

# QUALIFYING PAPER

For the degree of

master

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(degree name)

topic: **The project of the office building with investigation of the underground parking reinforced concrete column**

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Submitted by: 6th year student , group IMBm-62

specialty 192 "Civil engineering"

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(code and name of specialty)

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**ASSIGNMENT**  
**for QUALIFYING PAPER**

for the degree of master

(degree name)

specialty 192 "Civil engineering"

(code and name of the specialty)

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(surname, name, patronymic)

1. Paper topic The project of the office building with investigation of the underground parking reinforced concrete column

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2. Student's paper submission deadline December 21, 2020

3. Initial data for the paper Construction site – Ternopil. Climate conditions: wind region – 2, snow region – 3, average temperature of coldest 5-day period in winter -19.8°C, average temperature of the coldest month -5.4°C.

4. Paper contents (list of issues to be developed)

Architectural part. Constructive part. Technological and Organizational part. Labor protection.

Scientific research part.

5. List of graphic material (with exact number of required drawings, slides)

1st Floor plan, 2nd Floor plan – 1 A1. 3rd Floor plan, 4th Floor plan – 1 A1. Basement Parking Plan – 1 A1. Side elevation, Section – 1 A1. Foundation plan – 1 A1. Scheme of work on roofing – 1 A1.

Scheme of work on slabs installation – 1 A1. Research of the work of the underground parking column – 1 A1.



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## INTRODUCTION

**Relevance of the topic of the work.** During the construction of structures made of monolithic reinforced concrete, it is often difficult to achieve perfect joining of elements of different tiers, because their installation occurs at significant intervals. This leads to the emergence of eccentricities of application of loads and changes in the scheme of operation of structural elements and their stress state.

This effect can be dangerous, especially for elements such as columns, because it can cause eccentric compression, which can cause tensile stresses. Moreover, this poses a danger to concrete structures. Therefore, the study of the operation of the columns in the case of an eccentricity of the load is a relevant task.

**The purpose of the work** is to investigate the operation of the underground parking column in the case of load eccentricity.

### **Tasks of the work:**

1. Develop a finite element model of reinforced concrete column and calculation method taking into account the eccentricity of the load;
2. Analyse the stress-strain state of the column for different levels of load eccentricity.

**The object of research** is a reinforced concrete column of the underground parking lot of the designed office centre.

**The subject of research** is the stress-strain state of the column taking into account the eccentricity of the load.

### **Scientific novelty of the results:**

1. The method of modelling of reinforced concrete elements on eccentricity compression was further developed.

**The practical value of the work** is the simulation of the stress-strain state of the underground parking column with eccentricity up to  $e = 2.2$  cm, which allowed to take into account the change in stress level and choose the right materials.

**Approbation of work results.** Some of the research results were reported at the IX International Scientific and Technical Conference of Young Scientists and Students "Actual Problems of Modern Technologies".

**Publications.** M. Tesliuk, T. Gunda, A. Sorochak. Analysis of the influence of the banding type on stress-strain state of brickwork at the place of the wall joint // Actual Problems of Modern Technologies: Proceedings of the IX International Scientific and Technical Conference of Young Scientists and Students (Ternopil, November 25-26, 2020). – Vol. 1. – Ternopil : TNTU, 2020. – P. 133-134.

**Keywords:** CONCRETE COLUMN, ECCENTRICITY, STRESS STATE, OFFICE BUILDING, UNDERGROUND PARKING.



## CHAPTER 1

### ARCHITECTURAL PART

#### 1.1 Initial information.

I have planned a five story office, the principal floor will be a carport (basement that will be investigated in special part) and different floors will be offices.

Land zone of development (Geographic location) - Ternopil.

As indicated by the finish of the building geographical area soil conditions, at the bottom of the foundation we have noted that we have three types of soil:

- i. Sediment- 1.4m
- ii. Loamy Sand- 5.1
- iii. Fine Sand 0.6 with height 1.4m, loamy sand with stature of 5.1m, fine sand with tallness of 0.65m and medium sand with tallness of 14.5m and water level of 8m. The plan obstruction is 178.8.

Parameters of the climate in the region will be developing :

District climate: B. Coldest temperature of five-day 0.92:  $t_n = - 26 \text{ }^\circ\text{C}$ .

The determined temperature of the interior air:  $t_B = 20 \text{ }^\circ\text{C}$ .

Stickiness of relative air: 60%.

System dampness of the area is typical.

#### Transport Links

Transport of the Ternopil gives the public and monetary complex of the area in cargo and traveler transportation, impacts the monetary specialization of certain areas, expands its significance in global relations.

The total of all sorts of transport is the vehicle complex of Ternopil area.

Railroad transport

Ternopil is associated with primary railroad not just with the locales and urban communities of Ukraine yet additionally with unfamiliar urban communities.

To improve the activity of the railroad transport of the district, an arrangement of programmed traffic signal, autoblocking is presented, new trains and vehicles are utilized. It is wanted to grow holder transportation.

### **Designing land and hydrogeological states of the construction site.**

Ternopil district is situated in western Ukraine on the banks of Seret.

As indicated by designing land overviews, the geographical structure of the site comprises of the accompanying designing land components:

1. Mass soil layer, topsoil with development junk close to forty percent, followed, on independent destinations with family unit garbage, up to half, which isn't followed;
2. Free loess, strong, exceptionally permeable sessile  $P \geq 0,58-1,85 \text{ kgf/cm}^2$ ;
3. Soil loess, low-permeable, strong dying down at  $P > 1,70 \text{ kgf/cm}^2$ ;
4. The soil is low permeable, from hard to loose, with division of some fine sand.

## **1.2. Office building Master plan**

### **1.2.1. The reason for master plan decision.**

Region Conditions played a crucial role on the advancement of our office building master plan.

Situation of designing interchanges (Sewerage, water supply and power), and various different components.

This arrangement fulfills the utilitarian, clean, and sterile prerequisites natural, engineering, and tasteful prerequisites, and so on

The design of the plane is opposite to the hub of the interstate, i.e. in such a way that the primary exterior is set corresponding to the pivot of the interstate and the red structure line.

This area of the structure has a coherent significance in light of the fact that:

- the best states of utilization of normal lighting;
- the most normal utilization of common help.

Every finishing are going to be planted with a variety of nice trees and bushes. Wide determination of spaces, normally positioned on the geography, will permit you to make a complex scene and a special display of the climate when strolling.

Seats for rest are masterminded, where blossom beds of different setups are orchestrated.

The holding dividers are fixed with the purported "torn stone".

### **1.2.2. Measures to consent to clean and fire security norms of environmental assurance.**

To follow the sterile necessities, a purported clean finishing zone - clamor security zone and air refinement from residue and exhaust cloud have been set upstanding off the roadway.

Clean norms in the structure (warm moistness, air circulation, and so on) follow because of the most recent advancements and current designing interchanges. With the end goal of helpful fire quenching, a portable street is organized nearly around the structure permitting admittance to the structure around its edge.

Non-smoking steps are masterminded in the structure. Building plans and materials utilized are non-burnable and fireproof (concrete, strengthened solid, drywall, block).

There is an alarm all through the structure.

Toward the finish of development, as the top layer of soil was development garbage, fertilizer is dug for arranging.

The structure in general has no hurtful outflows.

### **1.2.3 Bearing structures. Reasoning for their decision.**

The plan is received blended in with the cross over load bearing dividers, which will be supported by walls

– Ceiling:

Roof of the house is done by methods for fortified solid empty plates, specifically PC 63.12; PC 54.12; PC 57. 12; PC 48.12; PC 48.15; PC 30.5.6, just as monolithic segments.

In areas where openings has penetrated without damaging any openings, must be fortified.

Slabs are mounted together with dividers by strengthening steel supposed anchors that are implanted in the dividers.

### **1.3. Thermal calculation of walls.**

#### **1.3.1 Initial conditions**

Construction area: Ternopil.

Name of the building: Office building with basement parking.

The outer dividers are made of permeable blocks made by ZAO "Triumph/Knauf". At <http://knauf.hst.ru> on the Internet you can locate a full depiction of the results of this organization.

In light of the topographical area of the extended structure, on this site you can get the information of warmth designing count and potential alternatives for the development of the external divider.

We likewise ascertain the thickness of the loft protection, which is expelled polystyrene froth with  $\gamma = 600\text{kg/m}^3$ .

The divider using block number 2NF also front brick 640mm (655mm with finishes) is depicted on fig. 1.1.

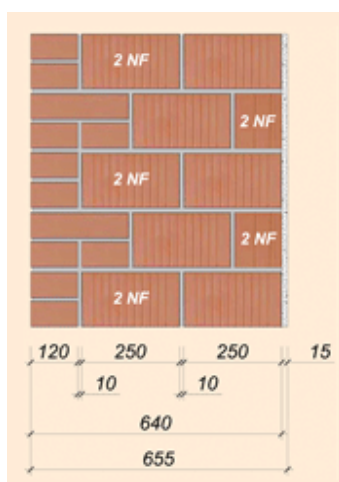


Figure 1.1 – Usage of divider blocks

### 1.3.2 Temperature calculation of the wall

Table 1.2 – Estimated thermal and technical parameters of wall layer materials

| № | The name of the layer   | Density of the material $\gamma$<br>kg / m <sup>3</sup> | The thickness of the material M | Coefficient of thermal conductivity $\lambda$<br>W/(m <sup>2</sup> ·°C) | Coefficient heat dissipation S<br>W/(m <sup>2</sup> ·°C) |
|---|-------------------------|---|---------------------------------|---|--|
| 1 | Ferroconcrete difficult | 2500  | 0,1                             | 1,92  | 17,98  |
| 2 | Polyfoam                | 100   | X                               | 0,052   | 0,85   |
| 3 | Ferroconcrete light     | 1000  | 0,065                           | 0,33  | 5,03   |

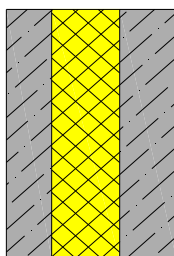


Figure 1.2 – Fence scheme

Table 1.3 – Calculated parameters of the climate of Ternopil

|                  |         |
|------------------|---------|
| $t_1^{0,98}$     | $-30^0$ |
| $t_1^{0,92}$     | $-27^0$ |
| $t_5^{0,92}$     | $-23^0$ |
| $t_B$            | $+20^0$ |
| $\varphi_B$      | 55 %    |
| Humidity zone    | A       |
| Temperature zone | I       |

Determine the design resistance of the heat transfer of the enclosing structure:

$$R_z = R_B + R_K + R_3$$

$R_B$  – thermal resistance to the internal surface of the fence

$R_K$  – thermal resistance of the structure

$R_z$  – resistance of heat transfer to the external surface of the fence

$(\alpha_B = 8,7 \text{ W} / (\text{m}^2 \cdot ^\circ\text{C}))$  – coefficient of thermal reception

$(\alpha_3 = 23 \text{ W} / (\text{m}^2 \cdot ^\circ\text{C}))$  – coefficient of heat transfer

$$R_B = \frac{1}{\alpha_B} = \frac{1}{8,7} = 0,115 \left( \frac{\text{m}^2 \cdot ^\circ\text{C}}{\text{W}} \right)$$

$$R_3 = \frac{1}{\alpha_3} = \frac{1}{23} = 0,043 \left( \frac{\text{m}^2 \cdot ^\circ\text{C}}{\text{W}} \right)$$

$$x = \delta_2 = \left[ R_{q \min} - \left( \frac{1}{\alpha_e} + \frac{\delta_1}{\lambda_1} + \dots + \frac{\delta_n}{\lambda_n} + \frac{1}{\alpha_3} \right) \right] \lambda_2$$

$$x = \delta_2 = \left[ 2.8 - \left( 0.115 + \frac{0.1}{1.92} + \frac{0.065}{0.33} + 0.043 \right) \right] 0.052 = 0.124$$

For a wall we accept a thickness of foam 0.13 m .

