Ministry of Education and Science of Ukraine
Ternopil Ivan Puluj National Technical University

Faculty of Engineering of Mehanics, Structures and Technolgies
(full name of faculty)
Structural Mechanics
(full name of department)

QUALIFYING PAPER

For the degree of

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(degree name)

topic: Project of the 11 storeys building in Ternopil with study of reinforced concrete strength

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Ternopil
2020

Ministry of Education and Science of Ukraine
Ternopil Ivan Puluj National Technical University
(full name of higher education institution)

Faculty Faculty of Engineering of Machines, Structures and Technologies

Department Structural Mechanics

Educational degree the first (bachelor)

Field of study 19 Architecture and construction
(code and title)

Specialism 192 Building and Civil Engineering
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APPROVED BY

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Assignment

FOR DIPLOMA PROJECT (THESIS) FOR STUDENT

Emmanuel Iyinoluwa Alao
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1. Project (thesis) theme. Project of the 11 storeys building in Ternopil with study of reinforced concrete strength

Project (thesis) supervisor Assoc. Prof., PhD. Volodymyr Iasnii
(surname, name, patronymic, scientific degree, academic rank)

1.Approved by university order as of 28.09 2020 № 4/7-682

2. Student's project (thesis) submission deadline December 20, 2020

3. Project (thesis) design basis Construction site location – Ternopil. Average temperature of the coldest month -5°C.

4. Contents of engineering analysis (list of issues to be developed)
The Literature Review, Architectural part. Constructive part. Technological and Organizational part. Special part. Labor protection.

5. List of graphic material (with exact number of required drawings, slides)
Master plan; Facades; Plans; Sections; Structural Connections; Foundations construction; Technological card; Construction site plan.

6. Advisors of design (thesis) chapters

Chapter	Advisor's surname, initials and position	Signature, date	
		assignment given	assignment accepted
Constructive-architectural	Assoc. Prof., PhD. Volodymyr Iasnii	01.10.20	01.10.20
Structural design	Assoc. Prof., PhD. Volodymyr Iasnii	01.10.20	01.10.20
Research	Assoc. Prof., PhD. Volodymyr Iasnii	01.10.20	01.10.20
Organization & Technology	Assoc. Prof., PhD. Volodymyr Iasnii	01.10.20	01.10.20
Labor protection	Assoc. Prof., Dr. Kaspruk V.B.	01.10.20	01.10.20
Normative control	Assoc. Prof., Dr. Chornomaz N.Y.	01.10.20	01.10.20

7. Date the assignment was given October 01, 2020

PROJECT TIME SCHEDULE

LN	Diploma project (thesis) stages	Project (thesis) stages deadlines	Notes
1	Input data analysis	15.10.20	
2	Constructive-architectural	20.10.20	
3	Structural design	30.10.20	
4	Research	15.11.20	
5	Organization & Technology	30.11.20	
6	Labor protection	05.12.20	
7	General conclusions	15.12.20	

Student ____________ E. I Alao
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Project (thesis) supervisor ____________ V. Iasnii
(signature) (surname and initials)

TABLE OF CONTENT

INTRODUCTION

What is a High-rise Residential building?

High-rise residential building is a type of housing that has multi-dwelling units built on the same land. A skyscraper is a tall high residential building of more than 7-10 floors or it is also a structure that has 18meters or more.

A high-rise building is described differently as a building in which:

- The number of floors occupants need to use a lift to get to their destination
- The height is above the reach of available fire-fighting equipment.
- The height can be a problem when evacuating.

In January 2020, following a fire outbreak in the student hostel where the building was under 18m in Bolton 2019, government had to lunch a proposal to reduce the height of height of high rise residential buildings to 11m.

High- rise residential buildings are described as tall buildings occupants are nopt willing to walk up and it requires lift for easy transportation. This includes a rather limited range of building uses, primarily residential apartments, hotels, and office buildings, though occasionally including retail and educational facilities. In addition, a type that has appeared recently is the mixed-use building, which contains varying amounts of residential, office, hotel, or commercial space. High-rise buildings are part of the largest buildings built, and their unit costs are expensive; their commercial and office functions require a high degree of flexibility.

High-rise buildings are more popular and convenient to move because of the invention of elevators or lift and also the availability of materials. Concrete and steel are the main materials used for the structural system of a high-rise residential building.

1. ARCHITECTURAL AND CONSTRUCTIVE PART

1. Initial information.

Region of development - Ternopol district.

In finish of the designing geographical conditions, at the base of the establishments there are three soil surface to be specific: medium sand, exceptionally fine sand and topsoil sandy.

Climatic state of the development region: Ternopil

Climatical conditions of area of district:

- District of snow. - 7°C will be the coldest month. The determined temperature of the inward air: $t_в$ = 20 °C.
- Wind Region – 6km/h
- surface type - B.
- Seismic of the site-6.
- Relative air stickiness: 100%.

The normal temperatures in the rooms:

- Offices - 21 °C.
- Kitchen - 20 °C.
- The bathroom and the restroom is 22 °C.
- The Verandas/hallway is 18 °C.

The standard estimation of the breeze pressure is 0.29 kPa

The regularizing estimation of the snow cover is 100 kg/m 2

Toughness: Degree II

Building: Class II

Imperviousness to fire: Degree II

Profundity of soil freezing: 1.35 m

Alleviation is quiet.

1.2 PLAN OF BUILDING

Building region - 561,600 square meters.

The all-inclusive strategy for a class II private structure is made in accordance with the prerequisites of SNiP 2.07.01-89 "City arranging. Arranging and advancement of metropolitan and provincial settlements ", a plan task and other introductory information. The building site is mannered by a backwoods fix on the two sides.

