MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
NATIONAL AVIATION UNIVERSITY
FACULTY OF ARCHITECTURE, CIVIL ENGINEERING AND DESIGN
COMPUTER TECHNOLOGIES OF AIRPORT CONSTRUCTION AND
RECONSTRUCTION DEPARTMENT

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Head of the Department
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«_8_» ____06____ 2022

BACHELOR THESIS

(EXPLANATORY ACCOUNT)

SPECIALTY 192 «BUILDING AND CIVIL ENGINEERING»

Educational and professional program: «Industrial and civil engineering»

Theme: **«Multifamily residential building in Bucha of Kyiv region»**

Performed by: student of group ЦБ – 406 Ба, Syrotiak Roman

Thesis Chair: Doctor of Engineering Sciences, Professor Hasii, H.M.

Design rule check: _____ O. Rodchenko

Kyiv 2022

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
_____ Н.І. Лапенко
« 8 » 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. Буча Київської області**

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Київ 2022

НАЦІОНАЛЬНИЙ АВІАЦІЙНИЙ УНІВЕРСИТЕТ
Факультет архітектури, будівництва та дизайну
Кафедра комп'ютерних технологій будівництва та реконструкції аеропортів
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ЗАТВЕРДЖУЮ
Завідувач кафедри
_____ О.І. Лапенко
«13» 04 2022 р.

ЗАВДАННЯ
на виконання дипломної роботи

Сиротяк Роман Васильович
(П.І.Б. випускника)

1. Тема роботи «Багатоквартирний житловий будинок в м. Буча Київської 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: 16-поверховий житловий будинок з цегли, 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	
2.	Архітектурно-будівельний розділ	16.05.22-20.05.22	
3.	Розрахунково-конструктивний розділ	23.05.22-02.06.22	
4.	Технологічно-організаційна частина	03.06.22-04.06.22	
5.	Вступ. Висновки. Список використаних джерел.	06.06.22-07.06.22	
6.	Підготовка доповіді та презентації	08.06.22-11.06.22	

8. Дата видачі завдання: «13» травня 2022 р.

Керівник дипломної роботи: _____ Гасій Г.М.

Завдання прийняв до виконання: _____ Сиротяк Р.В.

CONTENTS

INTRODUCTION

Of prodigious standing for the economic progress of our country is the revival of construction, and the creation of new buildings based on the use of advanced domestic and foreign technologies.

When designing new civil buildings, special attention should be paid to reducing their price while increasing the strength and reliability of structural elements and their components.

The main role is played by a high degree of industrialization, efficiency, and the creation of improved working conditions. The architecture of civil buildings is focus to high supplies due to the overall progress of architecture. Notwithstanding the current variety of civil buildings, those that differ in terms of spatial planning, construction technology, and microclimate, the general criterion in the evaluation of new types of buildings is the intersectoral unification of spatial planning and design solutions.

The basis for the industrialization of civil engineering is the principle of factory manufacture of structures and parts with maximum automation of construction and setting up work.

CHAPTER 1. ANALYTICAL REVIEW

Additionally, this applies to the capital, which appeals like a magnet, compatriots who hope to find a place "under the sun", or their future, feeling the benefits in terms of employment and prospects for growth of their well-being. That is, anything offered by the market will eventually find a suitable consumer.

Native construction of multi-apartment housing in modern veracities more and more resembles a conveyor belt for the construction of apartments for all tastes and wallets for those who need them. It is the profits that support the constant request for housing, according to the logic of the well-known proverb "every product has its buyer".

It seems rather natural: request generates supply, particularly naturally, because it corresponds to the basic law of economic advance. Especially if you do not pay attention to the idiom about "anything", the essence of which it somewhat contradicts or "adapts" to domestic realities. At the same time, negatively upsets the advanced tendencies of enormous cities as hubs of mass application of countless investment and architectural plans and business developments. And where, according to certain marketing expediency, as well as a flexible pricing policy, more and more objects are emerging. Where, tremendously high request for housing lets you build not only individual houses, based on certain categories of consumers, but also entire residential complexes and neighborhoods. Given the national codes and standards, as well as regulations recognized by local management. Methods of reducing costs and savings in construction, even where this is unacceptable or prohibited.

Speciously, it is not worth arguing that the existing purchasing power of the populace, due to the circumstances, can be separated into three main groups of potential consumers, namely:

- able to buy, even expensive, high-quality housing;
- focused on the purchase of comfortable, in their understanding, apartments in a certain price range, with a lower cost, to some extent, without paying attention to some imperfections around the house space and infrastructure;
- who have the opportunity to buy their housing, but are guided in the choice of apartments only by their cost characteristics.

Of course, there are other groups of consumers in the market, whose request is somewhat different from those declared above. The request, which the modern developer, also does not ignore, addresses the marketing demands of society in need, which need to be met. For example, the construction of so-called smart apartments overturned not only domestic stereotypes in the vision of what an apartment can be but also the fundamentals, principles, and methods to design. Focusing on those who can only spend the lowest of currency on the ceiling above the head among the four walls of the living space, even in 12 square meters. m of housing, which is not legally allowable for long-term residence, as documented in DBN B.2.2-15:2019 Buildings and structures. Residential buildings. Substantive provisions. With Modification.

CHAPTER 2. ARCHITECTURAL DESIGN

2.1. Characteristics of the conditions of the construction area

The scheme set sideways for the construction of a Multifamily residential building of improved planning is located in the residential area of in Bucha of Kyiv region.

The ground of the location is calm, with a total natural slant of the zone in the north-eastern route up to 3%.

Table 2.1

Technical and economic indicators of the building

№	Name of indicators	Unit	Qty
1	Number of floors	St.	16
2	Number of sections	Sec	1
3	Number of apartments	psc	80
4	Floor height	m	3.3
5	Building area	m^2	849.7
6	Total area of apartments	m^2	9159
7	Usable area	m^2	4201.4
8	Auxiliary area	m^2	5907.4
9	Construction volume	m^3	46394
10	Garage area	m^2	381.2

2.1. Master plan

The choice of the principal plan of the building is ranged by the standing leading plan of the district.