Check the condition

$$R_{\Sigma} \geq R_{\Sigma}^H$$

$$R_{\Sigma} = R_{\alpha} + R_{\kappa} + R_3 = \frac{1}{\alpha_{\alpha}} + \frac{\delta_1}{\lambda_1} + \frac{\delta_2}{\lambda_2} + \frac{\delta_3}{\lambda_3} + \frac{1}{\alpha_3}$$

$$R_{\Sigma} = 0,115 + 0,0521 + 0,197 + 2,5 + 0,043 = 2,907 \left( \frac{m^2 \cdot ^\circ C}{W} \right)$$

Determine the normative resistance of the heat transfer of the enclosing structure:

$R_{\Sigma}^H$  – is determined by the table, depending on the temperature zone

$$R_{\Sigma}^H = 2,8 (m^2 \cdot ^\circ C) / W$$

$$\dots R_{\Sigma} \geq R_{\Sigma}^H \quad 2,907 \geq 2,8$$

Determine the thermal inertia of the enclosing structure

$$D = \frac{0,12}{1,92} \cdot 17,98 + \frac{0,13}{0,052} \cdot 0,85 + \frac{0,065}{0,33} \cdot 5,03 = 8,5$$

Determine the estimated winter temperature of the outside air

$$t_3 = -22$$

We construct a line of temperature drop on the section of the fence construction

The temperature on the inner surface of the m-th layer of the fence, counting the layers from the interior surface of the fence,  $\tau_m$  °C, can be determined by the formula:

$$\tau_m = t_B - \frac{t_B - t_3}{R_\Sigma} \cdot \left( R_B + \sum_{i=1}^{m-1} R_i \right)$$

$t_B$  – internal air temperature, °C

$t_3$  – external air temperature, °C

$R_\Sigma$  – heat transfer resistance of the enclosing structure, m<sup>2</sup>·°C/W

$\sum_{i=1}^{m-1} R_i$  – thermal resistance of layers of the fence, m<sup>2</sup>·°C/W

$R_B$  - resistance to thermal acceptance of the inner surface of the enclosing structure, m<sup>2</sup>·°C/W

The temperature of the inner surface of the wall can be found by the formula:

$$\tau_B = t_B - \frac{t_B - t_3}{R_\Sigma} \cdot R_B \quad \tau_B = 20 - \frac{20 + 22}{2.8} \cdot \frac{1}{8.7} = 18.3^\circ \text{ C}$$

The temperature of the outer surface of the wall can be found by the formula:

$$\tau_3 = t_B - \frac{t_B - t_3}{R_\Sigma} \cdot (R_B + R_K) \quad \tau_3 = 20 - \frac{20 + 22}{2.8} \cdot \left( \frac{1}{8.7} + \frac{0.1}{1.92} + \frac{0.13}{0.052} + \frac{0.065}{0.33} \right) = -21.38^\circ \text{ C}$$

$$\tau_1 = t_B - \frac{t_B - t_3}{R_\Sigma} \cdot (R_B + R_1) = 20 - \frac{20 + 22}{2.8} \cdot \left( \frac{1}{8.7} + \frac{0.1}{1.92} \right) = 17.59^\circ \text{ C}$$

$$\tau_2 = t_B - \frac{t_B - t_3}{R_\Sigma} \cdot (R_B + R_1 + R_2) = 20 - \frac{20 + 23}{2.8} \cdot \left( \frac{1}{8.7} + \frac{0.1}{1.92} + \frac{0.13}{0.052} \right) = -18.53^\circ \text{ C}$$

where  $R_3 = 0,026$  – thermal resistance of the closed air layer (at the flow of heat from the bottom up, at a negative temperature of air in the stratum).

#### 1.4 Architectural Engineering and imaginative choice of the building.

Vital for the visual view of the structure is the shading, surface of the external dividers, the size and state of the window openings.



The engineering plan of the structure is molded by its outline, which in turn is adapted by the anticipating portions of the rooms with adjusted corners.

Because of the exhibition of individual pieces of the house will be a light shade, which will assuage the sensation of dullness of the house.

Additionally, the plinth, which is fixed with sections of characteristic stone, gives an exceptional appearance to the structure.

The dividers and roof of the primary floor painted in white give the individual in the room a feeling of extensive size, affectedness because of light reflections from white surfaces.

## **1.5 Equipment of hygiene**

### **1.5.1. Warming.**

The warming of a private structure is concentrated.

The purported heated floors are of the crucial in the compound—PA pipes are installed inside the floor which will then warm the floors.

Specialized necessities:

For level areas of pipelines, twists ("waves") that are curved upwards are prohibited.

The flat segments of the association with the curls of the warming planes of the floor should be situated at the degree of the loops themselves.

Each loop should be produced using one line cut without explanations.

Form of the warming plane should bend the distending sewer pipes, connected to the "dark" floor of the clean hardware uphold, etc.

Narrow containers of far off thermos sensors must always be disconnected from the source of heat.

At the convergences with dividers and roofs, pipelines should be secured by a layered line.

Various floors (ground floor floors, floors above non-warmed rooms, and so forth) are laid with pipeline, just as going through non-warmed rooms, should be protected to evade unreasonable warmth misfortunes.

### **1.5.2. Power supply.**

The structure's capacity supply is brought together from the city's cable of electrical. It is done from electric links that usually located underground situated at a profundity about 3m.

Electric boards controls the voltage and the standard voltage for Ukraine is 380 or 220 volts.

Bulbs, contingent upon the reason for the room and normal lighting.

Crisis lighting from battery-powered batteries is accommodated safe clearing on fire.

### **1.5.3. Office building waste and water supply**

Our office building water supply and seepage is unified. Supply of water to our office building is supplied by protected lines for use of the outer and interior heated water frameworks.)

It is likewise important to protect the focal lines associating the evaporator with the appropriation cupboards.

San machines - gave a shower, latrine, washbasin in the restrooms.

Dissemination wholesalers of the lower floor should be situated over the degree of the course siphon. The converse incline of pipelines in the kettle wholesaler segment is unacceptable.

The sewage framework is self-streaming, nearby, intended for a gathering of a few neighbouring homes. .

#### **1.5.4. Building ventilating system.**

The building ventilating is brought forth via a system of ventilation set with apparatuses that reuse the warmth of the active air and warmth the new channel air with this warmth not exclusively to revive the air, yet additionally to keep a steady warm system of the room.

Channel - outside. Ventilation is normal.

#### **1.6 Safety and healthy measures**

Problem with the word related security during development jobs unravelled in the task of development association. The association of the building site, areas of work and work environments must guarantee the security of laborers at all phases of the work.

The office building doesn't harmfully affect the climate, and as a consequence of working isn't the creation of material products, yet is proposed to play out a private capacity.

The office is given all ways out and doorways in the event of fire. And furthermore all fire-battling measures are taken by the regularizing records.

Lighting of premises and yard is completed by all prerequisites and norms specified by administrative archives.

All materials expected to be utilized in the development are in consistence with ecological principles and subsequently don't represent a danger to the climate.

Contrasts of floors and statures of flights of stairs are seen as per set up standards of wellbeing rules.

The stature of the means and edges is chosen with most extreme accommodation for the individuals who will utilize them.

#### **Fire counteraction measures.**

The advancement is completed as per the overall format of the possessed spot. Wooden rafters and strips of building covers have fire insurance (paints, impregnations, organizations, and so on) Departure of individuals is accommodated both the flight of stairs and the outside fire stepping stool.

Electrical gear and lightning assurance of the house is planned as per the prerequisites of the Electrical Safety Standards.

## CHAPTER 2

### CONSTRUCTIVE PART

#### 2.1 Foundation Characteristics

Operational dependability and solidness levelled houses and structures dictated by the nature of preparing bases and establishment of the foundation. Premise foundation and a raised structure is firmly related, commonly influence one another, and should in this way be considered as one framework.

Distortion and steadiness of soil establishments rely upon the extent of the applied burden, the sort and says of the foundation.

Thus, the productive plan of the building, development against essential components of the foundation are allocated relying upon the definition of the dirt compressibility and weight that they can see. Notwithstanding, as a rule, the foundation, and superstructure development plan independently.

Predictable figuring is decide the plan and the components of the foundation, this tackles 2 significant issues.

Foundation gives the vital unwavering quality and toughness of structures, which have a solid and stable base and establishment, and making the most practical arrangement regarding the cost of the scant materials, least volume, term and cost of the development work.

To this end, dealing with a few plan choices and all the premise of their specialized and financial correlation of picking the most expedient.

The decision of the most discerning and monetary developments of establishments and ideal approaches to create works with their gadget is one of the most troublesome and complex designing issues in development.

This isn't just incredible distinction of species and soil conditions, the variety of characteristic states of their event, the impact of topographical and hydro-geographical

marvels and cycles, yet additionally the variety and unpredictability of the creation states of development.

### **Assessment of designing and topographical states of constructional site**

Geomorphological, the site is situated on the Ternopil Plateau.

In light of the consequences of reviews in 2001, Sich LLC was researched topographical states of the site.

As per designing geographical studies, the topographical structure of the construction area comprises a couple designing geographical components. The geographical structure of the site is spoken to by a designing topographical area (Fig. 2.1.)

Hydrological overviews have indicated that groundwater isn't seen at profundities up to 29,00 m, however at a profundity of 26,0-27,0 m, soils are delicate.

As per the dirt conditions the site has a place with the II sort of subsidence.

In light of the led field and research facility contemplates, 4 IGEs were introduced. As per the examinations in the neighbouring regions and the consequences of the examinations.

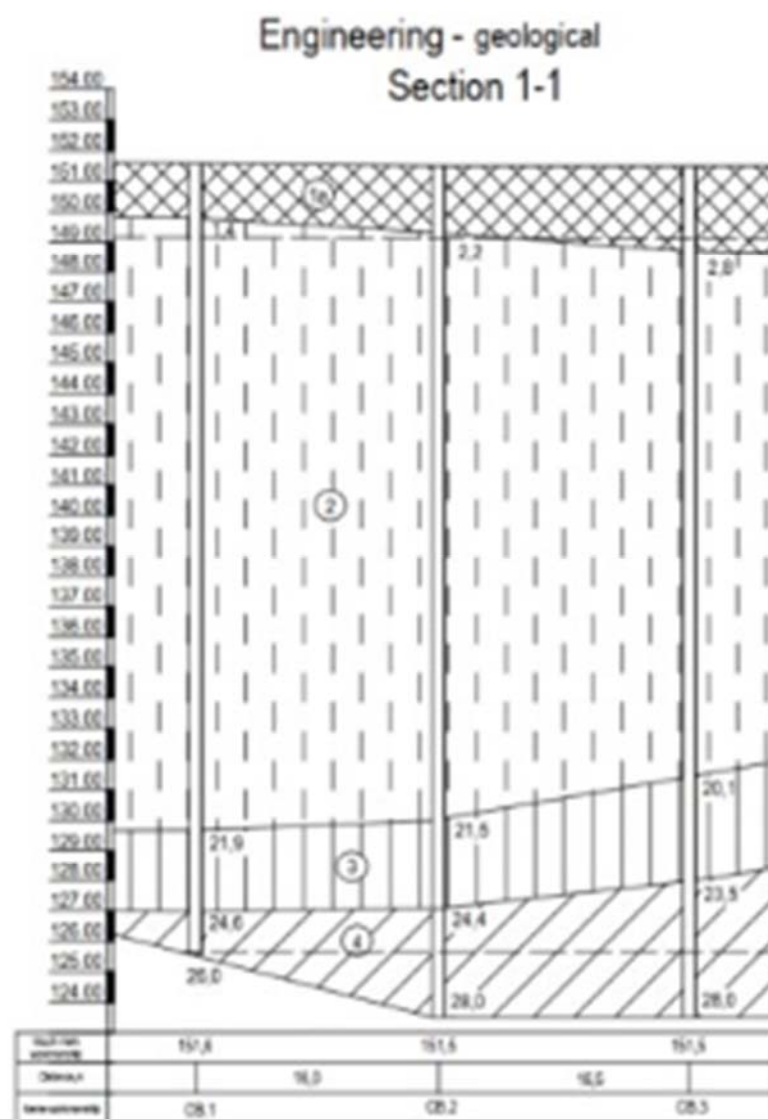


Figure 2.1 – Geological Engineering

## 2.2. Determination the strength of pile foundation.

On this part we are going to determine the strength of pile that is going to be on our foundation when we know the depth of pile is 7m (length) cross section of pile rectangular with both side 0.3m, the pile is hammered into the soil with hammer machine.