The arrangement of the structure gives: access to the structure from the current streets, flight of stairs, a pool, a vehicle leave, a trash house, Laundry zone, sport field and kids leave. The part of the overall arrangement is proposed to be boarded by an open green field
Inclusion of the entry to the carport and stopping – has a warming framework to forestall snow hills in the colder time of year season.
Covering flights of stairs – cobblestone
The scene permits course of action for blossom beds and yards in diversion territories and liberated from any structures and passerby ways. On the site as per the structure plan, there should be bushes and trees planted, encasing diversion zones. On the left half of the structure, the clothing zone, sport field and kids park is found. To make a limit between the outer piece of the house a developing bush is planted to fill in as a fence

All the details in the drawing follow natural fire wellbeing standard necessities in the domain of Ukraine for the security of human existence and wellbeing.
Likewise, the authoritative structure will be worked with various kinds of materials from rooftop to establishment. Likewise, in the establishment squares and segments are utilized to guarantee the strength of the structure.
Blocks will be utilized for the development of the dividers and all floors will be strengthened solid sections

1.3 Space-arranging arrangement.

The standard of utilitarian drafting of premises with position is the premise of arranging of the development. The fundamental passageway of the structure is a flight of stairs. The main floor comprise of a room, parlor, kitchen, latrine and restroom, storeroom, overhang. All floors are associated by a flight of stairs that begins from the front.
The stature of each floor is 3000 mm.

1.4 Building zone.

The structure zone is 561,600 square meters.

1.5 Finishing of inside and outside.

Because of the warm conductivity of permeable fired, its applying gives a long degree of change of the high temperature esteem from the outer piece of the structure to the inward part, and with a noticeable relaxing. Besides, since isolation of the cells at the appropriate time structure an entire arrangement of quieted chambers, sound assimilation is impressively higher than that of other divider materials. Withstanding exceptional warmth and sound retention characteristics, permeable earthenware production have worthy mechanical and

warmth strength.
Outside wall thickness is 510mm and 380mm , interior wall- 250mm and the two are made of brick.
Rooftop: rafters, covered sheets of zinc metal tiles.
Inside the flight of stairs – concrete covered with mable
Windows-stained glass
Stairways Glazed wood

1.6 Constructive arrangement.

The sort of establishment utilized for the structure is the Pile establishment intended for level help, with a base of sediment sand.Waterproofing at the vertical imprint hot bitumen covering twice.
Outside and inside wall workmanship is comprised of bricks.
steps on the ground floor are comprised of Monolithic steel strengthened solid sections singular r/c advances.
The structure of the rooftop is Truss. In the loft the lift control framework is introduced. The roofing material is aluminum steel. An outer channel is situated on the rooftop.
Profile metal casing makes up the segment and it is covered on the two sides with sheets of plasterboard in one layer. The electrical fittings and wiring are mounted to a fix fixed hardware inside the casing of the divider.

1.7 Fire avoidance measures.

The improvement of the structure is done in consistence with the overall design of Ternopol. The rafters and slats made of wood in the structure are covered with fire security (paints, impregnations, arrangements, and so forth) Outside flight of stairs and fire stepping stool are given to departure of the individuals. Electrical Safety Standards prerequisite were met in planning of the Electrical gear and lightning insurance.

1.8 Engineering gear of the structure.

The water supply framework is created by the nearby water participation of Ternopil. Every condo has an individual warming and wiring framework and fundamental control is situated along the edge of the structure.

The warmth wellspring of the high temp water supply and warming frameworks is individual for every unit, a warming gadget called WESTEN pulsar D

Copper is utilized for all pipeline. It is utilized to it's low temperature (<100).

Each room temperature is managed by the radiators introduced in each rooms and can be constrained by the directing framework in every organizer and furthermore indoor regulators introduced in the parlor.

The framework permits a programmed control framework giving an opportunity to rapidly direct.

The tree-like plan is done in the wiring framework. Pipelines are laid in even areas in the floor of development. In the development dividers, Vertical and inclining areas are laid.

Suggested establishment arrangement:

- Heated floors are set up in each rooms (The resilience is close to ± 5mm in the completing tirade).
- Niches for conveyance cupboards, fines and openings in divider and roof structures are readied.
- Distributive gatherers are collected
- Distribution cupboards and laying of focal parkways are introduced.
- Remote warming controlled floor are introduced
- Heating surfaces are associated and introduced. Filing the warming planes tirades and closing down the framework (cold and pressurized curls)

Necessities for detail:

Arched upward are the flat segments of pipelines twists. The flat areas of the curl association of the warming surface of the floor should be situated at the degree of the loops themselves. Additionally, the loop should be produced using one line cut with no explanations.

The warming plane shape should bend the stick out sewer pipes, connected to the dark floor of the sterile hardware uphold. The far off bottle sensors have a narrow cylinder which should be secluded from heat sources (pipeline, warming planes, and so forth) Where the divider and the roof pipelines converge should be ensured by a creased plastic line.

The pipeline areas put in virus floors for example ground floor. Floors above non-warmed rooms. There should be legitimate protection when going through a non-warmed space to evade extreme warmth misfortune.

The focal lines interfacing the evaporator with the dissemination cupboards is essential to be protected as well.

There should be appropriate dissemination, dispersion from lower floor should be situated over the degree of the course siphon. The contrary slant of pipelines in the kettle wholesaler segment is invalid.

Self-flowing is the sort of the sewage framework and its privately intended for a ton of neighbors. Sewage comes from the family latrines and its cleaned organically.

In the channel situated past the site of the overall arrangement. Water waste the line is made by standard with a breadth of 50-200 mm are thought of.

The Ventilation of the condos are considered in the arranging and drawing of the structure and it is normal

Power Supply – The force is created from an outer source, is associated from an underground electric link situated at a profundity of 2 m to 4 m. The voltage of 380/220 V is provided to the electric boards.

Lighting – It relies upon the flavor of inhabitants

Web and satellite organizations are introduced on the top of the structure for good correspondence and network. Security cameras by the passageway and lift of the structure is introduced

The waste of water is through the normal slant from the rooftop to the ground level toward the sewer gatherer.

1.9 Utilitarian process of a building

A helpful climate is imperative to the planning of homes that serves its practical, physiological and tasteful necessities of the tenants. One of the fundamental necessecity of a structure to have great security, warmth and sanctuary and light to individuals. These requires were in a general sense met by a cavern with a fire. In right now, after the fundamental necessities are provided. The new interest will be a modern and agreeable interior climate with a ton of offices.