The entire area within the chosen area and together streets are being considered.

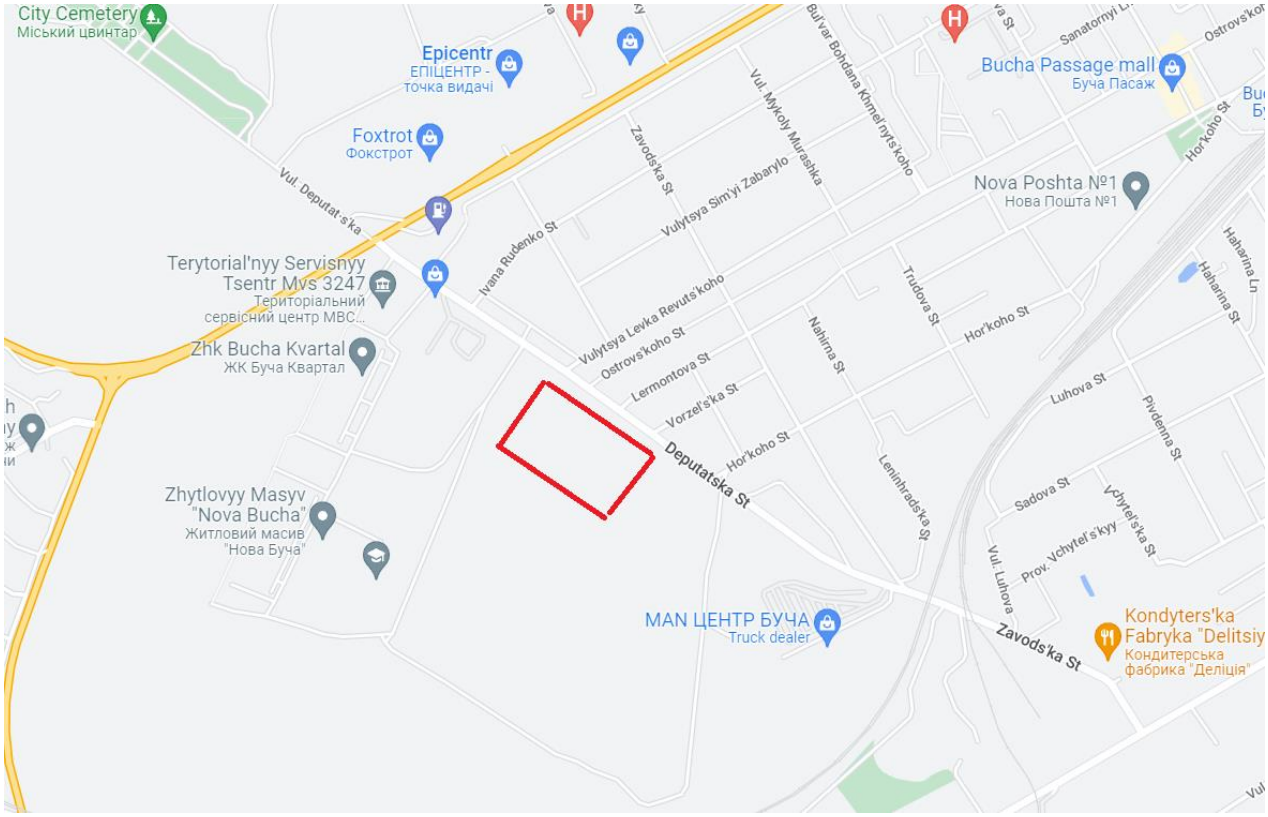

Fig. 2.1. Situational plan

Removal of extra soil from the construction site is carried out on the area located at a distance of 5 *km* from the construction area.

The building is located in a designated area according to the requirements of the finest location of the main premises. The entrances to the building are designed.

The plot has a cattle yard, which houses: play area for family needs and regeneration of residents.

Technical and economic gauges of the master plan:

- area of sites – 1.8 $thous.m^2$;
- area of current buildings – 0.85 $thous.m^2$;
- building area – 0.85 $thous.m^2$;
- building density – 15 %;
- redesigning area – 3.92 $thous.m^2$.
- area of rigid surface – 1.32 $thous.m^2$;
- design area – $11.2 \times 10^3 m^2$;
- the utilization rate of the area: 0.4.

There are locations for several objectives with the needed set of minor architectural systems.

Minor architectural systems and tackle of platforms are accepted on a series $310-4-1, and\ 310-5-4$.

The project envisages environmental protection measures: land reclamation, cleaning from dry debris, and the efficiency of green areas.

2.3. Spatial planning decision

The considered residential building has alike shape to the plan "L" with extents in the axes of about $34\ m\ by\ 32\ m$.

The building is 16 $storeys$, 1-section. The floors have height of 3.3 m. The building height is about 66.5 m.

Structural scheme of the building – without frame with longitudinal and transverse load-bearing walls. The spatial rigidity of the building is ensured by the joint work of longitudinal and transverse load-bearing walls, floor slabs, and flooring.

The basis of water supply is the contemporary water supply scheme $0.2\,m$, which runs along street. The water pressure at the connection point is $0.5\,MPa$, which affords the project pressure at the entrance to the building. Fire hydrants are installed in the wells along the water supply route. The water supply network is designed from copper welded water pipes with a length of $2500\,mm$.

Dirt removal from a residential building is considered in the present sewer $0.4\,m$, then in the current local treatment facilities.

The sewer network is designed from ceramic pipes.

Gas supply is provided by natural gas from the city's low-pressure gas pipeline. The laying of the external gas pipeline is designed to lift from the point of connection to the building.