### 2.2.1 Soil condition is next:

1<sup>st</sup> soil Loamy sand       $\Pi=0.3$

|                                 |                            |
|---------------------------------|----------------------------|
|                                 | $h_i=3.5\text{m}$          |
| 2 <sup>nd</sup> Soil loamy sand | $I_l=0.4$                  |
|                                 | $H_{ii}=1.5$               |
| 3 <sup>rd</sup> Soil Clay       | $I_l=0.5$                  |
|                                 | $H_{iii}=\text{Unlimited}$ |

### 2.2.2 Calculations of loadings:

$$F_d = \gamma_{cr}(\gamma_{cr} \times R \times A + U \times \gamma_{cf} \sum_i^n F_X \times h_i)$$

$$\gamma_{cr}=1$$

$$U=0.3+0.3+0.3+0.3=1.2\text{m}$$

$$\gamma_{cf}=0$$

$$R=9967\text{kpa}$$

$$A=0.3 \times 0.3=0.09\text{m}^2$$

$$Z_1=1+2.8=3.8\text{m}$$

$$Z_2=h_1+h_2/2+2.8=2+0.6+2.8=5.4\text{m}$$

$$Z_3=h_1+h_2+h_3/2+2.8=2+1.2+1+2.8=7\text{m}$$

$$Z_4=h_1+h_2+h_3+h_4/2+2.8=2+1.2+2+0.4+2.8=8.4\text{m}$$

$$Z_5=h_1+h_2+h_3+h_4+h_5/2+2.8=2+1.2+2+0.8+1+2.8=9.8\text{m}$$

$F_1$ =between 3 and 4, 0.2 and 0.3

$$Y=3.8 \quad y_1=3 \quad y_2=4$$

$$x_1=0.2 \quad x=0.29 \quad x_2=0.3$$

$$F_{11}=48 \quad f_{x1} \quad f_{21}=35$$

$$F_{12}=53 \quad f_{x2} \quad f_{22}=38$$

$$F_{x1} = \left( \frac{X-X_1}{X_2-X_1} \right) (Y_2 - Y_1) + Y_1$$

$$= \left( \frac{0.29-0.2}{0.3-0.2} \right) (35 - 48) + 48$$

$$F_{x1}=36.3$$

$$F_{x2} = \left( \frac{0.29-0.2}{0.3-0.2} \right) (38 - 53) + 53$$

$$F_{x2}=39.5\text{kpa}$$

$$F_1 = \left( \frac{3.8-3}{4-3} \right) (39.5 - 36.3) + 36.3$$

$$\mathbf{F_1=38.6\text{kpa}}$$



F2=between 5 and 6

$$Y=5.3 \quad y_1=5 \quad y_2=6$$

$$x_1=0.2 \quad x=0.29 \quad x_2=0.3$$

$$F_{11}=56 \quad f_{x1} \quad f_{21}=40$$

$$F_{12}=58 \quad f_{x2} \quad f_{22}=42$$

$$F_{x1} = \left( \frac{X-X_1}{X_2-X_1} \right) (Y_2 - Y_1) + Y_1$$

$$= \left( \frac{0.29-0.2}{0.3-0.2} \right) (40 - 56) + 56$$

$$F_{x1}=41.6$$

$$F_{x2} = \left( \frac{0.29-0.2}{0.3-0.2} \right) (42 - 58) + 58$$

$$F_{x2}=43.6 \text{ kpa}$$

$$F_2 = \left( \frac{5.4-5}{6-5} \right) (43.6 - 41.6) + 41.6$$

$$\mathbf{F_2=42.4 \text{ kpa}}$$

F3=between 6 and 8

$$Y_1=7 \quad y_2=8$$

$$x_1=6 \quad x=7 \quad x_2=8$$

$$F_3 = \left( \frac{X-X_1}{X_2-X_1} \right) (Y_2 - Y_1) + Y_1$$

$$= \left( \frac{7-6}{8-6} \right) (8 - 8) + 8$$

$$\mathbf{F_3=8 \text{ kpa}}$$

F4=between 8 and 10

$$Y_1=8 \quad y_2=8$$

$$x_1=8 \quad x=8.4 \quad x_2=10$$

$$F_4 = \left( \frac{X-X_1}{X_2-X_1} \right) (Y_2 - Y_1) + Y_1$$

$$= \left( \frac{8.4-8}{10-8} \right) (8 - 8) + 8$$

$$\mathbf{F_4=8 \text{ kpa}}$$

$$\mathbf{F_5=0}$$

$$\sum_I^n F_X \times h_i = (F_{1h1}) + (F_{1h2}) + (F_{1h3}) + (F_{1h4}) + (F_{1h5}) =$$

$$= (38.86 \times 3.8) + (42.4 \times 5.4) + (8 \times 7) + (8 \times 8.4) + (0 \times 9.8) = 499.82 \text{ kpa}$$

$$F_d = 1(1.0 \times 9967 \times 0.09 + 1.2 \times 1.0 \times 499.82) = 1496.79$$

$$N = F_d / \gamma_k \quad \text{where } \gamma_k = 1.4$$

$$N = 1496.79 / 1.4 = \mathbf{1069.14}$$

$$\psi_n = \frac{\psi_2 \times h_2 + \psi_3 \times h_3 + \psi_4 \times h_4^1}{h_2 + h_3 + h_4^1}$$

$$\psi_n = \frac{20.6 \times 3.2 + 18 \times 2.8 + 38.8 \times 2.3}{3.2 + 2.8 + 2.3}$$

$$\psi_n = 24.8$$

$$\beta = 2 \times L \times \tan(n/4) = 2 \times 8.3 \times \tan(24.8/40) = 1.8$$

$$\gamma_{\text{soil}} = \beta \times (L \times 2.8) \times 1 = 1.8 \times (8.3 \times 2.8) \times 1$$

$$N_{\text{full}} = (N_p + N_t) + N_{\text{block}} + N_{\text{con}} = 330.39 + 1.7 + 7.2 = 339.29 \text{ Kn}$$

$$n = 339.29 / 1069.4 \qquad P = N / b \times l = \frac{1069.14}{1.8 \times 2.1} = \mathbf{594.16 \text{ kPa}}$$

$$n = 0.32 = \mathbf{1 \text{ pile}}$$

On bottom of third layer

$$Bz g_9 = Bz g_8 + 8.97 \times 0.8 = 147.76 \text{ KP}$$

On bottom of foundation

$$Bz g_0 = Bz g_9 + 10.25 \times 2.3 = 147.76 + 10.25 \times 2.3 = 171.34 \text{ KPa}$$

$$Bz g_1 = Bz g_0 + 10.25 \times 3.02 = 171.34 + 10.25 \times 3.02 = 202.30 \text{ KPa}$$

$$Bz g_2 = Bz g_1 + 10.25 \times 3.74 = 202.30 + 10.25 \times 3.74 = 240.64 \text{ KPa}$$

$$Bz g_3 = Bz g_2 + 10.25 \times 4.46 = 240.64 + 10.25 \times 4.46 = 286.36 \text{ KPa}$$

$$Bz g_4 = Bz g_3 + 10.25 \times 5.18 = 286.36 + 10.25 \times 5.18 = 339.46 \text{ KPa}$$

$$Bz g_5 = Bz g_4 + 10.25 \times 5.90 = 339.46 + 10.25 \times 5.90 = 399.35 \text{ KPa}$$

$$Bz g_6 = Bz g_5 + 10.25 \times 6.62 = 399.35 + 10.25 \times 6.62 = 464.21 \text{ KPa}$$

$$Bz g_7 = Bz g_6 + 10.25 \times 7.34 = 464.21 + 10.25 \times 7.34 = 539.45 \text{ KPa}$$

$$P_0 = P - Bz g_0$$

$$P_0 = 594.16 - 171.34$$

$$P_0 = 422.83 \text{ KPA} = 19.98 \text{ kN/m}^2$$

$$\gamma = \frac{\gamma_1 \times h_1 + \gamma_2 \times h_2 + \gamma_3 \times h_3 + \gamma_{3.sat} \times h_3^{11} + \gamma_{4.sat} \times h_4^1}{h_2 + h_3^1 + h_3^{11}}$$

$$\gamma = \frac{(16.2 \times 2) + (18.4 \times 4) + (17.3 \times 2) + (8.97 \times 0.8) + (10.25 \times 2.3)}{2 + 4 + 2.8 + 2.3}$$

$$\gamma = 15.44 \text{ kN/m}$$

$$N_{con} = 0.6 \times 0.5 \times 24$$

$$= 7.2$$

$$H = 1.8 \times 0.4 = 0.72$$

$$N_{block} = n \times Mb/Lb$$

$$= 5 \times 0.815 / 2.4 = 1.70$$

Table 2.1 – Soil pressure

| Number Of Points | Depth of point from the bottom of the foundation | Relative depth | coefficient | Pressure from on weight of soil | Additional pressure on depth |
|------------------|--|----------------|-------------|---------------------------------|------------------------------|
| 0                | 0  | 0              | 1           | 147.78                          | 422.83                       |
| 1                | 0.72   | 0.8            | 0,881       | 202.30                          | 372.51                       |
| 2                | 1.44   | 1.6            | 0,642       | 240.64                          | 271.46                       |
| 3                | 2.16   | 2.4            | 0,477       | 286.36                          | 201.69                       |
| 4                | 2.88   | 3.2            | 0,374       | 339.46                          | 158.14                       |
| 5                | 3.6  | 4              | 0,306       | 399.35                          | 129.38                       |
| 6                | 4.32   | 4,8            | 0,258       | 467.21                          | 109.09                       |
| 7                | 5.04   | 5,6            | 0.223       | 539.45                          | 94.29                        |

Table 2.2 – Soil deformation

| Number Of Points | Additional pressure |                        |         | Deformation module | Thickness of layer | Deformation of layer |
|------------------|---------------------|------------------------|---------|--------------------|--------------------|----------------------|
|                  | On top of the layer | On bottom of the layer | Average |                    |                    |                      |
| 1                | 422.83              | 372.51                 | 397.67  | 34000              | 72                 | 0.84                 |
| 2                | 372.51              | 271.46                 | 321.99  | 34000              | 72                 | 0.68                 |
| 3                | 271.46              | 201.69                 | 236.58  | 34000              | 72                 | 0.38                 |
| 4                | 201.69              | 158.14                 | 179.92  | 34000              | 72                 | 0.38                 |
| 5                | 158.14              | 129.38                 | 143.76  | 34000              | 72                 | 0.34                 |
| 6                | 129.38              | 109.09                 | 119.24  | 34000              | 72                 | 0.25                 |
| 7                | 109.09              | 94.29                  | 101.69  | 34000              | 72                 | 0.21                 |