A few elements should be considered attempting to "give and keep" a helpful climate for inhabitants, for example, an agreeable work, living and recreation climate for individuals and agood climate for hardware and gear which needs the correct conditions to work. Moreover, comfort is an exceptionally emotional and contrasts starting with one individual then onto the next on the grounds that individuals have diverse solace stages. The errands of creators should be to make as a lot number of occupiers agreeable and maintain a strategic distance from distress. Solace factors are identified with our hearing, contact, vision, smell and faculties.

A structure should give and keep a decent visual and aural climate and a surrounding temperature additionally dodging sound contamination or smell, proficient and magnificent lighting, outside air, warmth or moderate temperature. Plan standards should comprise of every one of these necessities. Anyway the selection of materials relies upon a few issues, for example, area, atmosphere, time of occupiers, level of action of occupiers, cost and space and so forth;

a) VISUAL COMFORT – To have the option to see adequate in structures is a fundamental requirement for inhabitants to accomplish their work securely and continently or live easily in a helpful climate. There should be acceptable lighting given which is neither splendid, nor dull. Glare will be caused if there is a splendid wellspring of light and will give individuals visual uneasiness and might cause visual confusion. Originators should ensure nature of light and amount of light is placed into represent better lighting. Additionally, components with respect to amount comprise of the measure of light and dispersion of light separating, design and luminaire type. Components includes contrast, shading, glare. In extra factors which impact visual solace are veiling reflections and features, shadows and sparkle. Glare can be brought about by extreme light or reflection. A decent planned lighting ought to dispense with astonishing light. Brilliant light inside the field of view like a splendid light or a sunlit window can give in flare either as an immediate source or by reflection, for example, flare on PC.

b) VENTILATION AND AIR QUALITY – Ventilation in Building Regulations is the stock and expulsion of air by various methods either regular or mechanical, inside a structure" Additionally ventilation is utilized for accomplish sufficient air quality and expulsion of water fume from wet territories, for example, latrines and kitchen in building. Air quality is judged chiefly by smell, dusts or contamination are aggravation to eyes, nose or throat.

c) ACOUSTICS COMFORT (AURAL COMFORT) – Noise contamination can be basically characterized as undesirable sound. The vital significance of acoustic solace is a productively very climate which causes tenants to satisfy their day by day schedule in a favorable climate without interruption of commotion or vibration. "Sound is a vibration or weight wave that travels through a medium, for example, air. It is additionally a structure at a recurrence and power that can be identified by the human ear. The undesirable sound which comes from an outside source may enter a structure through the unclosed windows and also through holes and breaks in the structure and may experience the ventilation work and roof voids. Airborne sound can be diminished by protecting the commotion transmission courses. A solitary leaf block divider will give preferred sound protection over a solitary leaf lightweight segment divider. Then again twofold leaf segment divider can give improved sound protection gave the two leaves are protected as needs be.

d) CONDENSATION – Condensation is a significant issue in structures despite all the progression happening in the soggy sealing industry. Buildup happens when air conveying dampness interacts with colder surface. Buildup can be seen on a repellant surface, for example, tiles, mirror or windows. Now and again it can happen on other plane yet not saw until form begins developing or materials begin decaying.

The dampness of air happens because of different sources inside the properties, for example, breathing, cooking, clothing and drying, warming and so on The aftereffects of dampness produced become exceptionally terrible when it is kept in the properties. The least complex and essential approach to maintain a strategic distance from buildup is giving appropriate ventilation particularly in wet territories in the house, for example, restrooms and kitchens, where an incredible amount of dampness is acquired. Buildup regularly happens in properties with one coated windows. In spite of the fact that it is unimaginable to expect to stay away from buildup, having auxiliary coated windows with satisfactory ventilation reduce the measure of buildup made inside the property.

Moreover, without satisfactory ventilation buildup consistently mess up wet regions. Properties that we deal with frequently experience the ill effects of terrible buildup which is because of the inhabitants not arrangement that washroom, shower and kitchens needs sufficient ventilation to scatter the mugginess brought about by their capacity. To forestall drafts we regularly discover the vents have been covered over and windows not left open. The airborne water clutch tile joints and creates sodden spores, painted dividers additionally have same difficulties. Regularly vent blocks introduced in properties at low level to ventilate ground floor lumbers become hindered and the dissemination of air is diminished and this causes wet decay going to dry decay. I have no buildup issue at my home due to having great auxiliary coating, ventilation, warming and protection.

e) THERMAL COMFORT: Thermal solace is hard to characterize because of the quantity of individual and ecological elements which should be placed into thought during the plan stage. Since warm solace is identified with brain science of tenants and solace levels are customized, it is difficult to satisfy everybody except the point should be to make the most number of inhabitants thermally agreeable in a climate. Essentially warm solace is when inhabitants are content with the climate they possess in the structures. In structures the fundamental inside natural components incorporate temperature, air quality, moistness and air development, which rely upon the plan of the structure and the motivation behind the structure benefits, the utilization of the space and the outer climate conditions. To be agreeable a harmony between heat misfortune and gain should be placed into account, for example on the off chance that the encompassing temperature is at greatest, the body is excessively high (hot) and awkward. On the other hand if the encompassing temperature is too chilly, the body gets cold and not favorable. Hence balance of temperature is significant for warm solace

2 STRUCTURAL DESIGN

2.1 CALCULATION OF LOADING FOR EXTERNAL WALL

Distance of loading area of external wall loading area is equal to = 2,96 $\times$3,32 = 9,83m^2

Distance in between windows and doors = 2,96m

Half of distance between walls = 3320mm

1. Roof = 4,2KN/m^2 $\times$ 9.83 = 41,29 KN
2. Partition wall = 11 $\times$ 1 $\times$ 9,83 = 108.13KN
3. Loading for all wall= 18 $\times$ 0,51 $\times$ {33689+ 0.3} $\times$ 2,96- 11$\times${0.8+0,8}$\times$ 1,6 =665kN
4. Slab= 11$\times$ 3,6 $\times$ 9,83 =389,27KN