The pipeline is laid from steel electric welded pipes. Covert tubes are enclosed with bitumen-polymer lagging type as reinforced hard, overhead – glaze with the adding of aluminum precipitate. To find the anode zones on the gas pipeline, checkpoints are set up.

To protect gas pipelines from corrosion by stray currents, design protection, and insulating flanges are used. Active defense of pipelines from the wandering currents corrosion is solved in the complex protection of the municipal gas web.

The power supply of the building is provided from the substation $KTP160$. According to the degree of reliability of electricity supply belongs to the II category.

Outside illumination is providing by spotlights with mercury spotlights on park wires, the link of outside illumination is accepted out by a chain of the modern brand. The source of heat supply is the municipal heating system. The warmth tube is made of welded tubes.

The scheme delivers for the setting up of goggle-box feelers for shared use. The house is furnished with aeriation, eating and fire water stream, television, inside drainage, drain water, boiler, gas water radiators, electric gear, refuse.

2.4. Architectural and constructive decision

The arrangement of the premises of the typical plan has been adjusted to take into account the conditions of binding according to existing construction codes, regulations, and national standards.

Monolithic strengthened concrete pillars and crossbars with a cross-section of $0.6\,m$ by $0.6\,m$ made of heavy concrete $C28/35$ were used for the setting up of the subversive garage.

Next the technical situations for the use of constructions, products, and resources, the project delivers the subsequent solutions.

Basics are accepted tape manufactured and contain of strengthened concrete pads according to the series $1.112-5$ and concrete blocks, and monolithic glass kind. Basics are laid on a layer of concrete preparation of 0.1 m thick.

Reinforcement of the walls is made of mesh with a mesh of 0.5 to 0.50 m of wire.

The walls are complete of silicate block, kind M 200 on cement mortar M 150 on 1-5 floors, silicate block M150 on cement mortar M100 on from 6 to 10 floors, silicate block M100 on cement mortar M100 on from 11 to 16 floors. The thickness of the external walls is 0.64 m, and the inner 0.38 m.

The links among the slabs are filled with concrete C12/15. After setting up, the slabs are fixed.

Floors and covers are considered from normal manufactured strengthened concrete slabs with prestressing strengthening. The usage of assembled slabs and floors growths the speed of structure of the building. The specification of floor slabs is given in table 2.2.

Table 2.2

Specification of floor and floor slabs

Pos.	Name	Qty	By unit		Total	
			Concrete, м^3	Weight, kg	Concrete, м^3	Weight, t
S-1	ПК 42.12 – 8А*т*V*т*	548	0.6	1440	328.8	789.1
S-2	ПК 42.10 – 4т	70	0.49	1230	34.3	86.1
S-3	ПК 42.15 – 4т	48	0.79	1970	37.92	94.6

S-4	ПК 42.18 – 3т	33	0.89	2240	29.4	73.9
S-5	ПК 54.10 – 8АтVт	245	0.63	1575	154.4	385.9
S-6	ПК 54.12 – 4АтVт	72	0.76	1900	54.72	136.8
S-7	ПК 54.15 – 8АтVт	36	1.01	2525	36.36	90.9
S-8	ПК 54.18 – 8АтVт	17	1.15	2875	19.55	48.9
S-9	ПК 42.15 – 4т	17	0.79	1970	13.43	33.5
S-10	ПК 24.10 – 6т	16	0.29	712	4.64	11.39
S-11	ПК 24.15 – 4т	16	0.46	1140	7.36	18.2
S-12	ПК 27.10 – 4т	16	0.32	795	5.12	12.7
S-13	ПК 27.15 – 4т	16	0.52	1290	8.32	20.64
S-14	ПК73.12 – 8АтVт	60	1.12	2800	67.2	168
S-15	ПК73.10 – 8АтVт	125	0.95	2375	118.75	296.9
S-16	ПК73.15 – 8АтVт	18	1.35	3375	24.3	60.8
S-17	ПК75.15 – 8АтVт	18	1.375	3440	24.75	61.9
S-18	ПК75.12 – 8АтVт	35	1.1	2750	38.5	96.3
S-19	ПК75.10 – 8АтVт	311	0.95	2375	295.5	738.63
SB-1	The stove is individual	85	0.75	1875	63.8	159.4
SB-2	The stove is individual	17	0.69	1725	11.7	29.33
-	Total	–	-	-	1378.7	3413.8

Table 2.3

Specification of stair landings, marches and fences

Pos.	Name	Qty	Per unit		Total	
			Concrete, m³	Weight. kg	Concrete, m³	Weight . kg
$SM-1$	LM 33.12.12 – 4	35	0.7	1700	23.8	59.5
$SP-1$	2ЛП25.12	33	0.5	1160	15.31	38.3
$SP-2$	2ЛП25.12В	2	0.5	1185	0.948	2.4
$OG-1$	$OL-33-1$	33	–	39.5	–	1.302
$OG-2$	$PV12.9R-11$	2	–	31.8	–	0.06
Total (weight of reinforced concrete products)					40.1	100.2

Cleaning from dry wreckage. To uphold the sanitary form of the area, cleaning from solid waste and cleansing of sewage outside the sector are envisaged. The housework system is accepted for transfer. Special bins are mounted on the sidewalks for road garbage. Solid waste and refuse are taken out by trucks to the landfill. Garbage gathering is furnished with electric illumination, sewerage and plumbing.

Walls accepted blocks of hollow clay plastic $M75$ on cement mortar $M50$ thick of 120 mm.

The roof is engaged in rolls with a defensive coating of gravel, glued through bituminous mastic. Defending coating – of well-lit gravel by a scrap size of from 5 to 10 mm, coating thickness – 1.5 cm. The roofing coatings is attached to the distended parts of the floor with nails, and the links are endangered by covering and stuffed with spurred roofing steel.