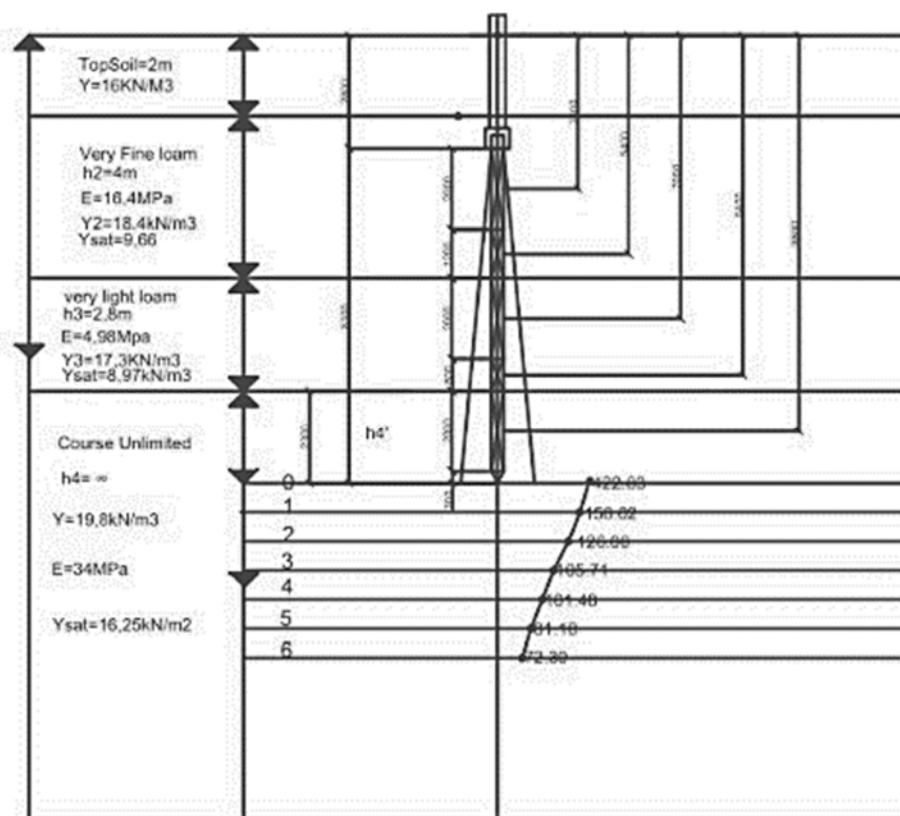


Figure 2.2 – Deformation of pile foundation from our calculations

## CHAPTER 3

### TECHNOLOGICAL AND ORGANIZATION PART

#### 3.1 Depiction of the fundamental mechanical cycles

During the preliminary time frame (18 working days) the accompanying tasks are executed at the site:

- The construction site is absolved from existing plantings (removing every obstructive bush and trees);
- breaks the geodetic matrix with the course of action of impermanent and perpetual benchmarks;
- imported to the site and introduced impermanent structures;
- Fundamental correspondences are made.

##### 3.1.1 Site preparation

Preparations start by cutting the ground layer of soil 30 cm thick all through the whole-building site. The tractor accomplishes this work in two movements of soil to be collapsed into brief cavaliers. To lessen soil misfortune, the tractor edge is furnished with side openings. Soil cutting is done with a wedge-formed cut, a channel strategy for work.

The tractor over and again passes on very much the same path, delivering a channel to 0.6 m of the divider which forestalls soil from dissipating. Between the channels, there are jumper widths of 0.4 - 0.5 m, at that point they are cut in a similar technique.

Soil advancement is the main cycle and is performed by an excavator backhoe.

The soil is being created by an earthmover in a cobblestone.

The dirt compaction is performed subsequent to refilling and filling the dirt with floor alters.

##### 3.1.2 Foundation arrangement

Under the dividers of the squares (stopping) mastermind the tape foundation of cement blocks, and under the structure foundation planned penetrating heaps.

Prior to the start of the foundation, the lower part of the pit is cleaned and arranged, and afterward, sand readiness is orchestrated. After fulfilment of preliminary work, the gadget starts to heap infusion heaps.

The squares are laid on top of the barbecue on a concrete-sand mortar.

Laying of the base concrete blocks is done with the covering both along the divider (at least 240 mm) and in the spots of contact of longitudinal and cross over dividers (at the very least 300 mm).

The important bounding of the squares is guaranteed by the utilization of solid areas.

### **3.1.3 Erection of block dividers (brick walls)**

Dividers are smoothed out by isolating the whole volume into six spaces. Simultaneously as the laying of the dividers, a group of installers organizes the framework and the installers of the crane feed beds with blocks to the spot of workmanship.

Check the nature of workmanship during the erection of the dividers of the foreman and ace.

### **3.1.3 Ceiling and cover**

After the cellar dividers are raised, the storm cellar floor pieces are mounted.

Plates are provided to the spot of addition by the crane. After that anchor the sheets, twist circles and make creases. At that point, the brickwork raises the dividers, and afterward introduce the floor chunks in a similar succession.

Work on the establishment of chunks of covering constantly should be completed by the current technique.

Solid territories of covering a lot should be done in such arrangement:

- formwork;
- append support networks;
- cementing;
- smaller solid blend
- solid consideration;

- eliminate formwork.

### **3.1.4 Floor plan**

There are three sorts of floors in the undertaking: parquet, earthenware, and mosaic – concrete (in passages and specialized rooms).

Work in any case the course of action of solid arrangements, and afterward tirades.

The floors are arranged by 2 groups: 1st - flooring, 2nd - concrete.

After arranging the parquet floor in the storm cellar, the team of parquet workers goes to the base floor, and then concrete workers and mastermind the mosaic floor.

At that point rehash the way of the principal detachment.

### **3.1.5 Land improvement**

In the wake of destroying framework, work starts on the clearing of the region.

To the uncovered spots return a vegetative layer, mastermind yards.

Blacktop an organization of tracks, solid steps. shrubs and different vegetation are planted.

All job is done as per the all-inclusive strategy.

## **3.2 Labour insurance during performing of works**

When performing development works it is important to be guided by the prerequisites "Wellbeing in development".

All raising stuff must be tried and given with a test demonstration. Banners and cautioning sign must be put up on all perilous regions of the site.

Establishment of structures must be completed by labourers with the important capabilities and who have gotten suitable wellbeing and fire security preparing.

Elevation works are permitted exceptionally prepared labourers at the very least the third classification and work experience of in any event one year.

Establishment labourers should be furnished with overalls, head protectors and seat straps that is connected the to structures all the time when working.

During establishment, all the installers must always on exceptional portable stages outfitted with handrails, which prohibit the chance of tumbling from a tallness.

People answerable for the activity of lifting machines and systems assess the sleepers no less than at regular intervals, snatch a month, slings like clockwork.

There should be a solitary caution framework at the building site and connecting slingers to the crane.

When emptying the equipment or the other way around, the driver must leave the machine to forestall mishaps.

Exceptional vehicles complete transport of huge burdens. The heaps will be made sure about to keep them from moving.

### **3.3 How to perfume work in winter**

#### **3.3.1 First stage will be earthworks**

Soil to be created in winter is protected from getting frozen by bringing down to a profundity of 30 cm assisted by earthmovers or diesel hammer C-254.

With little volumes for blowing, it is prescribed to take drills.

When inlaying, ice and snow are gathered, frozen ground tubers break.

#### **3.3.2 Stone work**

The fundamental technique for workmanship in the colder time of year is the freezing strategy: the workmanship is done outside not warmed by a snow-cleaned block in a warmed arrangement, which will permit pressure of the arrangement in the creases of the brickwork. At air temperature  $t = - 4^{\circ}\text{C}$  to  $- 20^{\circ}\text{C}$ , the evaluation of mortar for winter brick work increments by one degree contrasted with the mark set for summer brick work.



### 3.3.3 Solid (concrete work)

At least every day air temperature, the solid blend should be set up in warmed water. Warming of the total comes when the warmth brought into the solid with hot water isn't sufficient.

The blending of the solid combination increments by half contrasted with the late spring.

The solid blend is applied to the base, which is frozen and liberated from day off ice.

### 3.4 Innovative guide for the establishment of stairs and platforms

The innovative guide is intended for the establishment of step walks and stages for the progression confine of a 5-story working with stopping in the storm cellar.

The work is acted in two movements.

Preceding the installation of steps and walks is vital:

- To complete the brickwork of the dividers of the flight of stairs to the base characteristic of the stage;
- Prepare instruments, executes, installations fundamental for flights of stairs and walks;
- To stamp the spot of laying of the flights of stairs on a level plane and to check the space between locales on vertical direction;

Stepping stool walks and stages are available in the scope of our crane, considering the succession of establishment

All of the levels on the tallness of the stack cushions with areas of  $8 \times 7$  cm are orchestrated vertically in a similar plane.

Lifting and moving components of steps and stages during stacking and dumping is performed easily, without jerks, shaking with the utilization of augmentations. The throwing of steps and stages is done by mounting circles with a six-path sling.

When introducing fortified solid walks and stages, the crane is first taken up to a stature of 0.2-0.3 m above ground and held for some time on the weight to check the

unwavering quality of the sling and the right situation of the lifting component and afterward the lift proceeds.

At level, moving development rises at least 0,5m over the obstructions, experienced on route. Establishment of steps and stages must be completed over the span of the brickwork of the flight of stairs.

The method of establishment of precast solid structures of the flight of stairs is as follows:

- build up the a respectable starting point stage, check it and fix it, at that point mount the subsequent stage also, close a stepping stool walk, and so forth

Specific consideration is paid to the establishment of the main stage, as blunders in the establishment site will cause abandons in the establishment of all components of the flight of stairs.

The degree of the stages is checked by levelling at the degree of cover of each floor.

In the middle of establishment, the accompanying activities are performed:

- apparatuses preparation ;
- arrangement of subject ;
- establishment of a stepping stool walk and stage;
- surveillance of the stepping stool walk and stage;
- breakdown;
- hemp and crease fill.

To start with, the installers with the assistance of steel roulette plan the spot of establishment of the flight of stairs with the checking on the divider.

The second changes the piece arrangement of the construction area and deduces in the plan position. The joints are procured by the arrangement.

The establishment of the flight of stairs starts with the cleaning of the outside of the flight of stairs to help the walk and the bedding arrangement.

.

After finish of the compromise checks the even of the steps.

When playing out the work it is important to notice the wellbeing rules, paying exceptional thoughtfulness regarding the accompanying:

- All specialists occupied with establishment work must be prepared and trained on the security of working strategies as per the wellbeing guidelines for the establishment of steel and fortified solid structures.

### **3.5 Innovative guide for plan of rooftop, gadget of tile floors**

#### **3.5.1 Field of utilization**

The innovative guide is intended for the material gadget made of moved machines (material).

#### **3.5.2 Organizational and innovation of development solutions**

Material courses of action should be finished before the start of the institution and acknowledged:

- all development and institution contend with protected regions, institution and fixing to the steel profiled decks of canal channels, development joints, anchor jolts, disinfectant wood bars for fixing protective layers and defensive covers;

- The layers of the steam and heat protection, tirades, and later a verification was done from the inclines and uniformity of the bottom beneath the top side on all surfaces, together with the overhang of the top sides and also the spots of adjoining distending over the rooftop underlying parts.

In the event that every one of the conditions of the enterprise for the character of the bottom is reached, the upper part of the denouncement will be ready.

Base, is dry behind making ready therefore ready for the top side to be introduced.

The warm protection doused throughout institutions should be taken out and supplanted.

Throughout time of labor, associate degree uncommon condition is that the protection job should be wiped out a dry climate, to stay the materials from obtaining wet.

The character of the nice and cozy protection should be indicated within the shrouded jobs.

The widget of the top side cowl within the operating commitment begins with the weakened territories: overhang, zones of the realm of the drain pipes, and depressions.