TOTAL PERMANENT LOADING = 41,29+ 389,27+ 108,13+ 665 =1203,69KN

Temporary snow load (1KN/m)

1 $\times$9,83= 9,83KN

5. On slab (all)

ψn1 = this coefficient means all the floors can be full loaded during same time

$$\psi n1 = 0,3 + \frac{0,6}{\sqrt{n}}$$

$$= 0,3 + \frac{0,6}{\sqrt{11}} = 0,48$$

11 $\times$ 9,83 $\times$ 0.48 $\times$1,5 =77,85KN

TOTAL = 9,83 + 77,85 = 87,68 KN

2.2 CALCULATION OF LOADING FOR INTERNAL WALL

For internal loading half of room =3320 + 1070

=4390 $\times$ 1m^2

=4,39m^2

1. Roof = 4,2 $\times$4,39 = 18,44KN
2. On last slab = 0,75 $\times$4,39= 3.3KN
3. Slab= 11 $\times$ 3,6 $\times$4,39 = 173,84 KN
4. Partition wall = 11 $\times$1 $\times$ 4,39 = **48,29**KN

TOTAL =18,44 + 173,84 +48,29 +3.3

=243,87KN

TEMPORARY

5. 1 $\times$ 4,39= 4,39KN
6. 11 $\times$ 4,39 $\times$ 1 $\times$ 0,48 $\times$ 1,5 =34,8KN

TOTAL = 4,39 + 34,8

= 39,19KN

PERMANENT AND TEMPORARY LOADING

FROM 1M OF EXTERNAL WALL AND INTERNAL WALL

NP.ext = $\dfrac{total\ permanent\ loadinmg}{distance\ between\ 2windows} \times 1$

=$\dfrac{1203.69KN}{2.96} \times 1 = 406.7KN$

NT.ext= $\dfrac{39.19}{2.96} \times 1 = 13.2KN$

NP.int =$\dfrac{243.87}{1} \times 1 = 243.87KN$

NT.int=$\dfrac{39.19}{1} \times 1 = 39.19KN$

2.3 CALCULATION OF DEPTH OF FOUNDATION

1) Determine depth of foundation by climate condition

Dfn =do$\sqrt{Mt}$

Where, do special depth depending on type of soil

do for silt belongs to clay (do=0.23)

Mt sum of absolute values of negative temperature , (JANUARY -5℃, February

-3℃, December -3℃).

$Mt= -5+ (-3) + (-5)$
$= -11$℃

$dfn= 0.23\sqrt{11}$
$=0.76$

$d1=kh.dfn +0.2$

where kh coefficient that depends from the temperature in the room, connected to to the ground (kh=0.5)

$d1=0.5(0.76)+0.2$
$=0.58m$

2) By geological conditions : by geological condition we have our foundation deeper at least 40cm that first weak layer

d2= first layer+ deeper
=1.6+0.4
=2.0m

3)By construction conditions

d3= hbl +hpl +hm

where hbl Is height of block
hpl is height of foundation plate
hm is height of block above ground or surface level

hpl= 30cm 0r 50 cm, hm =0.5
hbl= n(0.6)

n is mount of block and

0.6 standard height of block(0.58) and concrete connection (0.02)

we have to fimd amount of blocks knowing that d3 should be bigger than d1 and d2 with less amounts of blocks

d3= (4(0.6)) + 0.5-0.5
=2.4m

2.4 DETERMINATION OF WIDTH OF FOUNDATION

To calculate the width of foundation use next formula.

$$b=\frac{N}{\mathscr{R} - \delta_0 d}$$

where N is loading received from the wall on foundation (temporary + permanent loading).

$\mathscr{R}_0$ is calculated resistance (taken from second layer).
δ_0 its average unit weight of soil that is above foundation.
d is depth of foundation.

FOR EXTERNAL

Given
External permanent loading(Npex)= 406.7KN
External temporary loading (Ntex)= 13.2KN
$\mathscr{R}_0 = 150$KPa
d= 2.4m

$$\delta_0 = \frac{\delta_1 h_1 + \delta_2 h_2'}{h_1 + h_2'}$$

$\delta_1 = 18KN/m^3, h_1 = 1.6m$, $\delta_2 = 17.5KN/m^3$, $h_2^{'}$ = d-h_1

$h_2^{'}$ =d-h_1

= 2.4-1.6

=0.8m

$$\delta_0 = \frac{(18 \times 1.6) + (17.5 + 0.8)}{1.6 + 0.8}$$

δ_0 =17.8KN/m^3

N= 406.7 + 13.2

= 420KN

$$b = \frac{420}{150 - (17.8 \times 2.4)}$$

b=3.9m

FOUNDATION PLATE 20.12-2

2.5 DETERMINING ACTUAL RESISTANCE OF THE SOIL ON THE BOTTOM OF FOUNDATION LEVEL

$$\mathscr{R} = \frac{\gamma_{C1}.\gamma_{C2}}{K}\left\{M_{\gamma}.K_Z.b.\ \delta + M_q d_1.\delta' + \left(M_q - 1\right)d_b\delta' + M_C C_n\right\}$$

Where

$\gamma_{C1}.\gamma_{C2}$this are coefficient that depends on the type of soil and shape of building

k Is coefficient of reality that's is equal too 1 if you received all strength values using field experience or k=1.1 if you receive value from tables

d_b is depth of your basement from surface level to basement floor.(in case if you don't have basement it will be zero)

M_γ , M_q, M_C they are coefficients taken from the table that depends on internal friction angle .

d_1 its (in the case we don't have basement its equal to the depth of foundation otherwise d_1= hs+hcf.$\frac{\gamma cf}{\delta'}$

C_n= cohension

hcf thickness of basement floor
hs thickness of soil between basement floor and bottom of foundation

$\delta' = \delta_0$ unit weight of soil above foundation (average value)

$\delta'\ if$ unit weight of material of basement floor in case if you use concrete floor is 20 KN/m^3

