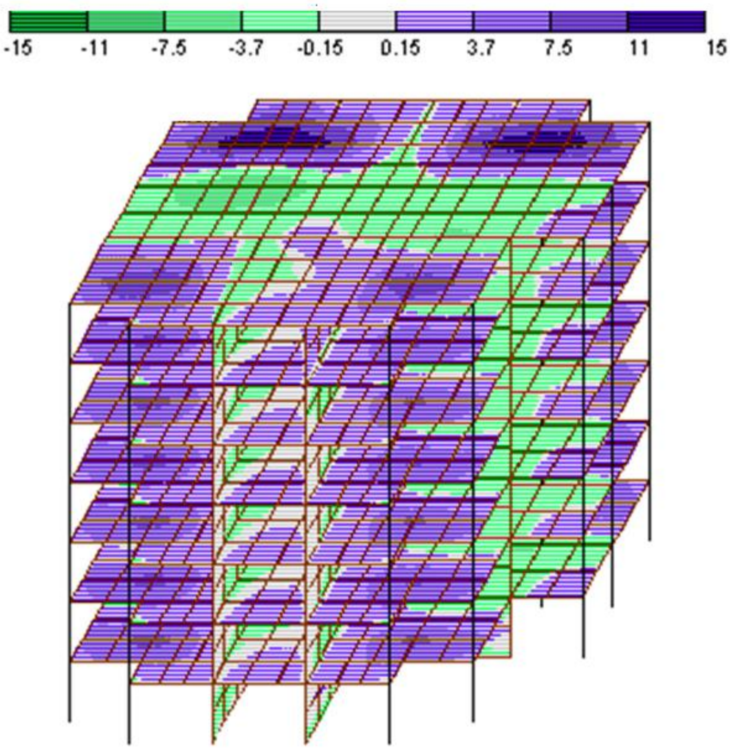


Fig. 3.5. Stresses $My$

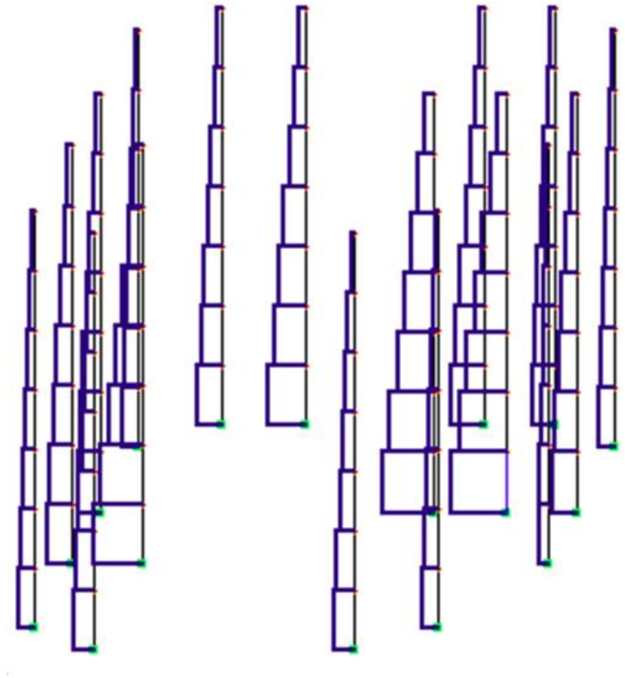

Fig. 3.6. Force diagram $N$

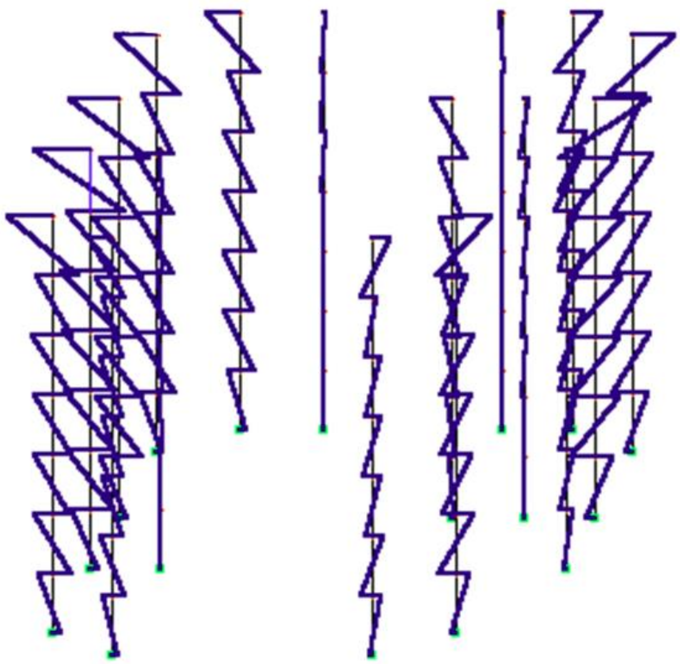

Fig. 3.7. Diagram $My$

**3.4. Slab reinforcement**

We accept class B20 concrete for the slab, reinforcement for reinforcement. After the calculation by the program, the calculation results are summarized in diagrams (shown below), the calculation is performed by the finite element method using the program.

Splitting the slab into finite elements. Taking into account the location of the vertical load-bearing elements and building axes, we break the monolithic slab into finite elements.

Applicable formulas:

Full design load (δ = 180 mm - monolithic floor thickness) $q + \delta;\ N/m^2$.

Taking into account the reliability factor for the intended purpose $\gamma n\ =\ 0.95$.

$$\xi R\ =\ \omega\ /\ (1 +\ \sigma_{SR}\ /\ \sigma_{SC}\ \cdot\ (1\ -\ \omega\ /\ 1{,}1)) \quad (3.1)$$

$\omega\ =\ \alpha - 0.008\, f_{cd},$

$\alpha\ =\ 0.85$

$\alpha m\ =\ \mathrm{M}\ /\ f_{cd} bho^2$

$\mathrm{A}S\ =\ \mathrm{M}\ /\ f_t \zeta h_0$

Condition: F ≤ α Rbt Um ho, where F is the punching force

$$F=(q_{п}+q_b)(l_1\ l_2 - 4(x + h_o)(y + h_o)) \quad (3.2)$$

α = 1 - heavy concrete

Design value of wind load $\omega_n = \omega_{mn} 3.6 \dots 0.95$, where 3.6 is the width of the design band; $\gamma_n = 0.95$ – reliability factor by purpose.