Supplementary two coatings are placed in the places contiguous a roof to bulwarks.

Stairs are received from manufactured strengthened concrete treks and manufactured strengthened concrete stages.

Drainage of stream and liquefy water from the tiles of the building is approved out by an inside gutter into the outdoor system of rainfall drainage. Inside gutters are finished of metal-plastic piping of diameter $0.1\,m$.

The floor structure must be well-thought-out as the all-encompassing insulation of the floor and the noise insulation as well.

The floor on the room necessity meets the settings of strength, sufficient elasticity, noiselessness, wear resistance, and ease of housework.

Openings for windows are occupied with modern edges with tripartite energy-saving glass. The top of the windows is as close as thinkable to the top limit, which delivers well illumination in the lowest point of the accommodations. The windows are particular giving to the national standards by the expanse of the accommodations to be illuminated.

To confirm speedy removal, entirely entrances open to the outdoor in the route of rush-hour traffic on the highway constructed on the settings of the emptying of persons from the structure in fire situation. Door leaves are hung on hinges, which permit to remove open door leaves from hinges – for repair or replacement of the door leaf. Door frames are installed in openings to uncontaminated wooden pads, which are placed in the brickwork throughout the structure of the walls. For outside doors on marching stages, foyer area is organized with thresholds, and for inside doors – without beginnings.

Drainage of rainfall from the building is approved out on the planned surface in the trays of adjacent driveways, and then outdoor the site on the carriageway of main street.

The discharge of rainfall from inside drains is considered in drainage trays.

Outdoor pavement is design. Layer of footpaths, paths, and stands are made from fine-grained asphalt-concrete. The edge of drives, platforms and paths are framed by edges.

The entry to the building is six meters of wide.

Exterior adornment. The external walls of the structure are decked with plastic cladding shielded by mineral wool.

Grain elevator. There are two elevators with an area of freight 5 m² and passenger $3\,m^2$. Elevators are recognized giving to standards. Elevator huts are complete of $M200$ silicate block on $M150$ cement mortar.

Entirely wooden and metal tops are coated with oil dyes two times.

The base of the building is ornamented with blocks of false marble.

Inner beautification. Interior walls and partitions excepting for baths and toilets are covered with dry plaster and glued completed with wall covering.

In bathrooms, the walls are covered with ceramic tiles at height. Sideways with the stairways and landings – oil frieze $0.45\,m$ high, overhead acrylic-styrene painting. Entirely pantries, clothing – acrylic-styrene paint.

In kitchens the tops of a wall among the floor and hinged cases is covered with a ceramic tile on all area of the kitchen at middle height, all other tops of walls are dyed with acrylic-styrene coat.

The location be in the right place to type IV in terms of possible overflowing. Hence, water defense procedures are not essential.

Dealings to defend the territory from overflowing. Founded on environmental surveys at the site, groundwater does not affect the earth and cannot reason overflowing.

Landscape gardening. The plot contains plants, which is involved in the wide-ranging landscape gardening arrangement.

The selection of perennials is strongminded by local potentials, and the arrangement of herbaceous plants is used for spreading grasses.

The design has approved ordinary implanting materials for landscape gardening, from the range of local plant sales outlet.

Preparation of green estates is linked with the location of services.

Landscaping opposite the household band was solved by positioning grasses with collection implanting of recurrent flowers.

The greenery contained on the location is well-preserved as much as probable in the general group of landscaping.

Engineering preparation of the area. The organization of the ground of the location is decided in conjunction with the nearby area, taking into account the finest height of the building and ensuring the drainage of rainfall.

2.5. Calculations for the architectural and construction part

The thermal resistance of each layer of the enclosure building is strongminded:

$$R = \frac{\delta}{\lambda} \qquad (2.1)$$

where δ – the thickness of the layer of the enclosing structure, m;

λ – thermal conductivity, $W/(m \cdot {}^0C)$.

$$R_1 = \frac{0.64}{0.87} = 0.736 \ \frac{m^2 \cdot {}^0C}{W}$$

$$R_2 = \frac{0.015}{0.76} = 0.02 \ \frac{m^2 \cdot {}^0C}{W}$$

$$R_4 = \frac{0.01}{0.72} = 0.014 \ \frac{m^2 \cdot {}^0C}{W}$$

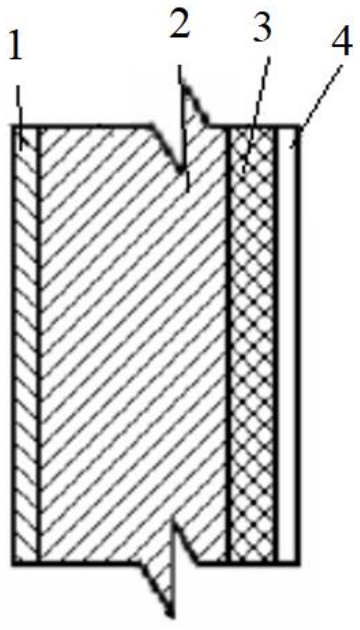

Fig. 2.2. Cross-section of the wall:

1-cement-sand plaster = 15 mm; 2-silicate brick of the M200 brand = 640 mm; 3- mineral wool insulation = 120 mm; 4- metal sheet.

The thermal resistance of the enclosing structure is determined:

$$R = R_1 + R_2 + R_3 + R_4 =$$

$$R = 0{,}736 + 0{,}02 + 1{,}4 + 0{,}014 = 2{,}17 \ \frac{m^2 \cdot {}^0C}{W} \qquad (2.2)$$

Pre-accept the design of the fence to a degree, such a design is gradually airconditioned. In designs, a short-term reduction in outdoor temperature to a smallest will only lead to whole cooling of its outer part, and the temperature on the surface facing the room will remain almost unmoved. Whole cooling of such a structure can be completed in just a few days. Though, during this time, the outdoor air temperature will change and will be above the smallest. Therefore, the temperature of the coldest five days is taken as the design temperature.