K_Z coefficient which is equal to 1 if your b is less than 10 m otherwise

K_Zb= $\frac{8}{b}$ + 0.2

δ unit weight of soil below foundation plates (average values) counting underground water

b= from foundation plate 20.12-2, therefore width is 2m

$\gamma_{C1.}$= 1.3 ,

γ_{C2}=$\frac{L}{H}$

where L length of building =34.871m
H height of building =33.989m

$\gamma_{C2}=\frac{34.871}{33.989}$

$=1.03$

from table $\gamma_{C2}=1,3$

$M_{\gamma} = 0.08$

$M_{q}=1.32$

$M_{C}=3.61$

$K_{Z}= 1$

$d_{b} =0$

$d_{1}=2.4m$

$\delta' = \delta_{0}=17.8 KN/m^{3}$

$C_{n}= 25$

$$\delta = \frac{\delta_2 h_2^{''} + \delta_{2sat} h_2^{'''}}{h_2^{''} + h_2^{'''}}$$

$\delta_{2}=17.5 KN/m^{3}$

$h_2^{''}=2.9m$

$h_2^{'''}=1.9m$

$\delta_{2sat}=9.22 KN/m^{3}$

$$\delta = \frac{(17.5 \times 2.9) + (9.22 \times 1.9)}{2.9 + 1.9}$$

δ= 14.22KN/m^3

$$\mathcal{R} = \frac{\gamma_{C1}.\gamma_{C2}}{K}\left\{M_\gamma . K_Z . b . \ \delta + \ M_q d_1 . \delta' + \left(\ M_q - 1\right) d_b \delta' + M_C C_n\right\}$$

$$\mathcal{R} = \frac{(1.3 \times 1.3)}{1}\{0.08 \times 1 \times 2 \times 14.2 + \ 1.32 \times 2.4 \times 17.8 + (\ 1.32 - 1)0 \times$$

=251.7KPa

We are checking actual pressure under foundation plate

$$P = \frac{N}{b . 1}$$

P$\leq \mathcal{R}$

P should be less than the actual resistance ($\mathcal{R}$)

N_T= Summation of all loadings

N_T= N + Gf +Gs

where N=(Npex +Ntex)

Gf= loading from foundation

Gs= loading from soil on top of foundation

Total volume of foundation and soil on top of it (v_0) equal

$$v_0 = \ b \times d \times 1 + hm \times hpl \times 1$$

=2$\times$ 2.4 $\times$ 1 + 0.5 $\times$ 0.5 $\times$ 1

= 5.05m^3

FOUNDATION BLOCK 24-5-6

Volume of foundation Vf= n.$\frac{Vb}{Lb}$ $.1 + \frac{Vpl}{Lpl}$ $.1$

n= 4

Vf= $4 \times \frac{0.679}{2.4}$ .1 + $\frac{0.78}{1.2}$ $.1$

= 1.78m^3

Vs=v_0 - v_f

Vs= 5.05-1.78
=3.27m^3

Loading from soil Gs=Vs$\times$ δ'

Gs=3.27$\times$17.8
=58.21KN

Loading from foundation Gf= n$\times$ $\frac{M_b . g}{L_b}$ .1 + $\frac{M_{pl} .\ g}{L_{pl}}$ .1

= 4$\times$ $\frac{1.63 \times 9.8}{2.4}$ $.1$ + $\frac{1.95 \times 9.8}{1.2}$ $.1$

=42.5KN

from N_T= N + Gf +Gs

N_T= 420+42.5+3.27

=465.77KN

therefore P= $\frac{N}{b\,.\,1}$

where N_T = 465.77KN

b =2m

P= $\frac{465.5}{2 \times 1}$

P=232.89

From

P $\leq \mathscr{R}$

The condition is satisfied and this plate can be used

CHECKING UNNESSARY RESISTANCE

$$= \frac{\mathscr{R} - P}{\mathscr{R}} \times 100$$

$$= \frac{251.7 - 232.89}{251.7} \times 100$$

=7.47%

It shouldn't be more than 10%if more we have to take smaller plate

Thus, its 7.47% is less than 10%so the condition is satisfied so the plate is perfect for it.

SOIL PROPERTIES TABLE (Table 2.1)

№ of soil	Name of soil	Layer thickness, m	Unit weight, kN/m^3	Unit weight of solid particles, kN/m^3	Unit weight of dry soil, kN/m^3	Unit weight of saturated soil, kN/m^3	Moisture, %	Moisture on plastic limit, %	Moisture on liquid limit, %	Plasticity index	Liquidity index	Void ratio	Degree of saturation	Cohesion, kPa	Internal friction angle, degrees	Deformation modulus, MPa	Calculated resistance, kPa
		t	□	□$_s$	□$_d$	□$_{sat}$	w	w_P	w_L	I_P	I_L	e	S_r	c_n	ϕ	E	R_0
1	SILT	1.6	18		15.93		0.13										
2	VERY FINE SAND	5.6	17.5	26.5	14.83	9.22	0.18					0.79	0.60	25	3	11	150
3	REDEPLOYED BROWN LOAM	4.8	19.2	26.7	16.13	10.12	0.19	0.15	0.34	0.19	0.21	0.65	0.78	31	24	22	248.85
4	TERTIARY CLAY	6.2	20.1	26.5	17.03	10.58	0.18	0.15	0.44	0.29	0.10	0.56	0.85	79.7	20.9	27.6	520
5																	

2.6 CALCULATION OF DEFORMATION OF SOIL BENEATH FOUNDATION

Determine amount of compression of strip foundation of its width 2.0m depth 2.4m average pressure 232.89KPa

Calculations

(1) We have to make calculation for smaller layers to accurately determine deformation of soil

hi= 0.4$\times$ b

=0.4$\times$ 2

=0.8m

2 Determine pressure from own weight of soil in specific points

(a)First specific point $\sigma_{zg}= \delta_1 h_1$

=18(1.6)

=28.8kPa

(b)Second specific point is bottom of foundation

$\sigma_{zg0}= \sigma_{zg} + \delta_2 h_2^{\prime}$

= 28.8 + 17.5(0.8)