Conditional critical force:

$$N_{cr} = 6.4E_b/l_o(J/\varphi l(0.11/(0.1+\delta_e\varphi)+0.1))+\alpha J_S) \quad (3.3)$$

Here $J=bh^3/12$; $cm^4$

$\varphi_1 = 1 + \beta\ ((M_1 l)\ /\ M)$,

where $\beta = 1$ – heavy concrete

$\delta = e_0/h$

$\alpha = E_s/E_b$

$J_s = \mu b h_0 (0.5h - a)^2$,

where $\mu = 0.04$ is the first approximation

Element flexibility: $\lambda = lo/i = 24.6 > 14$, therefore, it is necessary to take into account the effect of element deflection on its strength.

Random eccentricity accept 10 mm.

Coefficient $\eta = 1/(1-(N/Ncr))$

$e = e_0\eta + 0.5h - a$

$A_s = A_s' = (Ne - f_{cd} bx(h_0 - 0.5x))/(R_{sc}(h_0 - a'))$

$A_s = A_s' < 0$

Fittings are installed constructively.

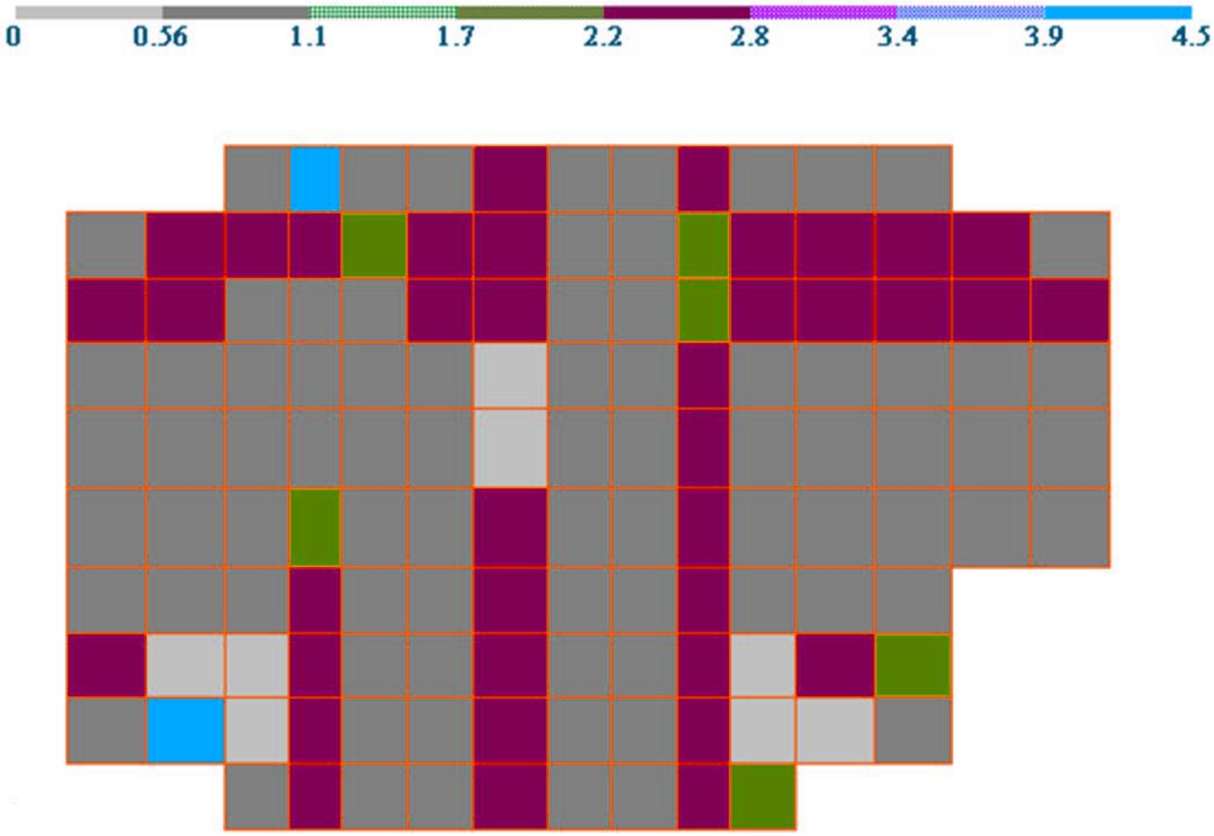


Fig. 3.8. Reinforcement area per 1 p/m along the X axis at the bottom edge

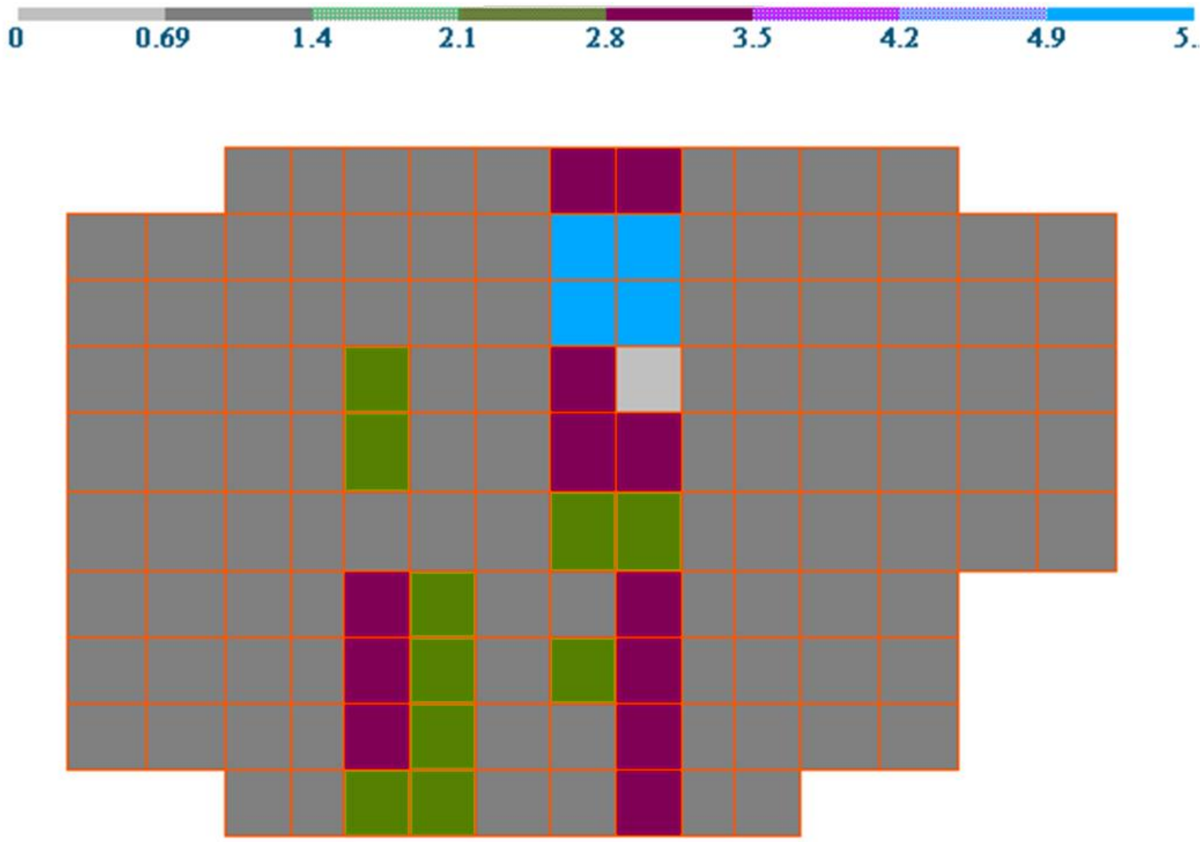


Fig. 3.9. Reinforcement area per 1 p/m along the X axis at the top face

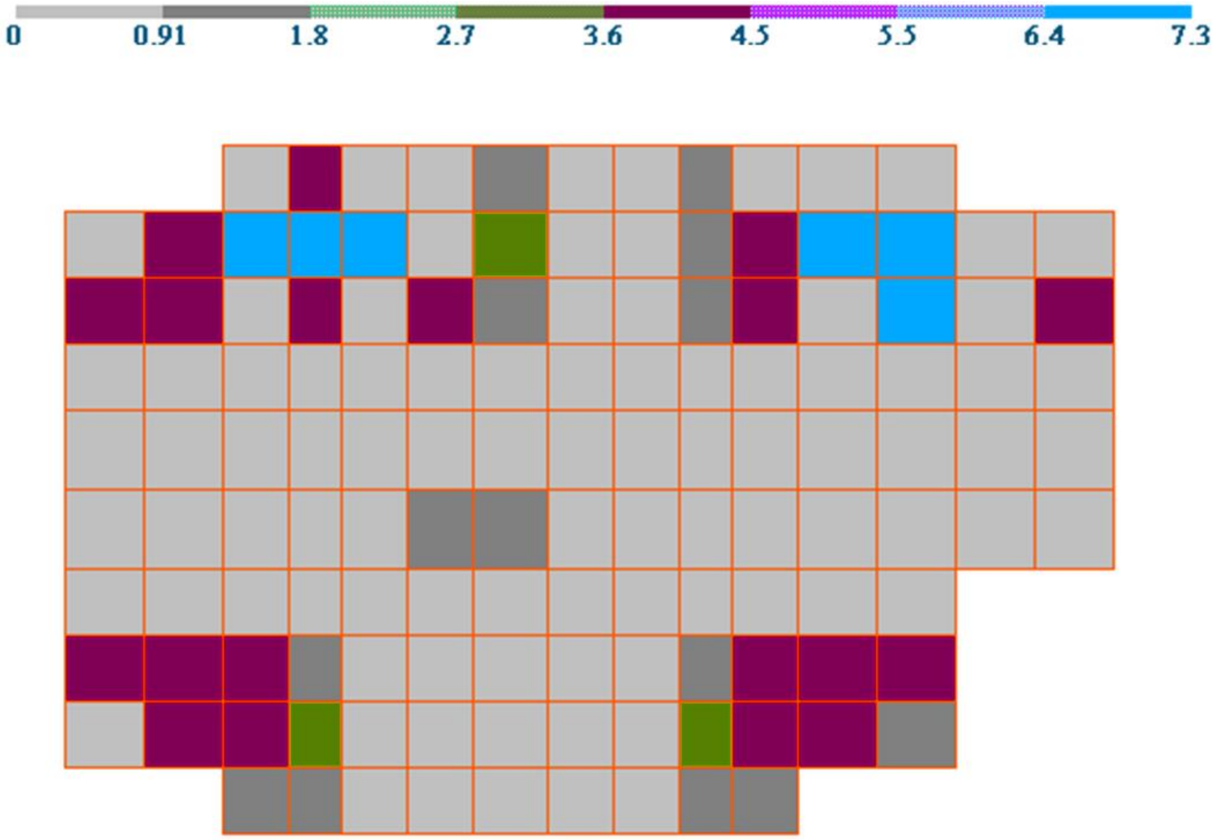


Fig. 3.10. Reinforcement area per 1 p/m along the Y axis at the bottom edge

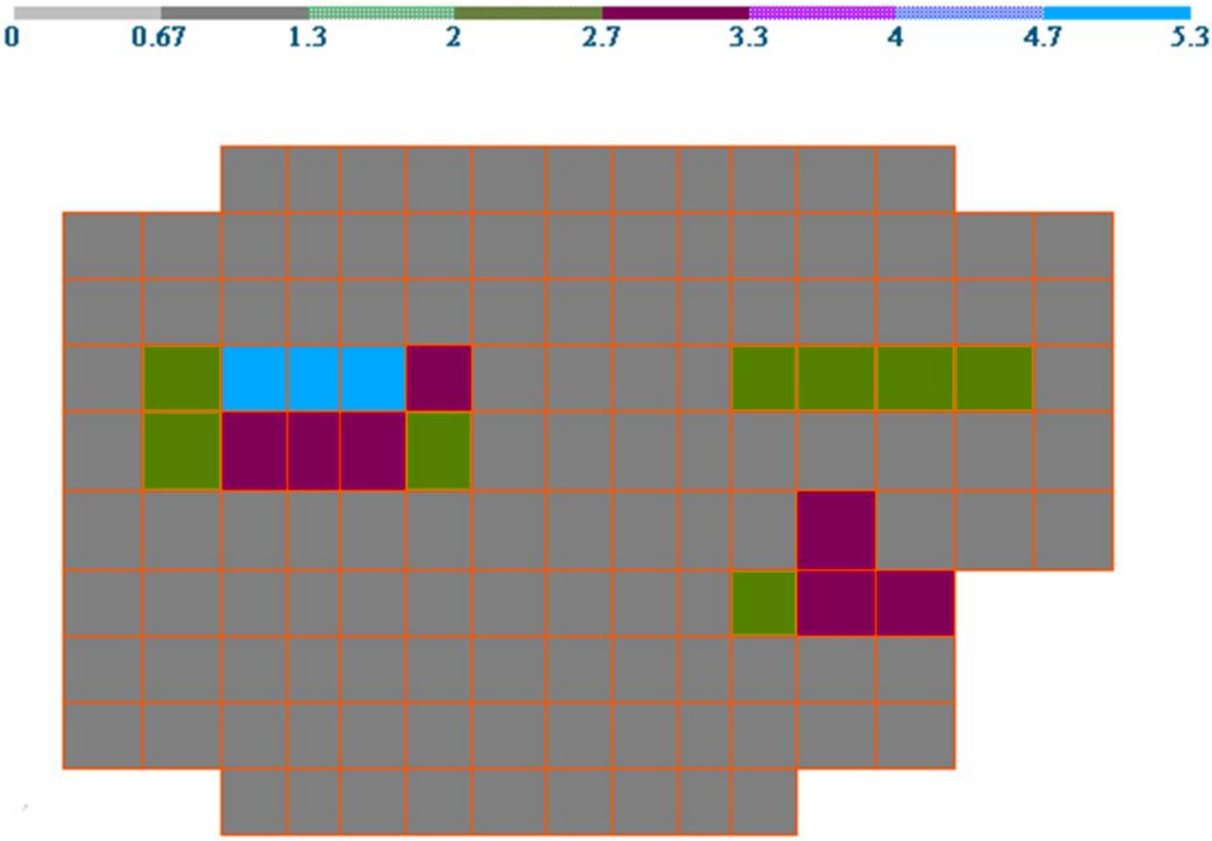


Fig. 3.11. Reinforcement area per 1 p/m along the Y axis at the top face

Transverse reinforcement according to the calculation is not required. As a longitudinal reinforcement for $1\ p/m$, we take 10 rods $d10mm\ A240$ with $As = 7.85\ cm^2$. Therefore, we accept the transverse reinforcement structurally for $1\ p/m$, we accept 10 rods $d10mm\ A240$ with $As = 7.85\ cm^2$.

# CHAPTER 4. TECHNOLOGY OF CONSTRUCTION

## 4.1. Brief description of the construction site

The site of the planned construction is located in Okhtyrka residential area. The territory of the construction site borders on the north and east with a forest; in the west and south – with residential buildings.

The relief of most of the site is not disturbed by human activities

Geologically, the site is located within the gabbro massif. In its upper part, bedrocks are destroyed to the state of crumbling, crushed stone, gruss, loam, soil and plant layer.

Gabbro roofing is characterized by uniform weathering.

Groundwater is not found in the area.

According to the difficulty of mechanized development, the above soils belong to the different groups.

The site is connected to the public road network with the existing road from main Street.

Enterprises and quarries that serve construction with local materials are located in the city of Okhtyrka, and partly in the region. The capacity of enterprises and quarries of contractors makes it possible to provide construction with building structures, products, parts, semi-finished products and materials in the amount necessary for the uninterrupted production of construction and installation works.