Whereas staying protection layers, allow the contiguous adjacent networks to be.

Innovative procedures for stickers of surfaced move material could be extraordinary. The work will be acted within the related request: on the readied premise end up 5-7 rolls, take a stab at one move admire another, and provides the important leave.

### **3.5.3 Security proposals**

Whilst operating with liquid petroleum fireplace gear, it's prescribed to wear eudemonia eyeglasses.

In the middle of interferences, the hearth of the burner should be strangled and its valves firmly shut.

On the off probability that gas spills from chambers are distinguished, work ought to be halted quickly.

Fix of chambers or different gear within the operating setting of gas fireworks is not permissible. The roofer's operating setting should be furnished with the related golf shot out fires and clinical equipment:

- i. Dry chimal fireplace quenchers at every single top side phase
- ii. Box with sand maximum size 0.05 cubical meters;
- iii. Cutting edges - two pairs;
- iv. amphibole canvas - one sq. m;
- v. emergency treatment pack with a bunch of medicine. In the case of a piece setting fireplace, it's necessary to smother it with the use of fireside dousters, dry sand, covering the flames with amphibole or canvas cloth. The material works at the same time as different development and erection deal with rooftops known with the use of open flares ( fastening, and then on) aren't permissible.

On the off probability that there's a flammable or intense signs (smoke, intense scent, fever, and then on):

- i. tell the native cluster of fire-fighters right away;
- ii. Do everything to evacuate people, put out fires, guarantee the insurance of the property.

When you fulfillment of the job, it's necessary to review the destinations and convey them into fireplace condition.

The workplace should distinguish the individual in charge of the conservation and standing for essential fireplace suffocative specialists.

### 3.6 Definition of the scope of labor

The sheet of the labor intensity of labor and also the wants of machine-shifts and list of all work varieties in scope shown in Appendix A.

### **3.6 Security estimates when performing material works**

Extra wellbeing prerequisites are forced on roofers occupied with development work.

Roofers are permitted to go through clinical assessments, exceptional instructional classes, and have breezed through tests and are affirmed to be at any rate 18 years old and more than 60 years old.

The office must be outfitted with an emergency treatment unit and prescription.

Working environments should, where important, have walled in areas, defensive and security gadgets.

All labourers occupied with material work must be given overalls, work footwear of the necessary sizes and individual defensive hardware as per the nature of the work being performed.

All laborers should be told ablaze wellbeing measures. Work environments that are dangerous to the hearth circumstance are outfitted with the essential strategies for suffocative fire.

While fitting the hydrocarbon preliminary, warm to seventy ° C, the hydrocarbon is stuffed into a soluble vessel and mixed with a wooden stirrer.

On border of the structure, it's meant to line up a district that's risky for people to maneuver around, shut-in, or check it with remarkably obvious admonition signs. The dimension of the zone at developing stature to.

### **3.7 Calculation of the term of development**

The term of the event time-frame is run by the rules of development term and development time.

As for the event of a 5-story personal structure with underground parking, the event time-frame is 443 days.

Summarized and delayed, considering that the innovative grouping of labor additionally, the rules of labor security aren't abused.

#### **3.7.1. Schedule of development**

The schedule arrangement is formed in step with the essential principles of its development, considering the use of complicated automation, innovative arrangement, process of doing work exactitude, and also the most extreme conceivable arrangement.

The framework arrange has fifty occasions also decided about the determinant.

The quantity and work input info were used to accumulate the determinants.

Completed works done from the bottom to the bottom and for the catch, it's acknowledged:

- 1 hold - one8-16 stories
- 2 commitment - 15-13 stories
- 3 grips - 12-10 stories
- 4 grasps - 9-7 stories
- 5 handle - 6-4 stories

6 grasps - 3-1 story In corresponding with the finishing works, the within is remotely ready.

### **3.7.2 Thought of necessities of security at configuration schedule plan.**

A work routine is a fundamental plan report that sets up a mechanical connection between singular development measures and the versatility of laborers after some time to guarantee the making of a completed item.

While connecting the succession of development works for the development of a farm hauler mechanics shop, the highlights of innovation of complex cycles, plan and arranging choices, administrative terms of development, security conditions when performing independent works and when joining a few works, the states of modern disinfection are taken into account.

The institution of structures is completed merely when the institution, testing, and specialized examination of the positioning crane.

At the construction site (occupation), wherever the institution work is completed, we have a tendency to limit the execution of various works and discovering further people.

In the middle of construction of the structure, it is taboo to perform business related to discovering individuals in a single area (occupation, segment), over which the development, establishment also, brief fixing of components of pre-assembled structures or gear is completed.

When raising an auto mechanics shop, concurrent execution of work consolidated vertically, is permitted with the composed request of the main specialist and we intend to perform them at various nibbles, if there is a threat when playing out the work underneath.

The method for finishing the add the schedule is organized in such a way that provides strength to the developments being installed and also the support of solid joints, to which allows the institution of the related primary parts of the building..

Following the state also security practise, it's wanted to join the takes a shot at the rooftop plan with the chips away at the course of action of solid planning for the floor, plan

of parcels, establishment of entryways and doors, workmanship of outlining, putting of edges and segments, completing fills in as external.

At the long-term, these jobs are joined, however, they're meant to be performed on varied items of the structure. When doing the activity material work utilizing hot hydrocarbon with many connections, the space between them is acknowledged.

Completing works are arranged in the warm season and, if important, after the beginning of focal warming.

Explicit works: clean and electrotechnical remembered for the classification of works to make protected and safe working conditions at the office and to make conditions for typical clean and sterile adjusting of laborers.

### 3.9. Development of end strategy

Development end strategy is one in each of the numerous items of the task of association of development and creation of works.

In light-weight of the created arrange, the life of would like preliminary for the event of structures plenty is resolved, the execution of that specifies the terms of the event of the structure.

The arrangement marks the realm of impermanent structures of our Crane. On the construction area, there's water graciously framework with fire water hydrants, water admissions, water graciously to shower rooms, intake space.

Impermanent force graciously framework provides the total capability to the vacant lot in the dead of night, and interfaces all units and instruments.

The area for the electrical device station and switchboards is cased to stay unapproved folks from getting into their region and electrical shock. The vacant lot on all sides is shut by a short-lived fence.



## CHAPTER 4

### SCIENTIFIC RESEARCH PART

#### 4.1 Formulation of the problem

During the construction of structures made of monolithic reinforced concrete, it is often difficult to achieve perfect joining of elements of different tiers, because their installation occurs at significant intervals. This leads to the emergence of eccentricities of application of loads and changes in the scheme of operation of structural elements and their stress state.

This effect can be dangerous, especially for elements such as columns, because it can cause eccentric compression, which can cause tensile stresses. Moreover, this poses a danger to concrete structures. Therefore, the study of the operation of the columns in the case of an eccentricity of the load is an important task.

The purpose of the work is to investigate the operation of the underground parking column in the case of load eccentricity.

Tasks of the work:

3. Develop a finite element model of reinforced concrete column and calculation method taking into account the eccentricity of the load;
4. Analyse the stress-strain state of the column for different levels of load eccentricity.

The object of research is a reinforced concrete column of the underground parking lot of the designed office centre.

The subject of research is the stress-strain state of the column taking into account the eccentricity of the load.

## 4.2 Methods of research of the underground parking column

The operation of the underground parking column was simulated taking into account the possible eccentricity of the application of the vertical load. LIRA-SAPR 2015 software tool was used for the finite-element modelling.

Column dimensions are  $60 \times 20$  cm, height 3 m. Three-dimensional model with a regular grid of 2 cm was created (fig. 1).

Internal reinforcement of 14d10 A400C was taken into account. Steel bars were modelled with rod elements with appropriate properties. To correctly take into account the joint work of reinforcement and concrete, common nodes were used for the elements that model them (fig. 4.1).

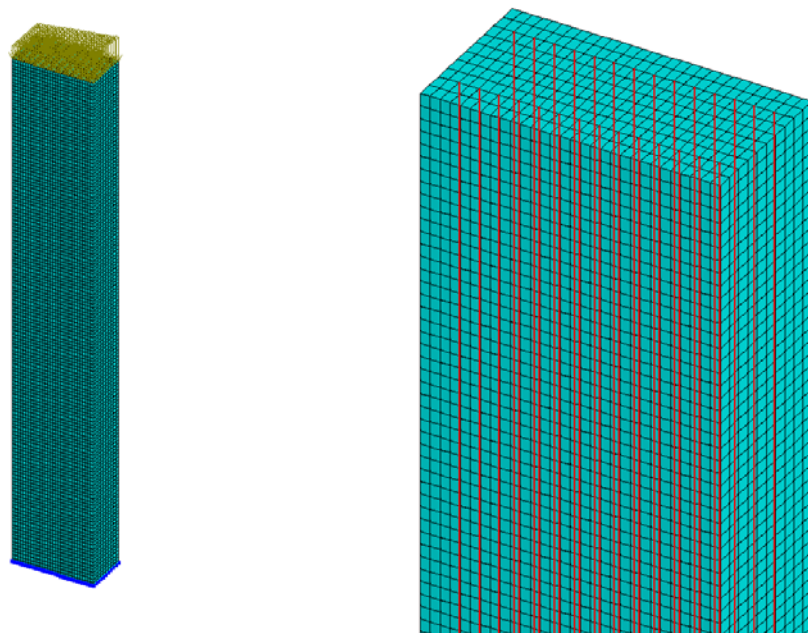


Figure 4.1 – 3D model of reinforcement concrete column with steel rods

The bottom of the column has restrains for all directions.

The load is collected from the weight of the ceiling and structures of the upper floors, as well as the temporary operating load. The dead weight of the elements was also taken into account.

The load was applied as a distributed trapezoidal on the upper face of the column. We considered 3 levels of eccentricity – 0.7, 1.4, 2.2 cm. The eccentricity of the load application was modelled by changing the parameters of the trapezoidal load, so that its centre of gravity falls to a point with the required deviation.

### **4.3 Results of research of work of a column of underground parking**

As a result of the calculation, the isofields of the displacements of the elements, the internal forces in the rods and the stresses in the main material in different directions were obtained for three levels of eccentricity (fig. 4.2).

As you can see, when there is even the slightest eccentricity, the distribution of stresses in the column of underground parking changes. From the side where the centre of gravity of the applied load is shifted, the values of vertical displacements and compressive stresses in the Z direction increase. At the same time, on the opposite side of the column, the values of the compressive stresses decrease compared to the case of the central application of the load.

To analyse the operation of the reinforcement, mosaics of displacements and internal forces in the rods were obtained (fig. 4.3). As you can see, in the case of compression along the entire cross section of the column in all rods there are only compressive forces N, their value is very small. This is because of the large cross-sectional area of the column, due to which the displacements are very small. This is especially important for underground structures. Reinforcing bars will be included in the work in case of tensile stresses.