= 42.8KPa

3) On water level $\sigma_{zg4} = \sigma_{zg0} + \delta_2 h_2^{\prime\prime}$

=42.8 +17.5(2.9)

=93.55KPa

4) on bottom of second layer $\sigma_{zg7}= \sigma_{zg4} + \delta_{2sat} h_2^{\prime\prime\prime\prime}$ = 93.55+ 9.22 (1.9)=111.068KPa

5) on top of third layer (with calculation of pressure from water because third layer is water resistance layer

IL <O.25 water resistance

Hence 0.21<0,25

$\sigma_{zg7}= \sigma_{zg7} + h_w \delta_w$

= 111.068+ 1.9(10)

=130.1KPa

6) Bottom of third layer

$\sigma_{zg13}= \sigma_{zg7}+ \delta_3 h_3$

=130.1+ 4.8(19.2) = 222.3KPa

Table 2.2

No of points	Depth of point from bottom of foundation z(m)	Relative depth $\varepsilon = 2.$	Coefficient α	Pressure from own weight of soil $\sigma_{zg}(KPa)$	Additional depth $\sigma_{zp} = \alpha P_O$ (KPa)
0	O.0	0.0	1	42.80	190.09
1	0.8	0.8	0.881		167.50
2	1.6	1.6	0.642		122.00
3	2.4	2.4	0.477		90.70
4	2.9	2.9	O.409	93.55	77.70
5	3.2	3.2	0.374		71.09
6	4.0	4.0	0.306		58.20
7	4.8	4.8	0.258	130.10	49.00
8	6.4	6.4	0.223		42.40
9	7.2	7.2	0.196		37.30
10	8.0	8.0	0.175	176.22	33.30

DETERMINATION OF ADDITIONAL PRESSURE

P_O= P - σ_{zg0}

=232.89 – 42.8

= 190.09KPa

CALCULATION FOR COEFFICEINT NOT USING TABLE

$$y = \frac{x - x_1}{x_2 - x_1}(y_2 - y_1) + y_1$$

$$x = \frac{2.9 - 2.8}{3.2 - 2.8}(0.374 - 0.420) + 0.420 = 0.409$$

Table 2.3

No of layers	ADDITIONAL PRESSURE σ_{zp}			DEFORMATION MODULE E, KPa	THICKNESS OF LAYER hi, cm	DEFORMATION OF LAYERS Si, cm
	ON TOP OF LAYER $\sigma_{zp,top}$	ON BOTTOM OF LAYER $\sigma_{zp,bot}$	Average $\sigma_{zp,av}$			
1	190.09	167.50	178.80	11000	80	1.04
2	167.50	122.00	144.80	11000	80	0.84
3	122.00	90.70	106.4	11000	80	0.62
4	90.70	77.70	84.20	11000	50	0.31
5	77.70	71.09	74.40	11000	30	0.16
6	71.09	58.20	64.60	11000	80	0.38
7	58.20	49.00	53.60	11000	80	0.31
8	49.00	42.40	45.70	22000	80	0.13
9	42.40	37.30	39.90	22000	80	0.12
10	37.30	33.30	35.30	22000	80	0.10
						S=4.01

FORMULARS

$$Si = (\beta \,.\, \sigma\_(zp, av) \quad \times hi)/E,$$

$$\sigma_{zp,av=}\frac{\sigma_{zp,top} + \ \sigma_{zp,bot}}{2}$$

CONCLUSION

We have to add all deformation for small layers and compare these numbers with maximum allowable S<Su

(Su maximum allowable)

for residential building is 12cm

S=4.01cm

Therefore, the condition is satisfied.

DETERMINATION OF WIDTH OF FOUNDATION

To determine width of foundation approximately base of foundation can be found using next formula.

$$b=\frac{N}{\mathscr{R} - \delta_0 d}$$

FOR INTERNAL

Internal permanent loading (N_{inp})= 243.87KN

Internal termprary loading (N_{int})= 39.19KN

N =$(N_{inp}) + (N_{int})$

=243.87+ 39.19

=283.06KN

d=(n(0.6)) + $(hm - hpl$))

= 4(0.6) + 0.3- 0.5

= 2.2m

δ_0 =17.8KN/m^3, $\mathscr{R}_0$ $=$ 150KPa, d=2.2m

$$b = \frac{283.06}{150 - (17.8)2.2}$$

=2.55m

FOUNDATION PLATE 16-12-4

2.7 DETERMINING ACTUAL RESISTANCE OF THE SOIL ON THE BOTTOM OF FOUNDATION LEVEL

$$\mathscr{R} = \frac{\gamma_{C1}.\gamma_{C2}}{K}\left\{M_{\gamma}.K_Z.b.\ \delta + M_q d_1.\delta' + \left(M_q - 1\right)d_b\delta' + M_C C_n\right\}$$

$\mathscr{R} = \frac{(1.3 \times 1.3)}{1} \{ 0.08 \times 1 \times 1.6 \times 14.2 + 1.32 \times 2.2 \times 17.8 + (1.32 - 1)0 \times$

=243KPa

We are checking actual pressure under foundation plate

P=$\frac{N}{b \cdot 1}$

P$\leq \mathscr{R}$

P should be less than the actual resistance ($\mathscr{R}$)

N_T= Summation of all loadings

N_T= N + Gf +Gs

where N=(Npex +Ntex)

Gf= loading from foundation

Gs= loading from soil on top of foundation

Total volume of foundation and soil on top of it (v_0) equal

$v_0 =$ b$\times d \times 1 + hm \times hpl \times 1$

=1.6$\times 2.2 \times 1 + 0.5 \times 0.5 \times 1$

= 3.77m^3

FOUNDATION BLOCK 24-5-6

Volume of foundation Vf= n.$\frac{Vb}{Lb} \cdot 1 + \frac{Vpl}{Lpl} \cdot 1$

n= 4

$$Vf= 4 \times \frac{0.679}{2.4} .1 + \frac{0.41}{1.2} . 1$$

$= 1.47 m^3$

Vs= $v_0 - v_f$

Vs= 3.77-1.47

=2.3m^3

Loading from soil Gs=Vs$\times \ \delta'$

Gs=2.3$\times$17.8

=40.94KN

Loading from foundation Gf= n$\times \frac{M_b . g}{L_b} .1 + \frac{M_{pl} . g}{L_{pl}} .1$

$$= 4 \times \frac{1.63 \times 9.8}{2.4} . 1 + \frac{1.03 \times 9.8}{1.2} . 1$$

=35.03KN

from N_T= N + Gf +Gs

N_T= 283.06+40.94+35.03

=359.03KN

therefore P=$\frac{N}{b . 1}$

where N_T =359.03KN

b =1.6m

$$P=\frac{359.03}{1.6\times 1}$$

P=224.4KPa

From
$P\leq \mathscr{R}$
The condition is satisfied and this plate can be used .