The contractor has a fleet of construction machines and vehicles of the required quantitative and qualitative composition.

## 4.2. Determining the duration of construction

According to DSTU B A.3.1-22: 2013 “Determining the duration of construction of facilities” [34], the duration of construction of a 5-7-storey monolithic residential building with a total area of 3631.63 m2 is 25 months, including:

- preparatory period – 3 months.
- installation of equipment – 2-3 months,

### 4.3. Preparation of construction production

According to [30], for the implementation of construction in a timely manner with high technical and economic indicators before the start of the main construction and installation work on the site must be prepared for construction, including organizational, preparatory, off-site and on-site work.

Organizational work includes:

- the decision of questions on conditions of use for needs of construction of the existing transport and engineering communications, the enterprises of the building industry, constructions of heat power, etc;
- -decisions on the maximum use of local construction materials and products;
- -determination of construction sites;
- the decision of questions on necessity of increase of production capacities of the construction and assembly organizations and attraction of the specialized subcontracting organizations for performance of separate kinds of works;

The implementation of organizational preparatory work should be preceded by a study of engineering and geological documentation and local construction conditions. Preparatory work should include the construction of access roads to the construction site, power lines, communications, transformer substations, main water supply networks, thermal power plants, sewers with sewage treatment plants, etc.

On-site preparatory work includes the creation of a geodetic base for construction, clearing the construction site, demolition of buildings and greenery. When organizing a construction site, it is necessary to pay attention to the location of permanent and temporary communications, temporary power supply networks, storage sites, temporary administrative and domestic and industrial premises in accordance with the construction plan.

### 4.4. Methods of production of construction and assembly works

#### 4.4.1. Geodetic center base.

By the beginning of geodetic work, the construction site is freed from buildings to be demolished. The geodetic base is created in the form of a network of points fixed with signs that determine the position of the designed buildings and structures on the ground.