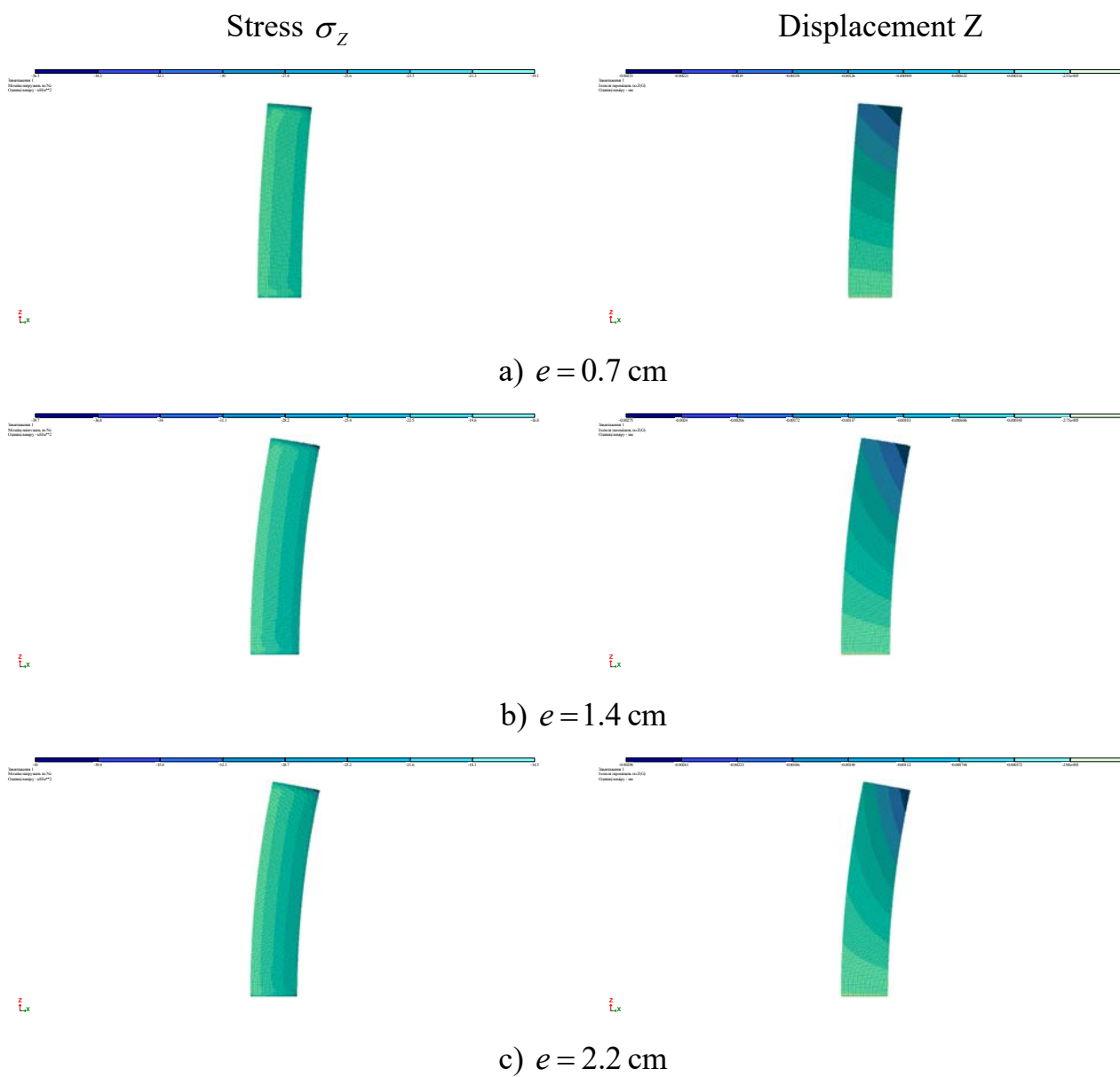


Figure 4.2 – Stress-strain state of the concrete column

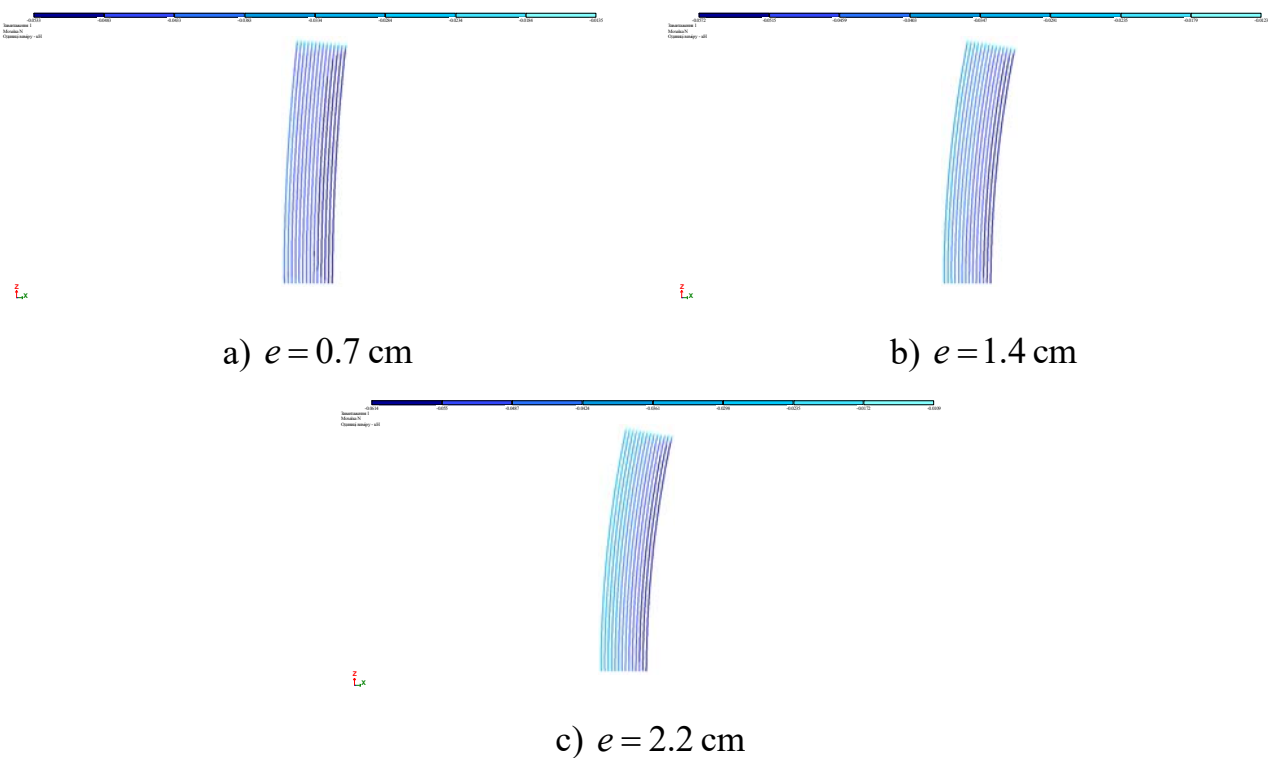


Figure 4.3 – Internal forces  $N_z$  in steel bars

For eccentricity  $e = 0.7$  cm we obtain the following values of maximum and minimum stresses in the concrete of the underground parking column:

$$N_{\max} = 36,5 \text{ MPa} \quad N_{\min} = 19,1 \text{ MPa} .$$

$$\text{For } e = 1.4 \text{ cm} - N_{\max} = 39,7 \text{ MPa} \quad N_{\min} = 16,8 \text{ MPa} .$$

$$\text{For } e = 2.2 \text{ cm} - N_{\max} = 43.0 \text{ MPa} \quad N_{\min} = 14.5 \text{ MPa} .$$

As we can see, the maximum and minimum compressive stresses change differently. The maximum compressive stress increases faster. Therefore, it is important to use high-strength concrete for the construction of the underground parking column.

#### 4.4 Conclusions of the research

The study analyses the operation of the underground parking column of the office centre, taking into account the eccentricity of the load. The obtained results indicate that with

the eccentricity  $e = 2.2$  cm tensile stresses does not occur and the strength of the column is provided.

Scientific novelty – the method of modelling of reinforced concrete elements on eccentricity compression was further developed.

The practical value of the work is the simulation of the stress-strain state of the underground parking column with eccentricity up to  $e = 2.2$  cm, which allowed to take into account the change in stress level and choose the right materials.

## CHAPTER 5

### LABOUR PROTECTION

#### **5.1 Security and fire wellbeing at the building site.**

The association of the building site, areas of work, and work environments must guarantee the security of laborers at all phases of the work.

The building site is midway found so it must be fenced off to forestall unapproved access.

Fenced in areas contiguous spots of mass entry of individuals must be fitted with a strong defensive visor. The plan of the fence must meet the necessities of GOST 23407-78: the plan of the fence should be folding with bound together components, associations and mounting subtleties. The tallness of the defensive boards with the visor is 2.0 m, in scanty boards fence distance in the hole the subtleties of filling the boards of the boards should be inside 80-100 mm. The defensive visor is introduced on the highest point of the walled-in area with the ascent to the skyline at a point of 200 towards the walkway. Boards of the visor ought to give the walkway and in stroll in his locale (the piece of the traffic) 50-100 mm.

Regions of possibly unsafe modern components must have signal nooks that meet the prerequisites of GOST 23407-78: the tallness of the racks of the sign walled in area should be 0.8 m, the distance between the racks ought not to surpass 6.0 m.

There are 1 passage and 1 exit to the building site, brief streets with a width of 6.0 m allow street transport with admittance to all stockrooms and intersections.

When entering a building site, a traffic design must be introduced, and street signs on the side of the road and street signs that obviously direct the traffic request of the vehicle in understanding of the traffic rules.

The speed of engine transport close to the creation locales ought not to surpass 10 km/h on straight areas and 5 km/h on turns.

At the building site, every dangerous zone (erection zone, crane region) is encased.

Establishment work is taken into consideration customary individuals who have gone through a clinical assessment and are permitted to work at elevation.

The throwing of merchandise is done by the specialized card, the conveyance of cargoes and fortified solid components is done in the wake of fixing them.

The platform must have a level working ground surface with a hole between the sheets of not in excess of 5 mm, and while setting the deck at tallness of 1.3 m or more –fencing and side components.

The association of decking sheets is just permitted alongside their length, where the closures of the reaching components should be set on the help and cover it at any rate 0.2 m toward every path.

The platform should be connected to the mass of the house under development.

Without explicit guidelines in the maker's directions, the mounting of the platform to the dividers of the structure must be made at least through one level for the outrageous focuses, through two ranges for the upper level, and one mounting for each 50 m<sup>2</sup> of the projection of the platform surface on the veneer of the building.

The premises in which dusty materials are to be taken care of, just as working environments close the apparatus for smashing, granulating, and sieving these materials, will be given ventilation frameworks (ventilation).

Work environments were cement, mastics, paints, and different materials producing touchy or then again unsafe substances are utilized or arranged, are not permitted to work utilizing open flares or starts.

On the domain of development in the areas of brief structures, stockrooms, workshops introduced fire shields/stands/and water barrels.

To forestall the spread of fire it is important to guarantee the development of adequate fire stifling specialists, to notice the principles of capacity, position, and restriction of the measure of burnable substances and materials, just as to conform to other prerequisites of GOST 12.1.004-76.



Violators of the guidelines of fire security, if the infringement had grave results, are held criminally subject under the Criminal Code, rebuffed by restorative work for a term up to 2 years, and if there were additionally human casualties, detainment as long as 8 years.

**The primary driver of flames during development work:**

- absconds in building structures, structures, the design of premises, the course of action of correspondences;
- absconds in hardware, breakdown of mechanical cycles, and inappropriate execution of works;
- breakdown of the force supply and fumes frameworks in the interior burning motors, the nonattendance of flash doublers on the fumes lines of the motors;
- infringement of the guidelines of the utilization of open flares, particularly close to the spots of utilization or the capacity of hot or combustible substances;
- need or disappointment of establishing of tanks with fluid oil items;
- glitch or nonappearance on certain objects of the arrangement of rankling assurance.

Posts with putting out fires offices should be coordinated at the building site, just as especially unsafe putting out fires regions should be distinguished. Inside these zones, oil paints, oils, tars, oils, fuel, and ointments ought not to be put away, these materials should be put away in independent extra spaces. under the overhang.

The capacity of oxygen chambers and chambers with other ignitable gases in a single room is disallowed. All open-fire work is allowed distinctly with the consent of the individual liable for fire security at the building site.

Fire security is a state of an item that takes out the chance of fire, and in an instance of its event takes out the impact on individuals of risky variables of fire and gives assurance of material qualities.