CHECKING UNNESSARY RESISTANCE

$$=\frac{\mathscr{R}-P}{\mathscr{R}}\times 100$$

$$=\frac{243-224.4}{243}\times 100$$

=7.7%
It shouldn't be more than 10%if more we have to take smaller plate
Thus, its 7.7% is less than 10%so the condition is satisfied so the plate is perfect for it.

2.7 CALCULATION OF DEFORMATION OF SOIL BENEATH FOUNDATION

Determine amount of compression of strip foundation of its width 1.6m depth 2.2m average pressure 224.4KPa

Calculations

(1) We have to make calculation for smaller layers to accurately determine deformation of soil

hi= 0.4$\times$ b

$=0.4\times 1.6$

$=0.64m$

2 Determine pressure from own weight of soil in specific points

(a)First specific point $\sigma_{zg}= \delta_1 h_1$

=18(1.6)

=28.8kPa

(b)Second specific point is bottom of foundation

$$\sigma_{zg0}= \sigma_{zg} + \delta_2 h_2^{\prime}$$

= 28.8 + 17.5(0.6)

=39.30KPa

3) On water level $\sigma_{zg5} = \sigma_{zg0} + \delta_2 h_2^{\prime\prime}$

=39.3 +17.5(3.1)

=93.55KPa

4) on bottom of second layer $\sigma_{zg9}= \sigma_{zg5}+ \delta_{2sat} h_2^{\prime\prime\prime\prime}$

= 93.55+ 9.22(1.9)

=111.068KPa

5) on top of third layer (with calculation of pressure from water because third layer is water resistance layer

IL <O.25 water resistance

Hence 0.21<0,25

$$\sigma_{zg9'}= \sigma_{zg9} +h_w \delta_w$$

= 111.068+ 1.9(10)

=130.1KPa

6) Bottom of third layer

$$\sigma_{zg18}= \sigma_{zg9'}+ \delta_3 h_3$$

=130.1+ 4.8(19.2)

=222.26KPa

DETERMINATION OF ADDITIONAL PRESSURE

P_O= P - σ_{zg0}

=224.4– 39.3

= 185.10KPa

Table 2.4

No of points	Depth of point from bottom of foundation z(m)	Relative depth $\varepsilon = 2.\frac{z}{b}$	Coefficient α	Pressure from own weight of soil $\sigma_{zg}(KPa)$	Additional depth $\sigma_{zp} = \alpha . P_O$ (KPa)
0	O.0	0.0	1	39.30	185.10
1	0.64	0.80	0.881		163.10
2	1.28	1.60	0.642		118.80
3	1.92	2.40	0.477		88.30
4	2.72	3.20	0.374		69.20
5	3.26	4.08	0.295	93.55	54.60
6	3.36	4.20	0.293		54.20
7	4.00	5.00	0.249		46.10
8	4.64	5.80	0.208		38.50
9	5.16	6.50	0.193	130.11	35.70
10	5.28	6.60	0.191	132.41	35.40
11	5.92	7.40	0.171	144.70	31.65
12	6,56	8.20	0.154	157.00	28.50

CALCULATION FOR COEFFICEINT NOT USING TABLE

y =$\frac{x - x_1}{x_2 - x_1}\left(y_2 - y_1\right) + y_1$

Table 2.5

	ADDITIONAL PRESSURE σ_{zp}			DEFORMATION MODULE E, KPa	THICKNESS OF LAYER hi, cm	DEFORMATION OF LAYERS Si, cm
	ON TOP OF LAYER $\sigma_{zp,t}$	ON BOTTOM OF LAYER $\sigma_{zp,bo}$	Average $\sigma_{zp,av}$			
1	185.10	163.1	174.10	11000	64	0.81
2	163.10	0	140.95	11000	64	0.65
3	118.80	118.8	103.55	11000	64	0,48
4	88.30	0	78.75	11000	64	0.37
5	69.20	88.30	61.90	11000	54	0.24
6	54.60	69.20	54.40	11000	10	0.04
7	54.20	54.60	50.15	11000	64	0.23
8	46.10	54.20	42.30	11000	64	0.20
9	38.50	46.10	37.10	11000	52	0.15
10	35.70	38.50	35.55	22000	12	0.02
11	35.40	35.70	33.33	22000	64	0.08
12	31.65	35.40	30.08	22000	64	0.07
		31.65				
		28.50				S=3.34

FORMULARS

$$Si = (\beta \, . \, \sigma\_(zp, av) \ \times hi)/E,$$

$$\sigma_{zp,av} = \frac{\sigma_{zp,top} + \sigma_{zp,bot}}{2}$$

CONCLUSION

We have to add all deformation for small layers and compare these numbers with maximum allowable S<Su

(Su maximum allowable)

for residential building is 12cm

S=3.34cm

Therefore, the condition is satisfied.

2.8Building description

- Building length = 34,871 m
- Building stature =35m
- This structure is a class II (private structure). Buildings when more than of the living territory is utilized for private purposes. Different structures ought not be viewed

as private. Contrast between private structures:

low rise private structures: it has various kinds of houses (disconnected, semi-confined, terraced houses, houses worked in succession, etc.) and has its own passage straightforwardly starting from the earliest stage

other private structures: involving all private structures other than ground-arranged private structures as characterized previously. The structure includes 11floors. Area of the structure is in Ternopil Ukraine and the atmosphere states of Ukraine needs proficient specialists to develop structures, which can withstand certain climate conditions. There is no cellar in my structure.