Signs of the geodetic base during the construction process should be monitored for their safety and stability.

#### 4.4.2. Excavation.

Earthworks are carried out in accordance with DSTU-N B B.2.1-28: 2013 “Guidelines for earthworks, arrangement of foundations and construction of foundations” [40].

The planning of the territory is carried out by the bulldozer D-217A:

- power – 79 $kW$;
- blade length – 3.03 $m$;
- blade height – 1.1 $m$;
- brand of tractor – $T - 100$;

– blade type – fixed.

The removed plant soil is taken out by dump trucks to the dump at a distance of 15 $km$.

The development of the excavation of the building is carried out by the single-bucket excavator $EO-5111$ "straight shovel":

• power – 74 $kW$;

• bucket capacity – 1 $m^3$;

• maximum digging depth – 9.4 $m$;

• the largest unloading radius – 12.2 $m$.

The soil used for backfilling is developed into a dump, the rest is loaded onto dump trucks and transported 15 $km$ to the dump.

### 4.4.3. Underground installation.

The construction of the basement is carried out by a crawler crane MKG-40:

- power – 88.5 $kW$;
- carrying capacity (main hook) – 16 $tons$;
- boom length – 30 $m$;
- lifting height of the main hook – 28.3 $m$.

We perform waterproofing of the underground part with a $DS-39A$ asphalt distributor:

- base vehicle $ZIL-130$;
- tank capacity – 3500 $l$;
- feed length and distribution width – 10 $and$ 3.8 $m$;
- the area of the processed surface from one parking lot – $20 \times 2$ (width x height) m;
- base car power – 110 $kW$.

Backfilling of trenches and foundation sinuses is carried out by an $EO - 2131A$ planner excavator ($59\ kW$) with layer-by-layer soil compaction by a $SP - 62$ pneumatic rammer:

- base excavator $EO - 4121B$;
- slab dimensions – $0.8 \times 0.8\ m$;
- impact energy – $8826\ J$;
- weight – $2\ tons$;
- excavator power – $95\ kW$.

#### 4.4.4. Above ground installation.

Construction and installation work on the construction of the above-ground part of the building is carried out in accordance with the requirements.

Works on the construction of the ground part of the building are carried out floor by floor in the following technological sequence:

- installation of formwork, reinforcement and concreting of the column;
- installation of formwork, reinforcement and concreting of walls;
- erection of walls of stairwells and elevator shafts;
- dismantling the formwork of the column and walls;
- installation of formwork for floor slabs;
- concreting of floor slabs;
- masonry of internal walls and partitions.

The construction of external walls is carried out by an independent flow.