Fire security is guaranteed by making an arrangement of fire counteraction measures and dynamic fire assurance.

Fire avoidance is a bunch of hierarchical measures and specialized methods focused on forestalling the conceivable event of a fire or lessening its belongings.

A functioning fire security framework is a bunch of authoritative measures and specialized implies for fighting flames and keeping individuals from causing risky flames, just as restricting material harm from it.

To forestall fires in development associations create hierarchical, specialized, the system, fire-departure, strategic, preventive, development, and different proportions of methods of activity of apparatus and gear, which totally takes out the chance of flashes and blazes.

Authoritative exercises incorporate the correct decision of innovation; avoidance of blockage of premises and building destinations; preparing workers in fire wellbeing rules; unique position of materials in distribution centers and gear in carports and fix shops.

Specialized measures incorporate legitimate choice and establishment of electrical hardware, lightning assurance frameworks and earthing plans, sparkle arresters, and so forth.

Proportions of a system nature are the restriction of smoking, the start of the fire, the best possible stockpiling of oiled fabrics, the consistent command over the capacity of materials that can light, etc.

Strategic and preventive measures incorporate the fast activity of fire groups, the arrangement of offices with essential fire doublers, just as the upkeep of the plumbing framework, and so on.

Development measures are utilized in the plan and development of structures, the formation of fire-avoidance structures of structures, just as in the plan of machines and gear.

## **5.2 Well-being measures.**

### **5.2.1 Safety at drilling works**

Appropriate association of penetrating works has two fundamental objectives:

- 1) mount the apparatus as indicated by security prerequisites;

2) to do establishment and destroying of the boring apparatus at the earliest opportunity.

Security at penetrating tasks relies generally upon the plan of the apparatus.

The penetrating apparatus comprised of a ground structure and penetrating force hardware, the plan of the apparatus ought to guarantee the discerning association of innovative cycles for penetrating wells, high efficiency and security of the drill group.

The boring apparatus must be given low-mechanical methods, just as systems and gadgets that expand security.

Manometers and other estimating instruments will be introduced with the goal that their markings are obviously noticeable to the working faculty. Boring apparatuses 14 m high or more should be secured with stretches of steel kainite, whose measurement is controlled by count.

In the event that laborers are needed to ascend a drill rig or should under working conditions, they should be fitted with stepping stool stepping stools, stepping stool stepping stools, or passage stepping stools. Stepladders will have a height point of more than 60 °, a width of at the very least 0.7 m. Venture steps no more prominent than 0.3 m, a side sheathing stature of 0.15 m, and twofold sided handrails 1 m high.

Penetrating apparatuses must have work stages with a safe house for the boring laborer from antagonistic climate conditions.

The stages ought to have a width of at least 0.7 m and a railing stature of 1...1.25 m.

While moving self-moved penetrating apparatuses, the laborer is permitted to be more breathable in the driver's taxi. While moving under the electrical cable, everybody aside from the driver must leave the establishment and the speed ought not to surpass 5 km/h.

It is prohibited to take a shot at the boring apparatus beneath the transmission line in the security zone of the LEI of the work, it is permitted to perform simply in the wake of educating the laborers and giving a dress-resilience.

The penetrating apparatus must be examined preceding the beginning of the change by the driller, occasionally, in any event once in 10 years by the driller 1 once at regular intervals by a specialist furthermore, repairman.

Hardware, apparatus, and gear utilized in penetrating apparatuses must have identifications, and rope lifts must be ensured.

Travel papers must be filled routinely by a repairman. Hardware, rigs loom and siphons should be worked at burden and weight not surpassing the visa, estimating instruments (checks), mass pointers, and so on) must have the seal or stamp of the fixing association.

Utilize unbending two poles or steel ropes while moving establishments. Individuals not straightforwardly engaged with the penetrating apparatus work should be brought to a perilous distance equivalent to one and a half-tallness of the apparatus.

The good ways from the pinnacle to the farm hauler conveying it must be at the very least the tallness of the pinnacle in addition to 5 m. The pinnacle should be moved during the day.

It is illegal to move them around evening time, in the weighty haze, during icing, and in the breeze more than 5 focuses.

Self-impelled boring apparatuses mounted on the vehicle are moved with the pole brought down what's more, the pole fixed.

Wellbeing rules for boring activities accommodate intermittent testing of penetrating apparatuses and poles during their activity.

The request for testing and winnowing of pinnacles is set by the business principles.

Boring apparatuses and poles are liable to testing after the deterioration time of activity, modernization, or significant fixes, in the wake of stacking, which has prompted the disappointment of metal structures and mishaps. A commission is delegated for the test.

Previously beginning, his bonus examines the drill apparatus and checks the trustworthiness of the metalwork and screw associations.

Whenever discovered inadmissible underlying components before the test, supplant them with quality.

All things considered, boring is completed either by the drillmaster himself or by an accomplished driller in his essence. Boring gear upkeep in the boring cycle is basic to make safe working conditions.

Prior to turning over the drive motors of the penetrating apparatus, check the presence and usefulness of the walled-in area, the nonappearance of incidental articles on them. From that point onward, an admonition signal is given and the switch is on. During the work it is illegal to fix, clean, grease up components, eliminate parts, wall, drive belts, control rope lifts, and so forth with their hands.

After fulfillment of boring tasks, it is important to do liquidation works as per the "Rules for the end of tamponade of boring wells for different purposes, inlaying of mining work and the unloading of those wells in to forestall contamination and exhaustion of groundwater", kill contamination from fuel and oils and remediation.

### **5.2.2 Safety measures for waterproofing works**

Development structures and pipelines are annihilated by the activity of water and different forceful conditions.

Various sorts of waterproofing are utilized to ensure them.

Factors, for example, mugginess, the forcefulness of the medium, hydrostatic weight, temperature and mechanical move are made into the account. Waterproofing works are performed with different hot bitumen, cement, epoxy mastics, move materials, plastics, stains, pitches, and so forth.

Every one of these materials can deliver vaporous substances and make a dangerous and fire- unsafe climate, just as hurtful consequences for the human body. The primary driver of injury during waterproofing work: the presence of an enormous the measure of manual work, the helpless association of working environments, deficient preparation of separators,

the presentation of work at tallness, doing these works without person methods for security, and so forth .

Prior to the utilization of waterproofing materials of a structure, it is important to plan appropriately, to free from residue and earth, to dry, and to prove. The planning of surfaces for protection is performed with the assistance of pneumatic and electric stun instruments, sandblasters, and mechanical wire brushes.

Subsequent to drying the preliminary layer, apply a lasting protecting layer.

Solid structures from the activity of forceful water-secure manufactured tars, stains, veneers. Hot black-top waterproofing is utilized to shield them from pressure water, concrete mortar waterproofing is utilized from pressure less water.

While applying a groundwork, stacking bitumen into the kettle and different robots where mastic might be showered, work in security glasses and respirators. In the spots of mastic arrangement, there must be a bunch of fire doublers (two fire quenchers, a digging tool, a crate of dryers. sand and specialized felt).

It is permitted to make bituminous mastic just on a uniquely assigned site. The last is picked in the level territory with advantageous access at any rate 50 m from wooden structures and stockrooms, 30 m from electrical cables, 15 m from the channels, and dump. Bituminous softening establishments should be put under 5 m separated.

The grass should be completely cleaned on the base of 5 m from the bitumen smelter.

It is important to put protecting materials under a covering a good ways off not closer than 25 m from the spot of the arrangement of mastic, and the stores of these materials and fuel in the volume of ordinary stacking - not closer than 5 m from the evaporator.

Bitumen boilers should be all-around fixed and have non-combustible, firmly fixed covers with handles. Close to 3/4 of their ability will be permitted to fill the boilers.

The pummeled fillers are filled the boilers in a dry structure and in little dosages. Wet bitumen may not be brought down into the evaporator, as the water spilled into the warmed bitumen may cause oily steam and launch of bitumen mastic.

The filler should be loaded up with a layer of bitumen on the outside of the bitumen and mixed for 15-20 minutes until the filler is totally dry. To forestall coking and to quicken the warming, the bitumen should be blended continually in the evaporator with a wooden stirrer sharp edge with a handle of at any rate 1.6 m long.

After the primary segment of bitumen is dissolved, the evaporator should be topped off by bringing down little bits of bitumen along with its dividers.

A moderate fire must be kept up in the heater with the goal that the bitumen in the evaporator doesn't warm over 200 ° C to keep it from touching off.

In case of a hole in the heater, the work should be halted by stifling the fire in the heater, and afterward, the evaporator must be cleaned and fixed. Cleaning of the kettle is permitted subsequent to cool to 50 °C.

In the event that bituminous mastic has ejected in the kettle, it is important to close it firmly with a cover and stop the fuel supply to the heater. It is illegal to flood bituminous mastic with water or snow.

The blending of bitumen with gas or diesel fuel in the planning of bituminous mastic is done in any event 50 m from the spot of cooking of the bitumen. The bitumen temperature ought not to surpass 70 ° C. No one but digging tools can blend the bitumen in with fuel or diesel. At the point when blended, warmed bitumen is filled gas (however not the other way around).

The bituminous mastic is shipped to the site of utilization in funnel-shaped tanks with tight covers. The tank is loaded up with bituminous mastic close to 3/4 of the volume. Empty the mastic into the tank with the assistance of since quite a while ago took care of pots. They convey the tanks to the working environment in an automated manner with the assistance of streetcars.

Hot mastic is served in a channel, protecting a rope with a carbine to the tank. It is as it were conceivable to acknowledge the tank after it has been safely introduced at the lower part of the channel. Versatile half-glasses are utilized for eye security.

Workwear is cleaned of residue after each change and washed with high temp water each week.

The satisfaction of these conditions made it conceivable to diminish work related infections and mechanical wounds in waterproofing works.

### **5.2.3 Security estimates when performing welding work.**

When performing welding work in similar live with different works, measures must be taken to dispense with the chance of the impact of risky and hurtful creation factors on workers.

When performing welding at various levels vertically, the security of the workforce working at the lower levels, from unintentional fall of articles, cathode obstructs, metal sprinkles, and so forth, must be guaranteed.

Regions with a hazardous creation factor should be fenced as per the prerequisites of DSTU 23407-78 and DSTU 12.2.062-81.

Working environments above 1.3 m from the level or ground of ceaseless cover will be outfitted with fenced in areas as per DSTU 12.4.059-89 at the very least 1.1 m high, comprising of a handrail, one transitional component, and a sideboard at least 0.15 m. When delivering welding work at tallness of in excess of 5 m, frameworks (stages) of non-ignitable materials must be orchestrated as per the necessities of DSTU 12.2.012-75.

Without frameworks (electric stages), electric welders should utilize seat straps and fireproof carburettor knocks.

Laborers should utilize extraordinary instrument sacks and gather terminal attachments.

The safeguarding of the beginning welding materials and completed items must be done in distribution centres which are prepared and kept up as per the prerequisites of building, clean and putting out fires rules and guidelines affirmed in due course.



When saving welded workpieces, welding materials, and completed items, there should be no impediment to normal light, ventilation, suction, entry, utilization of fire hardware and methods for the security of laborers.

The degreasing of the surfaces of welded items should be finished with arrangements endorsed for use by clean and fire control bodies.

Spent materials (obstructs of terminals, sheath, measure examples, degreasing squander, and so forth) should be gathered in metal holders and, as aggregated, eliminated from the locales to destinations for assortment and removal in the domain of the endeavor.

People who have been prepared, taught and tried for wellbeing necessities with an electrical wellbeing capability gathering of at least II and important testaments are permitted to perform welding.

Welding work at tallness 1 is considered laborers who have gone through an uncommon clinical assessment, who have the insight of climbing work for in any event one year and the level of the welder isn't lower than III.