The essential heat transfer resistance is strongminded:

$$R_0^{ex} = \frac{n \cdot (t_{in} - t_{ex})}{\Delta t^{ex} \cdot \alpha_{in}} \qquad (2.3)$$

where t_{ex} – estimated winter outdoor air temperature;

n – ratio, which is taken reliant on the place of the external surface of the enclosure structure relative to the outdoor air;

t_{in} – the valued indoor air temperature and following the design standards of the relevant buildings;

α_{in} – heat transfer ratio of the inside surface of the enclosure structure;

Δt^{ex} – regulating temperature variance among the temperature of the inside air and the temperature of the inner surface of the enclosure structure.

$$R_0^{ex} = \frac{1 \cdot \left(18 - (-25)\right)}{6 \cdot 8.7} = 0.8 \ \frac{m^2 \cdot \ ^0C}{W}$$

The heat transmission resistance is strongminded:

$$R_0 = \frac{1}{\alpha_в} + R + \frac{1}{\alpha_н} ¤ \qquad (2.4)$$

where $\alpha_н$ – heat transfer factor for winter air of the outside surface of the enclosing structure.

Then,

$$R_0 = \frac{1}{8.7} + 2.2 + \frac{1}{23} = 2.3 \ \frac{m^2 \cdot \ ^0C}{W}$$

The fulfillment of the condition is check $R_0 > R^{ex}$ $2.3 \frac{m^{2 \cdot \ 0}C}{Bm} > 0.8 \frac{m^{2 \cdot \ 0}C}{Bm}$ – the condition is met.

The thermal inertia of the enclosure structure is strongminded:

$$D = \sum R_i \cdot S_i \qquad (2.5)$$

where S_i – the heat absorption factor of the corresponding coat, $W/\left(m^2 \cdot \ ^0C\right)$;

R_i – heat transfer resistance of every coat, $m^2 \cdot \ ^0C/W$.

Then,

$D = 7.2$

Because $D = 7.2 > 7.01$ – the condition is met, the type of massive structure was chosen properly, and the wall structure will work efficiently.

CHAPTER 3. STRUCTURAL DESIGN

3.1. Rationale for the choice of structures

Structural of the building is short of frame by means of transverse and longitudinal bearing walls. The rigidity of the building is guaranteed by the combined behavior of transverse and longitudinal bearing walls, floor and roof slabs.

Stairs are finished of assembled strengthened concrete treks and manufactured reinforced concrete stands. Treks rest on the shelves of the stands, and stairwells on the walls. A analysis of the structures is mentioned in the previous section.

3.2. Calculation of prefabricated reinforced concrete march

The enlarged treks and stand plates of stairs signify the ribbed strengthened concrete slabs in a bend as elements of the T-section and in a compressed zone as well.

3.2.1. Determination of loads and efforts.

Mass of strengthened concrete stair trek, giving to the project is about $15\ kN$.

The area of the horizontal plan of the stairway is $3.8\ m^2$

The mass of the strengthened concrete stairwell per $1\ m^2$ of horizontal plan is determined with formula:

$$g = \frac{P}{S} = \frac{14.2 \times 10^3}{3.8} = 3.74\ kN/m^2 \quad (3.1)$$

The temporary load for the stairs of a building is $3\ kN/m^2$, and load reliability coefficient is γ=1.2

Long-term load is $1\ kN/m^2$.

The load per $1\ m$ of march length is $9.6\ kN/m^2$.

The bending moment in the middle of the march is $13.4\ kN$.

Shearing force on the support is $17.1\ kN$.

3.2.2. Preliminary appointment of the march section.

Concerning the typical factory forms, the thickness of tthe cross-section between the stairs is $30\ mm$, the height of the ribs is $1.7\ m$, and the thickness of the ribs is $80\ mm$ are assigned.

The definite cross-section of the trek is changed by an estimated with a shelf in the compressed zone is $b = 160\ mm$; the depth of the shelf in the absence of transverse ribs no more than $0.12\ m$ or $0.5\ m$ is accepted.

For the design, a lesser value is accepted.

3.2.3. Selection of the cross-sectional area of the longitudinal strengthening.

Under the condition, the designed case for the section $M \leq f_{cd}\gamma_{B2}b_f'h_f'(h_0 - 0{,}5h_f')$ the zero axis passes at the spot $M = 12.5\ kNm < 27.3\ kNm$, where $h_0 = 0.15\ m$ is established.

The condition is pleased, and the zero axis passes into the shelf. Designs of the area of longitudinal strengthening are achieved giving to the formulas for rectangular sections, the width of 0.57 m.

Check the strength of the element on an inclined strip among the inclined cracks $16\ kN < 87.3\ kN$.

The condition is detected, and the strength of the stair tread on the inclined section is provided.

The marching plate is strengthened with a lattice $of\ Ø3\ mm$ B500 rods, positioned with a step of $0.1\ m$.

The slab is monolithically linked to the steps, which are strengthened for structural explanations, and bearing capacity, taking into account the action of the steps is provided.

Steps laid on ribs are designed as freely supported beams of triangular section, the diameter of the main strengthening of the steps, taking into account installation effects are determined depending on the length of the step $Ø6\ A240$, clamps are made of strengthening $Ø4\ B500$, $0.2\ m$.

CHAPTER 4. TECHNOLOGY OF CONSTRUCTION

4.1. Scope of work

The technological section is considered for laying simple outside and internal brick walls with seams of a typical floor of a residential building. The plan and section are presented in the graphic part.

The works include:

– the brickwork;

– reorganization of scaffolding;

– transport and rigging work.

All work on the equipment of brick masonry is accomplished in the summer and is approved out in two shifts.