For the erection of wall and column structures, inventory formwork from Peri Trio is used, for ceilings - Peri Multiflex. Formwork installation is carried out in accordance with the standard technological maps "Installation of Peri Trio wall formwork" $TO - 17 - 6 - TTK$ and "Installation and dismantling of Multiflex formwork" $TO - 17 - 8 - TTK$.

Installation of structures of the above-ground part is carried out by a tower crane $KB - 403$:

- boom length – 30 $m$;
- maximum hook lifting height – 39.4 $m$;
- carrying capacity – 8 $tons$;
- power – 85 $kW$;

The concrete mixture is supplied by a $KB - 403$ crane using swivel buckets $BPV - 1.0$.

The advantage of the crane method of supplying concrete is the possibility of its transportation to any point within the reach of the boom and the height of the hook. In addition, the advantage of cranes is their versatility as lifting mechanisms - they deliver reinforcement, formwork, construction equipment to the place of concrete work, and also serve other types of construction and installation work within their coverage area.

During the construction of the column, the concrete mixture is compacted with a deep vibrator $IV - 56$:

- outer case diameter – 76 $mm$;
- length of the working part – 450 $mm$;
- power – 79 $kW$;
- weight – 19 $kg$.

To compact the concrete mixture during the construction of floors, vibrating screeds $SO - 131A$ are used:

- capture width – 1500 $mm$;
- dimensions – $1750 \times 430 \times 245$ $mm$;
- power – 0.26 $kW$;
- productivity – 90 $m^2/h$;
- weight – 45 $kg$.

In hard-to-reach places, a $PG - 2$ pneumovibratory smoother is used for compaction, complete with a $CO - 7A$ compressor:

- power – 4.5 $kW$;
- productivity – 20 $m^2/h$.

After completing the marking work and setting the orders, they begin laying the outer walls of ceramic bricks. Wall insulation is carried out simultaneously with the laying of walls. The laying of walls with a height of more than 1.5 m is carried out from portable platforms – scaffolding (flooring width – 2 m).

**4.4.5. Stone works.**

Brickwork with cladding is carried out in parallel with the installation of prefabricated structures. To do this, the building is divided into 2 grips. After the masons, working in 2 shifts, perform the task in (three tiers) brickwork on the 1st grip and move on to the 2nd grip, the assemblers come to the first.

To ensure the optimal height of the masonry $0.5 - 0.9\ mm$, To increase the productivity of masons we use self-elevating scaffolding, the supports of which are made in the form of hinged levers scissors whose height, including flooring with materials and workers, changes smoothly with hydraulic jacks.

The width of the mason's workplace on scaffolding, scaffolding, floors is $2.3 - 2.6\ m$.

Supply of bricks on scaffolding is made in packages on pallets - the brick is laid in a `herringbone`.

The solution is supplied by means of a dispensing hopper to the metal boxes of the tanks $0.27\ m^3$.

Recommended scaffolding

Hinged - panel scaffoldings of $PPU - 4$.

Installation of prefabricated reinforced concrete structures.

Acceptance of structures. Prefabricated reinforced concrete structures coming to the construction site must have:

- passport;
- on all designs - the marks and stamps of OTK put by indelible paint;
- on columns, crossbars, crane girders – axial risks;
- on one-sided reinforced elements – signs indicating the correct position during loading, unloading, warehousing and installation;
- on bulky and heavy structures – marks showing the location of the center of gravity.

At acceptance of designs of a bearing framework, elements check one by one; elements of other non-bearing structures – selectively.

Installation of a design. Before the beginning of installation of prefabricated designs it is necessary to make instrumental check of conformity of position of these prefabricated designs and mortgage details to design.

**4.4.6. Welding works.**

Are made after check of correctness of installation of elements of designs, position of welded details and preparation of joints for welding. Reinforcement outlets and embedded parts must be thoroughly cleaned of concrete, bitumen, paint, rust, moisture, snow, ice and dirt before welding.

Electrodes, type $E42$ with rutile coating are used for welding of galvanized details from Steel 3. Electrodes of type $350A$ are used for welding of steels of other classes.

**4.4.7. Sealing joints.**

Non-calculated joints that do not absorb design forces are made of concrete grade not less than 150 or mortar grade not less than 100. Sealing of joints and seams must be done in a mechanized way using inventory formwork.

Structures and products must be delivered to the site with all the necessary connection elements.

Window and door blocks in brick walls are installed simultaneously with the masonry. The surface of the blocks must be antiseptic and protected with waterproofing materials. The gaps between the blocks and the brickwork are carefully drilled with heat-insulating material.

Fastening of boxes in walls and partitions is carried out by the screws hammered in wooden stoppers.

The lower surface of window sills should have a slope inside the room of 1–1.5 %. Acceptance of wooden structures should be carried out before plastering.

**4.4.8.Waterproofing works.**

Are executed after installation of all embedded parts connected with the device in an isolated design of openings for passing of cables, anchors, and also with the device of temperature and sedimentary seams.

Insulated surfaces are leveled, cleaned and, if necessary, primed. Bitumen in the manufacture of mastic is heated, dehydrated, rolled materials are cleaned of dusting and rewound on the reverse side.

**4.4.9. Roofing works.**

We start the device of a roof after the termination of all construction and installation works on a roof, acceptance of the basis under a roof and after cleaning of a workplace of construction garbage. All necessary materials, mechanisms and equipment have been prepared for the beginning of roofing works. In order to ensure a solid and dense application of the rolled carpet "Bikrost", the base is primed under it. The primer is applied to the surface by spraying using pneumatic systems. Before a sticker of a rolled carpet on a cement coupler or on hot asphalt - in the winter), we carry out a first coat with cold mastic in the period of setting. This creates favorable conditions for the set of the required strength of the screed.

Before the beginning of roofing works the surface of a plate has to be cleared by the $KU - 405A$ sweeper ($power$ – $1.1\ kW$).

In the production of roofing works machines $CO - 100A$ ($60\ kW$), $CO - 122$ $and$ $CO - 99A$ ($1\ kW$) are used for the device of bituminous primer. Bitumen is delivered to the construction site by the BV-41 truck on the basis of $ZIL - 130$:

- capacity of the tank – $4000\ l$;
- power of the base car – $110\ kW$.
- The $OTS - 005$ manual torch complete with $CO - 12A$ and $CO - 7A$ is used for the device of a surfacing roof:
- productivity – $150\ m^2/h$;
- weight – $29\ kg$;
- power – $4\ kW$.

Compaction of cement-sand screed solution is made by $CO - 131A$ vibrating rail ($0.26\ kW$). In hard-to-reach places for consolidation use the $PG - 2$ pneumatic vibrating iron.

Containers, mechanisms and materials are fed to the roof by the $KB - 403$ crane.

**4.4.10. Finishing works.**

At production of finishing works – to be guided by DSTU-N B A.3.1-23: 2013 Guidelines for the installation of insulating, finishing, protective coatings for walls, floors and roofs of buildings and structures (SNiP 3.04.01-87, MOD) [39].