Laborers in the welding callings must be given the individual defensive gear as per the standard business guidelines affirmed in the endorsed way, and as per the nature and states of the work.

Security of the face and eyes is given shields as per GOST 12.4.035-78 and glasses as per GOST 12.4.013-85 (with channels - for GOST 12.4.080-79).

Individual defensive gear as per GOST 12.4.051-87 should be utilized for the assurance of hearing organs.

To shield the head from mechanical impacts and electric stun, defensive protective caps as per GOST 12.4.128-83 should be utilized.

#### **5.2.4 Security estimates when performing stonework.**

When applying cranes, fired stones, and other little squares to the work environment, beds, holders, and grasping gadgets must be utilized to keep the heap from falling at the point when lifted.

When laying the dividers of structures to a stature of 0.7 m from the working deck and the good ways from the level behind the divider being raised, to the outside of the earth (cover) more than 1.3 m, it is important to apply mass insurance (fencing or security belts).

Transitory trimmings of the roof components might be eliminated subsequent to coming to the strength determined in the plan.

Loss of obstruction by an individual can be identified with the impact of individual components (disease or physical and neuro-clairvoyant over-burden), just as with the impact on the human elements of the outer climate (development of crane materials, structures, and so on)

The breakdown of the platform is generally connected with an over-burden or infringement of the establishment or working guidelines, moreover, all the time the explanation behind the injury is the utilization of different infrequent backings, stepping stools, boxes, and so forth for the bedding.

### **5.2.5 Well-being measures during establishment work.**

In the creation of establishment (destroying) works in the states of the working venture, the worked power networks, and other existing designing frameworks in the zone of work must when in doubt, be disengaged, abbreviated, and the hardware and pipelines will be excluded from dangerous, flammable, and hurtful substances.

Strategies for the throwing of primary components and hardware must guarantee that they are taken care of to the establishment site in a position near the plan.

Cleaning of the segments to be amassed from the soil should be done previously lifting them.

Development mounted components will be shielded free from shaking and pivot by adaptable interruptions.

It is taboo to remain on the underlying components during their lifting or moving.

During the breaks, it isn't permitted to leave raised components of structures and hardware in the hanging position.

It isn't permitted to introduce installers on introduced structures and their components.

The components introduced in the plan position must be made sure about so as to guarantee their dependability and mathematical steadiness.

It is prohibited to put individuals under the components that are mounted prior to mounting them in the plan position and fixing.

On the off chance that vital, working under the hardware (structures) to be mounted and furthermore on the hardware (structures), uncommon measures must be taken to guarantee the wellbeing of laborers.

Painting and anticorrosive security of structures and hardware in situations when they are completed at the building site, should be done, generally speaking, before their ascent to the plan mark.

During the establishment of structures or structures, installers should be on recently introduced and safely fixed frameworks, which are utilized for the protected execution of works at tallness of 1 m over the ground level.

Structures normally use stock framework, platform, supports that have travel papers of the assembling organizations.

Non-loading devices are utilized in excellent cases with the authorization of the central designer of the development and gathering association, if the tallness of the non-stock framework is in excess of 4 m, they are worked by the endorsed plan.

The platform is utilized to perform development work inside one story.

They are introduced in the structure and moved by crane starting with one story then onto the next.

Examination of mishaps while chipping away at the platform shows that mishaps happen mostly because of the deficiency of soundness of framework, which is brought about by different reasons:

- mistaken and inadequate attaching of platforms to dividers, lopsided help of racks on the ground;

-over-burdening due to the aggregation of materials and development subtleties on the framework that surpasses the passable qualities;

- dynamic effect on the components of structures, platform, and loss of solidarity of their individual components.

The structure of the framework must be intended for durability and therefore the individual components for toughness.

Computations of burden-bearing components (underpins, decks, runs, and so on, and so on) are performed, considering the mass of laborers, (the mass of materials, holders, transport implies, and so on).

To guarantee the safety of the platforms the cross over the way, they ought to be safely affixed to the divider with secures.

All sheets should be nailed to within.

The destroying of the framework is finished within the opposite grouping of its establishment, when all materials, apparatuses, and vehicles are taken out from the decks, the platform components are brought down by methods for cranes.

To ensure individuals who are on the platform, a lightning bar is accommodated direct lightning strikes.

There are various works in development where fencing is unthinkable (at the edge of covering, molding, then forth), in these cases just rope assurance and mounting belts are utilized.

### **5.2.6 Security Measures in performing concrete and foundation works.**

Solid works incorporate the assembling and establishment of formwork, the planning of solid blend, its transportation, and laying, care of concrete, mechanical treatment of solid structures, internal control of labor, dismantling of formwork after relieving concrete and such.

The materials used to make the solid blend, within the preparation, transportation, and different activities, structure plenty of residues, which unfavorably influences the respiratory system of the individual and causes illnesses of the skin of the face and hands.

## GENERAL CONCLUSIONS

In this qualifying paper the construction of five-storey office centre was developed. It includes underground parking with concrete walls and columns. Basic architectural decisions were substantiated by the corresponding calculations. Design calculation of foundation structures has been performed. A technological map has been developed for the process of masonry and assembly works.

In the scientific research part analysis of the operation of the underground parking column of the office centre was made, taking into account the eccentricity of the load. The obtained results indicate that with the eccentricity  $e = 2.2$  cm tensile stresses does not occur and the strength of the column is provided.

Scientific novelty – the method of modelling of reinforced concrete elements on eccentricity compression was further developed.

The practical value of the work is the simulation of the stress-strain state of the underground parking column with eccentricity up to  $e = 2.2$  cm, which allowed to take into account the change in stress level and choose the proper materials.

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**APPENDIX**



## APPENDIX A

### Scope of work

Table A.1 - Definition of scope of work

| №  | Name of structural elements, types of work, sections   | Units of measurement according                                   | Amount | Note |
|----|--|--|--------|------|
| 1  | 2  | 3  | 4      | 5    |
| 1  | Mechanical working out of soil 3-rd gr. excavator EO-5015A bucket capacity 0.5 cubic meters. | 1000 cubic meters.   | 0,198  |      |
| 2  | Manual modification of the soil thickness of 5cm.  | 100 cubic meters.  | 0,140  |      |
| 3  | Installation of foundations weighing up to 0.5 tons.   | 100 pieces.  | 0,350  |      |
| 4  | Installation of foundations weighing up to 1.5 tons.   | 100 pieces.  | 0,250  |      |
| 5  | Arrangement of monolithic sections of foundations  | 100 cubic meters.  | 0,006  |      |
| 6  | Paint waterproofing  | 100 square meters.   | 0,493  |      |
| 7  | Oak waterproofing in 2 layers  | 1 square meters.   | 31,800 |      |
| 8  | Backfilling  | 1000 cubic meters.   | 0,067  |      |
| 9  | Masonry -assembly works  | watch the technical map for masonry and installation works, days | 52     |      |
| 10 | Installation of rafters  | 100 cubic meters.  | 0,140  |      |
| 11 | Installation of roofing from metal   | watch the technical map for roofing works, days                  | 6,5    |      |
| 12 | Fire protection DK   | 10 cubic meters.   | 5,600  |      |
| 13 | Fire protection for roofing  | 1000 square meters.  | 4,100  |      |
| 14 | Antiseptic DK  | 100 square meters.   | 0,101  |      |
| 15 | Installation of window blocks of up to 5m2   | 100 square meters.   | 0,560  |      |
| 16 | Installation of door blocks up to 3m2  | 100 square meters.   | 0,550  |      |
| 17 | Internal plaster of walls  | 100 square meters.   | 4,119  |      |
| 18 | Sealing walls with wallpaper   | 100 square meters.   | 5,270  |      |
| 19 | Wall painting  | 100 square meters.   | 4,150  |      |
| 20 | Wall cladding with ceramic tiles   |  | 1,112  |      |

| 1  | 2  | 3                  | 4     | 5 |
|----|--|--------------------|-------|---|
| 21 | Finishing the plinth with limestone slabs                          | 100 square meters. | 0,449 |   |
| 22 | Arrangement of the underlying layer from crushed stone and ramming | 1 cubic meters.    | 3,200 |   |
| 23 | Coating device blind area width 0.9m from asphalt concrete         | 100 square meters. | 0,480 |   |
| 24 | The device of concrete floors                                      | 100 square meters. | 0,630 |   |
| 25 | Laying the log on slabs  | 100 square meters. | 0,756 |   |
| 26 | Construction of wooden floors                                      | 100 square meters. | 0,756 |   |
| 27 | The device of floors from a ceramic tile                           | 100 square meters. | 0,870 |   |
| 28 | The device of polyvinylchloride skirting boards                    | 10 meters          | 6,200 |   |
| 29 | Installation of wooden skirting boards                             | 10 meters          | 5,400 |   |
| 30 | Fencing installation   | 100 meters         | 2,240 |   |

Table A.2 – The sheet of labor intensity of work and the needs of machine-shifts

| № | Name of structural elements. types of work, plots   | Scope of work      |        | Paragraph of the DBN | Rate per unit of volume |                    |      | For the whole volume |      |
|---|---|--------------------|--------|----------------------|-------------------------|--------------------|------|----------------------|------|
|   |   | units              | amount |                      | m-h                     | type of machines   | m-h  | m-d                  | m-s  |
| 1 | 2   | 3                  | 4      | 5                    | 6                       | 7                  | 8    | 9                    | 10   |
| 1 | Preparation period  | -                  | -      | -                    | -                       | -                  | -    | -                    | -    |
| 2 | Mechanized soil development of the 3rd group. excavator EO-5015A bucket capacity of 0.5 cubic meters. | 1000 cubic meters. | 4,86   | 1-17-15              | 9,25                    | Excavator EO-5015A | 20,7 | 5,59                 | 12,1 |
| 3 | Manual refinement of soil 2M gr. thickness. 5cm.  | 100 cubic meters.  | 1,67   | 1-169-2              | 19,25                   | -                  | -    | 4                    | -    |
| 4 | Installation of foundations weighing up to 0.5t   | 100 pieces.        | 0,9    | 7-1-1                | 38,6                    | Crane MKG-25.01    | 13,3 | 4,3                  | 1,49 |

| 1  | 2   | 3   | 4     | 5         | 6    | 7               | 8    | 9      | 10   |
|----|---|---|-------|-----------|------|-----------------|------|--------|------|
| 5  | Installation of foundations weighing up to 1.5t | 100 pieces.   | 2,59  | 7-1-2     | 53,2 | Crane MKG-25.01 | 18,2 | 17,2   | 6,08 |
| 8  | Lubricating waterproofing 2-3 layers            | 100 sq. m.  | 1,61  | 13-13-1,2 | 19,7 | -               | -    | 3,97   | -    |
| 10 | Backfilling                                     | 1000 cubic meters.  | 0,87  |           | -    | Bulldozer       | 6,54 | -      | 0,7  |
| 11 | Cloth-erection works                            | watch the technical map for clay and installation works, days |       |           |      |                 |      | 19days | -    |
| 12 | Installation of rafters                         | 1 м.кыб.  | 13,9  | 10-72-1   | 11,8 | -               | -    | 10,3   | -    |
| 13 | The device of the zinc roofing steel            | 100 sq m 10,56  |       |           |      |                 |      | 160,87 |      |
| 14 | Fire protection DK                              | 10 cubic meters.  | 6,4   | 10-51-1   | 7,8  | -               | -    | 3,12   | -    |
| 15 | Fire protection for roofing                     | 100 square meters.  | 7,5   | 10-52-1   | 29   | -               | -    | 13,6   | -    |
| 16 | Antiseptic DK                                   | 100 square meters.  | 0,255 | 10-53-3   | 4,03 | -               | -    | 0,06   | -    |