Table 4.1

Calculation of workloads

№	Name of the process	Unit	Qty
1	Laying of external walls with the connected vertical seams in the thickness of 2 1/2 bricks	m^3	174.9
2	Laying of internal walls with the connected vertical seams in the thickness of 1 1/2 bricks	m^3	171.9
3	Installation, permutation of package scaffolds at a thickness of external walls in 2 1/2 bricks	10 m^3	17.5

4	Installation, and rearrangement of package scaffolds at a thickness of external walls in 1 1/2 bricks	10 m³	17.2
5	Unloading bricks from the car with a tower crane	1000 psc.	69.3
6	Lifting bricks with a tower crane using a removable grip	1000 psc.	69.3
7	Lifting and delivery of solution using the auger reloader	m³	41
8	Lifting of a solution by the tower crane in bunkers with a capacity of 1 m³ with unloading in 4 points on height to 12 m	m³	41
9	Unloading from the car by the tower crane of platforms	100 t	0.13
10	Unloading of boards for the equipment of protective visors at the weight of the rising freight, to 1 t	100 t	0.037
11	Equipment and disassembly of protective visors with the suspension of metal arms	100 m canopy	1.07
12	Laying floor slabs	100 items	1.14
13	Laying jumpers	10 opening	6.3
14	Electric welding of joints	10 m seam	46

4.2. Organization and technology of work

Before the start of bricklaying of walls should be performed:

- work on the organization of the construction site;
- zero cycle construction works;
- geodetic breakdown of the axes of the house;
- delivered to the site and prepared for work tower crane, scaffolding, equipment, necessary devices, and materials.

The solution is delivered to the object by dump trucks or mortar trucks and unloaded into the installation for mixing and dispensing the solution or dispensing hopper. In the process of laying the stock of materials is replenished. Bricks are delivered to the site in packages in specially equipped onboard machines.

The solution is fed to the workplace with an inventory dispensing hopper with a capacity of $1\,m^3$ in metal boxes with a capacity of $0.25\,m^3$. Slinging schemes are given in the graphic part of this technological map. Unloading of bricks from cars and giving them to a warehouse, and a workplace is carried out by packages. At the same time, certainly the bottoms of packages protect with tarpaulin aprons from falling out of brick.

Storage of bricks is carried out on the planned site on pallets. The arrangement of warehousing is given in the graphic section of this technological design.

The construction of a typical floor of a residential building is performed by a team of 15 people:

- bricklayer of the 3rd category – 10
- rigging installer 2 category – 2
- carpenter 4 category – 1
- carpenter 2 category – 2

The total width of the workplaces is assumed to be $2.6\,m$, including the working area to $0.7\,m$.

Works on the production of bricklaying of external walls of a typical floor of a house are carried out in the following technological sequence:

- establish orders with the indication of the marks of window and door openings;
- brick masonry with seams.
- place on the scaffolding bricks in the amount required for two-part work;
- preparation of bricklayer's jobs;
- preparation of mason jobs is performed in the following order;
- install scaffolding;
- place boxes for the solution.

In the construction of bricklaying of walls usage inventory hinged and package platforms: for laying of outdoor walls in a zone of a stairwell - transition platforms and platforms for laying of pylons.

The process of bricklaying consists of the following operations:

- cutting of bricks;
- check of correctness of a laying;
- installation and permutation of the berth;
- shoveling, feeding, spreading, and leveling the solution on the wall;
- supply of bricks and their layout on the wall;

– laying bricks in the structure;

– stitching.

Brick masonry with seams is planned to be conducted by four links in two shifts.

In the process of masonry work, the link is distributed as follows. The bricklayer of the 3rd category establishes a rail order and tightens a mooring cord for ensuring the straightness of a laying. Another bricklayer of the 3rd category takes bricks from a package and lays them out. The bricks are laid out on the wall in a certain order. For the outer verst the bricks are laid out on the inner side of the wall, and for the inner verst - in the middle of the wall. Then the mason spreads the solution.

At this time, the bricklayer conducts the masonry of the outer and inner verst by the method of clamping. After laying $4 - 5$ bricks, the mason will trim the excess of the solution squeezed from the horizontal seam on the face of the wall with the edge of the trowel.

Simultaneously with the masonry wall mason sews seams, and first sews vertical seams, and then horizontal. The bricklayer makes the seams first with a wider part of the seam and then narrower.

After laying the outer verst, the mason builds the wall, and the mason helps him. If there are slots in the wall, then when bricklaying the inner verst, the mason lays tarred plugs for fastening window blocks.

At the end of the masonry, mason square checks the correctness and horizontality of the rows of masonry.

The thickness of the walls, the length of the partitions, and the width of the window openings will be measured in meters. In case of eccentricities, the mason corrects a laying by a rule and a hammer.

After that, the masons move to work on another hobby.

After completing the brickwork on the first tier, masons move to work on the second tier. For this purpose, it is necessary to establish hinged and package platforms in the first position. Installation of articulated scaffolding in the first position is performed in the following order.

The rigger of the second category visually checks the serviceability of scaffolding and if there is a need eliminates malfunctions. After clearing the scaffolding of the solution, he slings them for four outer loops.

At the signal, the crane driver delivers the scaffolding to the installation site. The carpenters of the 4th and 2nd categories adopt scaffolds, adjust their position above the installation site, and gradually lower them into place, monitoring the density of their adjacency to the adjacent scaffolding, if necessary, adjust their position with crowbars.

The installed scaffolding is untied. Installation of scaffolding from the first position to the second position is as follows. Carpenters of the 4th and 2nd categories sling the scaffolding behind the 4 outer loops, pass the guard next to the scaffolding, signal the crane driver to rise, and monitor the uniform opening of the supports and the horizontalness of the scaffolding.

After the full opening of supports and their movement in vertical position carpenters of the 4th and 2nd digits establish platforms on overlapping, if necessary, adjusting using crowbars their position. Then they climb the stairs to the scaffolding and untie them.