Includes plastering, cladding, painting, glass and wallpaper.

Prior to the start of finishing works in the building, the general construction and installation works must be completely completed, the networks must be pressed and tested. Finishing work begins on the upper floors. Plastering, cladding and preparatory painting work may be started from the lower floors, provided that at least two floors are installed above the finished premises, and no installation work is currently underway.

Finishing is carried out at the operating constant systems of heating and ventilation. If necessary, use a temporary heating system (heater type). The use of temporary stoves is prohibited. Finishing work is performed in the following sequence:

- plaster works;
- facing works;
- preparation of walls for oil painting and whitewashing of ceilings;
- device of floors;
- final painting of surfaces with glue and oil paint;
- sanding and rubbing the floor.

The $PSHS - 4$ plaster station ($34\,kW$) is used for supplying the solution to the floors and mechanized application.

Perform high-quality plaster with a thickness of $20\,mm$, consisting of a layer of spray, two layers of soil, and a layer of cover with leveling the soil on the beacons and grouting the cover layer with a grater.

High-quality oil painting is carried out by the $CO - 115$ station complete with the $CO - 12A$ injectors, the $CO - 71A$ air spray gun and the $CO - 7A$ compressor. Various means of lubrication are used: at a height of up to $4\,m$ – mobile scaffolding, in hard-to-reach places - tables and ladders.

The installation of floors is made element by element:

- underlying layer;
- waterproofing;
- screeds;

– top cover.

Plank and parquet floor coverings may be installed only after the completion of works in the room related to the humidification of the floor, while the windows must be glazed and doors hung.

Linoleum, polyvinyl acetate and polyvinylchloride coverings are arranged only after finishing works.

Cement binder coatings that are not primed with a bitumen solution must harden in humid conditions.

# CONCLUSIONS

In this work was designed Multicompartment building in Okhtyrka city of Sumy region.

The first part of this thesis describes the analytical review.

The second part of this thesis describes the Architectural solution of the Multicompartment building. The Multicompartment building was designed in Okhtyrka city of Sumy region.

The architectural and planning solution of the residential building was adopted taking into account the urban development situation. The residential building consists of two block – sections, five-story, and seven-story, interconnected at the level of 4.5 floors by verandas.

In the residential block section, a passenger-and-freight elevator with a carrying capacity of $500\,kg$, and a staircase with a march width of $1.2\,m$ were designed. The normative height of a residential building is less than $26\,m$.

The first floor is designed to accommodate families with disabilities. In addition, part of the first floor, in axes $1-3$, is occupied by built-in public facilities.

The frame and ceilings of the block sections are designed in a monolithic version using the PERI universal formwork. Columns are made of monolithic reinforced concrete of class $B\,20$ with a section of $400 \times 400\,mm$. Ceilings and roofing – a monolithic, beamless reinforced concrete slab $180\,mm$ thick made of class $B\,20$ concrete supported by columns and walls. The elevator shaft is made of monolithic reinforced concrete with a wall thickness of $200\,mm$. Stair flights are monolithic $1.2\,m$ wide. Ventilation blocks – prefabricated reinforced concrete of individual design. Lintels – prefabricated reinforced concrete according to series $1.038.1-1$ and individual metal ones.

Spatial rigidity is ensured by a monolithic ceiling $180\,mm$ thick and monolithic walls $200\,mm$ thick.

The outer walls are designed as non-load-bearing enclosing structures with floor-by-floor support on floors. The structure of the outer walls is layered brickwork with insulation with $PSB - S$ polystyrene boards. Insulation – plates of polystyrene foam $PSB$ – $C$ a thickness of $150\,mm\,\gamma\ =\ 40\,kg/m^3$.

The brickwork of the inner layer of hollow brick $1400\,kg/m^3$ on mortar $M - 50$, $250\,mm$ thick. The outer layer of face brick $1400\,kg/m^3$ on the mortar $M - 50$, $120\,mm$ thick with jointing. In areas of masonry for sheathing and plastering, the outer layer of hollow brick follows [38] $1400\,kg/m^3$ on the mortar $M - 50$, $120\,mm$ thick without jointing.

Loggia fencing is made of bricks with face brick cladding and concrete white facade slabs.

Internal inter-apartment walls made of bricks$1400\,kg/m^3$ on the mortar $M - 50$ and monolithic reinforced concrete. Intra-apartment partitions made of double gypsum-fiber sheets on a metal frame manufactured by $Uralgips\ KNAUF$. Partitions of bathrooms and kitchens along the front of the installation of equipment from solid clay $1400\,kg/m^3$ on the mortar $M - 50$.

The window blocks are made of wood with triple glazing. Socle made of clay solid brick $1400\,kg/m^3$ on the mortar $M - 50$. The following engineering support systems are provided in the residential building: water supply, sewerage, heat supply, electricity supply, and garbage chute. Ventilation from kitchens and bathrooms is natural, through ventilation blocks. There is a container area for collecting garbage near the residential building.

The plinth of the outer walls should be faced with split concrete stones $SKTs\ -\ 1R\ -\ 1T$ made of heavy concrete, size $400 \times 100 \times 200$ of the company $LLP$ "$DEDOGOR$", the seams should be sinking by $20\,mm$. Lay the corner stones with the smooth side facing out.

Exterior walls to be faced with facing bricks with jointing. Walls of bay windows should be lined with white plates "$Fast\ -\ A$", as an option, facing with beige plates is possible. The walls of the first floor of the built-in premises are decorative high-quality stone plaster with rustication and trapezoidal rustication. Rusts are made using planed wooden slats. Plaster walls of entrances without rustication.

The composition of the stone mixture in% by weight:

| | |
|---|---|
| White Portland cement (M-400) | 20 |
| Lime dough | 5 |
| A crumb of white limestone with a particle size of $0.6 - 5\ mm$ | 75 |

Inclusions of other colors up to $2\ \%$ are allowed. The composition of the plaster and the technology for the production of plaster work according to the builder's guide or similar but more recent editions.

The paint rust throughout the building is white.

Windows – oil painting for two times white. Balcony glazing - oil painting for two times light gray. Entrance doors - finishing with weatherproof varnish.

Decorative screens of the attic and the roof of the entrance canopies should be made of metal tiles, dark green by Monterrey.

Around the building, make a concrete pavement with a width of $700\ mm$ from the concrete of class $B\ 7.5$ on a crushed stone base.

As finishing options, it is possible to change the color of the window blocks from white and light gray to light green. It is also possible to replace white plaster with plaster imitating granite.

The calculation includes a multicompartment building, a $7$-story building. Columns are made of monolithic reinforced concrete of class $B20$ with a section of $400 \times 400\ mm$. Ceilings and roofing – a monolithic, beamless reinforced concrete slab $180\ mm$ thick made of class $B\ 20$ concrete supported by columns and walls. The elevator shaft is made of monolithic reinforced concrete with a wall thickness of $200\ mm$. Stair flights are monolithic $1200\ mm$ wide. Ventilation blocks – prefabricated reinforced concrete of individual design.

Lintels – prefabricated reinforced concrete according to series $1.038.1 - 1$ and individual metal ones. Spatial rigidity is ensured by a monolithic ceiling

180 $mm$ thick and monolithic walls 200 $mm$ thick. The outer walls are designed as non-load-bearing enclosing structures with floor-by-floor support on the ceilings.

The site of the planned construction is located in Okhtyrka residential area. The territory of the construction site borders on the north and east with a forest; in the west and south – with residential buildings.

The relief of most of the site is not disturbed by human activities

Geologically, the site is located within the gabbro massif. In its upper part, bedrocks are destroyed to the state of crumbling, crushed stone, gruss, loam, soil and plant layer.

Gabbro roofing is characterized by uniform weathering.

Groundwater is not found in the area.

According to the difficulty of mechanized development, the above soils belong to the different groups.

The site is connected to the public road network with the existing road from main Street.

Enterprises and quarries that serve construction with local materials are located in the city of Okhtyrka, and partly in the region. The capacity of enterprises and quarries of contractors makes it possible to provide construction with building structures, products, parts, semi-finished products and materials in the amount necessary for the uninterrupted production of construction and installation works.

The contractor has a fleet of construction machines and vehicles of the required quantitative and qualitative composition.

# REFERENCES

1. Gasii G. Constructive concept of composite structures for construction including geological specifics / G. Gasii, O. Zabolotskyi // Budownictwo o zoptymalizowanym potencjale energetycznym. – 2017. – Vol. 2(20). – p. 37-42.
2. Gasii G. Full changing of the load-bearing wall of the bunker's building of the coal mine / G. Gasii, V. Shushkevych, O. Hasii, O. Telichenko // E3S Web Conf. – 2020. – vol. 201. –01031.
3. Gasii G. M. Form-building units of the steel and concrete composite cable space frames / G. M. Gasii // Ресурсоекономні матеріали, конструкції, будівлі та споруди. – Рівне, 2017. – № 34. – С. 184–190.
4. Gasii G. M. Laboratory testing the combined elongate structural elements of support of a mine opening / G. M. Gasii, O. V. Hasii // Modern Technology, Materials and Design in Construction. - 2021. - 1 (30). - P. 20-27.
5. Gasii G. M. Production of full-scale experimental modular specimens of the steel and concrete composite cable space frame / G. M. Gasii // Inżynieria Bezpieczeństwa Obiektów Antropogenicznych. – Warszawa, 2017. – № 3–4. – P. 13–17.
6. Gasii G. Testing of the combined structural elements of support of a mine opening / G. Gasii, O. Hasii, V. Klimenko // In E3S Web of Conferences. – 2020. – Vol. 168. – 00028. EDP Sciences.
7. Gasii G. Testing of the combined structural elements of support of a mine opening / G. Gasii O. Hasii V. Klimenko // E3S Web Conf. — 2020. — Volume 168. — 00028.
8. Gasii G. M. Structural and design specifics of space grid systems / G. M. Gasii // Science and Technique. – 2017. – № 16 (6). – P. 475–484. http://dx.doi.org/10.21122/2227-1031-2017-16-6-475-484.

9. Guerrero H. (2019). Experimental tests of precast reinforced concrete beam-column connections / H. Guerrero, V. Rodriguez, J. A. Escobar, S. M. Alcocer, F. Bennetts, M. Suarez // Soil Dynamics and Earthquake Engineering. – 2019. – Vol. 125. – 105743.

10. Kolokhov V. Structure material physic-mechanical characteristics accuracy determination while changing the level of stresses in the structure / V. Kolokhov, A. Sopilniak, G. Gasii, A. Kolokhov // International Journal of Engineering & Technology. – 2018. – Vol. 7. – № 4.8. – P. 74–78.

11. Kolokhov V. Structure materialphysic-mechanical characteristics accuracy determination while changing the level of stresses in the structure / V. Kolokhov, A. Sopilniak, G. Gasii, A. Kolokhov // International Journal of Engineering &Technology. – 2018. – Vol. 7(4.8). – pp. 74-78.

12. Kolokhov V. Time measurement of ultrasonic vibrations extension in concrete of different compositions / V. Kolokhov, M. Savytskyi, A. Sopilniak, G. Gasii // Lecture Notes in Civil Engineering. – 2020. – vol. 73. – P. 95–102.

13. Kozlovská, M. (2016). A comparison of the structural and energetic parameters of selected modern methods of construction // M. Kozlovská // International Multidisciplinary Scientific GeoConference: SGEM, 2016. – Vol. 2. – p. 9-16.

14. Mechtcherine V. (2019). Large-scale digital concrete construction–CONPrint3D concept for on-site, monolithic 3D-printing / V. Mechtcherine, V. N. Nerella, F. Will, M. Näther, J. Otto, M. Krause // Automation in Construction. – 2019. – Vol. 107. – 102933.

15. Moussard, M., Garibaldi, P., & Curbach, M. (2018). The invention of Reinforced concrete (1848–1906) / M. Moussard, P. Garibaldi, M. Curbach // In High Tech Concrete: Where Technology and Engineering Meet. 2018. – pp. 2785-2794. Springer, Cham.

16. Semko, P., & Gasii, G. (2021). Determination of the Bearing Capacity of Concrete-Filled Steel Tubular Structures Coupled with Dismountable Joints / P.

Semko, G. Gasii //International Journal of Sustainable Construction Engineering and Technology. – 2021. – 11(4). P. 8–17. – https://doi.org/10.30880/ijscet.2021.11.04.002

17. Storozhenko L. Preparation Technique of Experimental Specimens of Steel and Concrete Composite Slabs / L. Storozhenko, G. Gasii, M. Hohol, O. Hasii // Lecture Notes in Civil Engineering. – 2022. – vol. 181. – P. 147–154. Springer, Cham. https://doi.org/10.1007/978-3-030-85043-2_14
18. Storozhenko L. The modern steel and concrete composite cable space frames / L. Storozhenko, G. Gasii // Sustainable housing and human settlement: Monograph. – Dnipro – Bratislava: SHEE «Prydniprovska State Academy of Civil Engineering and Architecture» – Slovak University of Technology in Bratislava, 2018. – P. 116–119.
19. Storozhenko L.I. Experience and current issues of designing of steel and concrete composite structures of roof and floor systems / L.I. Storozhenko, G.M. Gasii // ACADEMIC JOURNAL Industrial Machine Building, Civil Engineering. – Poltava: PNTU, 2020. – VOL. 2 (55). – P. 15–25. – https://doi.org/10.26906/znp.2020.55.2337
20. Tullini N. Grouted sleeve connections used in precast reinforced concrete construction–Experimental investigation of a column-to-column joint / N. Tullini, F. Minghini, // Engineering Structures. – 2016. – Vol. 127. – p. 784-803.
21. Yeoh G. H.. On numerical comparison of enclosure fire in a multi-compartment building / G. H. Yeoh, R. K. Yuen, S. M. Lo, D. H. Chen // Fire Safety Journal. – 2003. – Vol. 38(1). – pp. 85-94.
22. Yuliati N. C. E. Comparative study of behaviour of reinforced concrete beam-column joints with reference to monolithic and non-monolithic connection / N. C. E. Yuliati, D. S. Murni, W. Ari //In MATEC Web of Conferences. – 2018. – Vol. 195. – 02021. EDP Sciences.