The tower crane based on setting up parameters giving to the highest design is accepted for giving of materials to a place of construction.

Table 4.2

Technical characteristics of the crane

Name of building structures	Required parameters			Technical characteristics		
	G, т	$Hк$, м	$Lстр.$ м	G, т	$Hк$, м	$Lстр.$ м
Floor slab	3.5	56.4	31.3	10	77	35

4.3. Requirements for quality and acceptance of works

The stone construction should be carried out following the technical requirements:

- instructions on the type of materials used for masonry, their design marks for strength and frost resistance;
- the way of laying and a measure provided that durability and stability of designs in a construction stage.

Technical criteria and means of control of operations and processes are given in the table.

Table 4. 3

Technical criteria and means of control of operations and processes

Name of the processes to be controlled	Subject of control	Tool and method of control	Frequency of control	Responsible for control	Technical criteria for quality assessment
Brickwork	Quality of mortar bricks, fittings, embedded parts	External inspection, verification of passports and certificates	Before laying the walls of the floor	In case of doubt, the laboratory	Must meet the requirements of standards and technical specifications. It is not allowed to use dehydrated solutions
	Correctness of axis breakdown	Steel roulette	Before laying	Surveyor	Axis offset $-10\ mm$
	Horizontal evaluation of masonry edges under the overlap	Level, rail, level	Before installing overlapping panels	Surveyor	Deviation of pruning estimates $-15\ mm$
Brickwork	Geometric dimensions of masonry (thickness, slots)	Steel roulette	After each 10 m3 of masonry	Master	Deviation in thickness of structures - 15 mm, the width of slots $-15\ mm$

	Verticality, horizontality, and the surface of wall masonry	Level, rail, slope	In the process and after the end of laying the walls of the floor	Master, foreman	Deviation of surfaces and masonry angles from the vertical to the 1st floor $-10\ mm$, for the whole house with a height of more than 2 floors $-30\ mm$. Deviation of rows of masonry from the horizontal by 10 m of wall length $-15\ mm$. Irregularities on the vertical surface of the masonry - when applying a rail with a length of 2 m $-$ 10 mm
Brickwork	Quality of masonry seams (dimensions and filling)	Steel ruler, 2-meter rail	After each 10 m^3 of masonry	Master	The average thickness of horizontal seams within the height of the floor is 12 mm
					The average thickness of vertical seams $-$ is 10 mm
Install jumpers	Jumper position, sawing, placement, laying	Steel ruler, visually	After installing jumpers	Master	–

4.4. Safety precautions

Works on the bricklaying of outside walls are approved with observance of DBN A.3.2-2-2009 [8]. It is necessary to use the directives for the operation of used machines and equipment.

The level of masonry after each movement of the scaffolding must be at least 0.7 m above the level of the working flooring or floor.

It is not allowed to lay external walls up to $0.75\,m$ thick in the standing position on the wall.

When placing walls higher than $7\,m$, it is necessary to use protective visors around the perimeter of the house, which meets the following requirements:

– the width of the defensive visors must be at least 1.5 m, and they must be installed with a slope to the wall so that the angle formed between the lowest of the wall of the house and the surface of the visor was 110°, and the gap between the wall and the visor flooring did not exceed $50\,mm$;

– the first row of defensive visors must have a solid deck at a height of not more than 6 m from the ground and be stored until the end of masonry, and the second row, made of solid or mesh materials with a nest of not more than 50 × 50 mm, should be mounted at a height of $7\,m$ above the first row, and then in the course of masonry rearranged every $7\,m$.

Workers involved in the setting up, cleaning, or removal of visors must wear seat belts. Walking on visors, using them as scaffolding, as well as stacking materials on them are not permitted.

CONCLUSIONS

This work was designed Multifamily residential building in Bucha of Kyiv region.

The first part of this thesis describes the analytical review.

The second part of this thesis describes the Architectural solution of the Office center.

The scheme set sideways for the construction of a Multifamily residential building of improved planning is located in the residential area of in Bucha of Kyiv region.

The ground of the location is calm, with a total natural slant of the zone in the north-eastern route up to 3%.

The choice of the principal plan of the building is ranged by the standing leading plan of the district.

The entire area within the chosen area and together streets are being considered.

Removal of extra soil from the construction site is carried out on the area located at a distance of 5 km from the construction area.

The building is located in a designated area according to the requirements of the finest location of the main premises. The entrances to the building are designed.

The plot has a cattle yard, which houses: play area for family needs and regeneration of residents.

There are locations for several objectives with the needed set of minor architectural systems.

The project envisages environmental protection measures: land reclamation, cleaning from dry debris, and the efficiency of green areas.

The considered residential building has alike shape to the plan "L" with extents in the axes of about $34\ m\ by\ 32\ m$.

The building is $16\ storeys$, 1-section. The floors have height of 3.3 m. The building height is about $66.5\ m$.

Structural scheme of the building – without frame with longitudinal and transverse load-bearing walls. The spatial rigidity of the building is ensured by the joint work of longitudinal and transverse load-bearing walls, floor slabs, and flooring.

The basis of water supply is the contemporary water supply scheme $0.2\ m$, which runs along street. The water pressure at the connection point is $0.5\ MPa$, which affords the project pressure at the entrance to the building. Fire hydrants are installed in the wells along the water supply route. The water supply network is designed from copper welded water pipes with a length of $2.5\ m$.

Dirt removal from a residential building is considered in the present sewer $0.4\ m$, then in the current local treatment facilities.

The sewer network is designed from ceramic pipes.

Gas supply is provided by natural gas from the city's low-pressure gas pipeline. The laying of the external gas pipeline is designed to lift from the point of connection to the building.

The pipeline is laid from steel electric welded pipes. Covert tubes are enclosed with bitumen-polymer lagging type as reinforced hard, overhead – glaze with the adding of aluminum precipitate. To find the anode zones on the gas pipeline, checkpoints are set up.