23. Гасій Г. М. Напружено-деформований стан структурно-вантової сталезалізобетонної конструкції / Г. М. Гасій // Сучасні будівельні конструкції з металу, деревини та пластмас. – Одеса, 2017. – № 21. – С. 33–39.
24. Гасій Г. М. Динаміка розвитку, сутність та галузь застосування просторових структурно-вантових сталезалізобетонних конструкцій / Г. М. Гасій // Наука та прогрес транспорту. Вісник Дніпропетровського національного університету залізничного транспорту імені академіка В. Лазаряна. – Дніпро, 2017. – № 5 (71). – С. 107–114. DOI: https://doi.org/10.15802/stp2017/107449
25. Гасій Г. М. Експериментально-теоретичні дослідження напружено-деформованого стану плити структурно-вантової сталезалізобетонної конструкції / Г. М. Гасій // Збірник наукових праць Українського державного університету залізничного транспорту. – Харків: УкрДУЗТ, 2017. – Вип. 170. – С. 72–78.
26. Гасій Г. М. Рекомендації до проектування просторових структурно-вантових сталезалізобетонних конструкцій / Г. М. Гасій. — Полтава: ТОВ «АСМІ», 2018. — 69 с.
27. Гасій Г. М. Скінченно-елементний аналіз НДС вузла з’єднання елементів верхнього пояса структурно-вантової сталезалізобетонної конструкції / Г. М. Гасій // Збірник наукових праць Українського державного університету залізничного транспорту. – Харків: УкрДУЗТ, 2017. – Вип. 171. – С. 69–76.
28. ДБН В.2.6-31:2016 Теплова ізоляція будівель – [Чинний від 2017-05-01]. – К.: Мінрегіон України, 2017. – 31 с.
29. ДБН В.2.6-98:2009 Конструкції будинків і споруд. Бетонні та залізобетонні конструкції. Основні положення – [Чинний від 2011-06-01]. – К.: Мінрегіонбуд України, 2011. – 71 с.
30. ДБН А.3.1-5:2016 Організація будівельного виробництва – [Чинний від 2017-01-01]. – К.: Мінрегіон України, 2016. – 52 с.

31. ДБН А.3.2-2-2009 Система стандартів безпеки праці. Охорона праці і промислова безпека у будівництві. Основні положення (НПАОП 45.2-7.02-12) – [Чинний від 2012-04-01]. – К.: Мінрегіонбуд України, 2012. – 116 с.

32. ДБН Б.2.2-12:2019 Планування та забудова територій – [Чинний від 2019-10-01]. – К.: Мінрегіонбуд України, 2019. – 177 с.

33. ДСТУ Б EN 13163:2012 Матеріали будівельні теплоізоляційні. Вироби зі спіненого полістиролу (EPS). Технічні умови (EN 13163:2008, IDT) – [Чинний від 2013-04-01]. – К.: Мінрегіонбуд України, 2013. – 63 с. – (Національні стандарти України).

34. ДСТУ Б А.3.1-22:2013 Визначення тривалості будівництва об'єктів – [Чинний від 2014-01-01]. – К.: Мінрегіонбуд України, 2014. – (Національні стандарти України).

35. ДСТУ Б В.2.5-46:2010 Труби залізобетонні безнапірні. Технічні умови (ГОСТ 6482-88, MOD) – [Чинний від 2012-01-01]. – К.: Мінрегіонбуд України, 2012. – (Національні стандарти України).

36. ДСТУ ГОСТ 6810:2004 Шпалери. Технічні умови (ГОСТ 6810-2002 (ЕН 233-89), IDT). Зі змінами № 1, 2 – [Чинний від 2006-07-01]. – К.: ДЕРЖСПОЖИВСТАНДАРТ УКРАЇНИ, 2004. – (Національні стандарти України).

37. ДСТУ EN 14351-1:2020 Вікна та двері. Вимоги. Частина 1. Вікна та зовнішні двері (EN 14351-1:2006 + A2:2016, IDT) – [Чинний від 2021-02-01]. – К.: ДП «УкрНДНЦ», 2021. – 81 с. – (Національні стандарти України).

38. ДСТУ Б В.2.7-61:2008 Будівельні матеріали. Цегла та камені керамічні рядові і лицьові. Технічні умови (EN 771-1:2003, NEQ) – [Чинний від 2010-01-01]. – К.: Мінрегіонбуд України, 2009. – 27 с. – (Національні стандарти України).

39. ДСТУ-Н Б А.3.1-23:2013 Настанова щодо проведення робіт з улаштування ізоляційних, оздоблювальних, захисних покриттів стін, підлог і покрівель

будівель і споруд (СНиП 3.04.01-87, MOD) – [Чинний від 2014-01-01]. – К.: Мінрегіон України, 2014. – (Національні стандарти України).

40. ДСТУ-Н Б В.2.1-28:2013 Настанова щодо проведення земляних робіт, улаштування основ та спорудження фундаментів (СНиП 3.02.01-87, MOD) – [Чинний від 2014-01-01]. – К.: Мінрегіон України, 2014. – (Національні стандарти України).

41. Патент на корисну модель 119590 Україна, МПК E04G 1/00. Модульний спосіб виготовлення просторових сталезалізобетонних конструкцій / Л. І. Стороженко, Г. М. Гасій; власник ПолтНТУ. — № u201704289; заявл. 13.05.2017; опубл. 25.09.2017, Бюл. № 18/2017. — 6 с

42. Стороженко Л. І. Випробування експериментальних зразків пологої структурно-вантової оболонки з суцільним нижнім поясом / Л. І. Стороженко, Г. М. Гасій // Вісник Львівського національного аграрного університету: архітектура і сільськогосподарське будівництво. – Львів: ЛНАУ, 2017. – № 18. – С. 109–115.