To protect gas pipelines from corrosion by stray currents, design protection, and insulating flanges are used. Active defense of pipelines from

the wandering currents corrosion is solved in the complex protection of the municipal gas web.

Outside illumination is providing by spotlights with mercury spotlights on park wires, the link of outside illumination is accepted out by a chain of the modern brand. The source of heat supply is the municipal heating system. The warmth tube is made of welded tubes.

The scheme delivers for the setting up of goggle-box feelers for shared use. The house is furnished with aeriation, eating and fire water stream, television, inside drainage, drain water, boiler, gas water radiators, electric gear, refuse.

The arrangement of the premises of the typical plan has been adjusted to take into account the conditions of binding according to existing construction codes, regulations, and national standards.

Monolithic strengthened concrete pillars and crossbars with a cross-section of $0.6\,m$ by $0.6\,m$ made of heavy concrete C28/35 were used for the setting up of the subversive garage.

Next the technical situations for the use of constructions, products, and resources, the project delivers the subsequent solutions.

Basics are accepted tape manufactured and contain of strengthened concrete pads and concrete blocks, and monolithic glass kind. Basics are laid on a layer of concrete preparation of 0.1 m thick.

Reinforcement of the walls is made of mesh with a mesh of 0.5 to 0.50 m of wire.

The links among the slabs are filled with concrete C12/15. After setting up, the slabs are fixed.

Floors and covers are considered from normal manufactured strengthened concrete slabs with prestressing strengthening. The usage of assembled slabs and floors growths the speed of structure of the building.

Cleaning from dry wreckage. To uphold the sanitary form of the area, cleaning from solid waste and cleansing of sewage outside the sector are envisaged. The housework system is accepted for transfer. Special bins are mounted on the sidewalks for road garbage. Solid waste and refuse are taken out by trucks to the landfill. Garbage gathering is furnished with electric illumination, sewerage and plumbing.

The roof is engaged in rolls with a defensive coating of gravel, glued through bituminous mastic. Defending coating – of well-lit gravel by a scrap size of from 5 to 10 mm, coating thickness $-$ 1.5 cm. The roofing coatings is attached to the distended parts of the floor with nails, and the links are endangered by covering and stuffed with spurred roofing steel. Supplementary two coatings are placed in the places contiguous a roof to bulwarks.

Stairs are received from manufactured strengthened concrete treks and manufactured strengthened concrete stages.

Drainage of stream and liquefy water from the tiles of the building is approved out by an inside gutter into the outdoor system of rainfall drainage. Inside gutters are finished of metal-plastic piping of diameter 0.1 m.

The floor structure must be well-thought-out as the all-encompassing insulation of the floor and the noise insulation as well.

The floor on the room necessity meets the settings of strength, sufficient elasticity, noiselessness, wear resistance, and ease of housework.

Openings for windows are occupied with modern edges with tripartite energy-saving glass. The top of the windows is as close as thinkable to the top limit, which delivers well illumination in the lowest point of the accommodations. The windows are particular giving to the national standards by the expanse of the accommodations to be illuminated.

To confirm speedy removal, entirely entrances open to the outdoor in the route of rush-hour traffic on the highway constructed on the settings of the emptying of persons from the structure in fire situation. Door leaves are hung on hinges, which permit to remove open door leaves from hinges – for repair or replacement of the door leaf. Door frames are installed in openings to uncontaminated wooden pads, which are placed in the brickwork throughout the structure of the walls. For outside doors on marching stages, foyer area is organized with thresholds, and for inside doors – without beginnings.

Drainage of rainfall from the building is approved out on the planned surface in the trays of adjacent driveways, and then outdoor the site on the carriageway of main street.

The discharge of rainfall from inside drains is considered in drainage trays.

Outdoor pavement is design. Layer of footpaths, paths, and stands are made from fine-grained asphalt-concrete. The edge of drives, platforms and paths are framed by edges.

The entry to the building is six meters of wide.

Exterior adornment. The external walls of the structure are decked with plastic cladding shielded by mineral wool.

Grain elevator. There are two elevators with an area of freight 5 m² and passenger $3\,m^2$. Elevators are recognized giving to standards. Elevator huts are complete of $M200$ silicate block on $M150$ cement mortar.

Entirely wooden and metal tops are coated with oil dyes two times.

The base of the building is ornamented with blocks of false marble.

Inner beautification. Interior walls and partitions excepting for baths and toilets are covered with dry plaster and glued completed with wall covering.

In bathrooms, the walls are covered with ceramic tiles at height. Sideways with the stairways and landings – oil frieze $0.45\,m$ high, overhead acrylic-styrene painting. Entirely pantries, clothing – acrylic-styrene paint.

In kitchens the tops of a wall among the floor and hinged cases is covered with a ceramic tile on all area of the kitchen at middle height, all other tops of walls are dyed with acrylic-styrene coat.

The location be in the right place to type IV in terms of possible overflowing. Hence, water defense procedures are not essential.

Dealings to defend the territory from overflowing. Founded on environmental surveys at the site, groundwater does not affect the earth and cannot reason overflowing.

Landscape gardening. The plot contains plants, which is involved in the wide-ranging landscape gardening arrangement.

The selection of perennials is strongminded by local potentials, and the arrangement of herbaceous plants is used for spreading grasses.

The design has approved ordinary implanting materials for landscape gardening, from the range of local plant sales outlet.

Preparation of green estates is linked with the location of services.

Landscaping opposite the household band was solved by positioning grasses with collection implanting of recurrent flowers.

The greenery contained on the location is well-preserved as much as probable in the general group of landscaping.

Engineering preparation of the area. The organization of the ground of the location is decided in conjunction with the nearby area, taking into account the finest height of the building and ensuring the drainage of rainfall.

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