- thickness of outside dividers =510mm, 380mm
- thickness of inward divider = 250mm
- Floor thickness = 300mm
- Height of floor = 3000mm

3. TECHNOLOGICAL PART

3.1 Development of a technological map for production of stone works

The innovative guide is utilized for the formation of stone works by a stream eviscerated strategy by block layers with great and standard hardware for automation, gear, devices and establishment of floor pieces over the main floor.

In the valuable piece of the recognition venture, block was utilized for dividers and strengthened cement for sections, rooftop and flight of stairs.

A tied rebar confine (steel bar) is built before the solid is poured.

Rebar likewise known as reinforcing steel or reinforcement steel, is a steel bar or the association of steel wires which fills in as a pressure gadget in fortified cement fortifies the strengthened stone work to improve the solid under strain. The advantage of concrete is that it is more grounded under tension anyway has a weak versatility. Steel bar serves to extends the unbending nature of the structure

3.2 Form work

Formwork is one of the most important in building construction because it is used to cast for a structure in which concrete is poured and its allowed to dry or harden subsequently

It consists of panels induced out of thin steel plates stiffened along the edges by small steel angles. Fitting clamps, bolt or nuts are used to put the panel units together. Any desire design, shape or size can be made with the panels. In large projects, steel form are used where there is large number of formwork is needed.

Figure 3.1

. Formwork structures are temporary and her made to economical expenditures. Stripping is the process of removing the formwork. Formwork that are stripped are reusable. Panel forms and form stripping are reusable formwork.

When there is necessary strength formworks are removed or taken off and next stage grouting.

Requirements for good form work are:

- Enough strength to withstand all forms of Loadings.
- The rigidity must be considered and have efficient braces to clamp or hold up horizontally or vertically to maintain its shape and size.
- Tight joint connection to avoid cement leakage.
- The formwork should be able to be removed subsequently without the damage of the concrete.
- Formwork materials should be available and cheap with good quality to be able to be reused.
- The formwork should be correctly lined up and level plane surface
- The formwork must be weightless.
- The quality of the materials should be good to avoid deformation when exposed to concrete.
- It must rest on strong surface.

3. 3 After formwork

Concrete is poured and mixed evenly ad placed in leads, 2 to 3 inches above the forms, that's where the top of concrete should mound before leveling. A vibrator should be used to combine and distribute the concrete evenly. Slightly above the form, the surface of the concrete must be relatively flat.

Reinforced concrete (RC)

It is concrete in which aluminum steel is implanted in such a manner that the two materials act together in withstanding forces. The reinforcing steel—rods, bars, or mesh—absorbs the tensile, shear, and sometimes the compactive stresses in a concrete structure.

For a durable, ductile and strong construction the reinforcement needs to have the following qualities in the very least:

- High toleration of tensile shear
- High relative force
- Outstanding bond to the concrete, regardless of moisture, pH and similar factors
- Thermal compatibility, not resulting in unwanted stresses (e.g. contraction or expansion)

in response to temperature difference.

- **3.4 Formwork construction.**

Either roundabout or stay set up formwork is required for this lodging. A formwork development is a colossal sound board (formwork board) or pre-assembled structure for pouring (burrow formwork) which permits to save the shape during setting time by evading solid blend from pouring

The types of formwork development in utilization are extraordinary:

Vertical, creeping, for adjusted components and horizontal.

Figure 3.2 Concrete formwork

Concrete mixture and grouting.

Solid combination can be made relying upon the solid development size quickly on the structure ground in the mixing bunch or on unique solid merchandise manufacturing plant. The moto blender is the place where the solid is placed for this situation.

Works with setting concrete

The concrete becomes densified after been filled in a framework. Air lock is remove din this important step, which can worsen the work of the mixture. Pervibrator or external vibrator helps in the densification of the concrete mixture. Surface smoothness of walls and ceiling is influenced by the quality of the desification of concrete mixture which can affect the budget of fine finish.

Benefits and Flaw

Monolithic houses have both good and bad.

Most of the houses are constructed according to a certain design as it is defined by its constructional quirk. Monolithic house has no limits. Building plans can be different in such houses, multi floors, with ceilings of varying height which is not ideal for block or brick houses.

The lack of open joints in a monolithic house gives a number of advantages which includes:

- house life-longevity
- lowered of construction weight
- sound adsorption level increase
- Increase in strength
- Cracking protection

3.5 Precast concrete

Precast slabs

Precast concrete is produced using projecting cement in a reusable structure, which is a fortified solid that is projected away from the structure site and afterward shipped to the building site, collected nearby and lifted into place.

Precast stone is separated from precast solid utilizing a good aggregate in the combination, so the last debut resembles that of a normally happening rock or stones. Extended polystyrene is being utilized as the base to precast divider boards as of late. This is slender and has great warmth protection.

There are different kinds of precast cement shaping frameworks for structural applications, varying in cost, size and use. Precast design boards likewise capacity to cover all or part of a building front or unattached dividers utilized for landscaping, soundproofing, and security dividers, and some can be precastconcrete building components.

Figure 3.3

3.6 Installation of inventory scaffolds and filling openings.

The workableness of the pivoted joints, fixing components, flooring is checked prior to introducing the pivoted board frameworks. The deck is cleaned of unfamiliar items. Simply after the expulsion of building materials situated on framework, the revamp is then done. It is important to introduce monitors when framework of stature 1,200 and 1,800mm is been introduced

In the kickoff of the outside of window and outer entryway blocks, close to the stone dividers, should be germicide, outfitted with move on waterproofing materials before establishment.

It is checked evenly and vertically by level and plumb line after the unit is been introduced in the opening. The ruffs are utilized to secure the squares to the divider to the wooden plugs lowered in the docks. Wall remembered for the standard set are introduced, transitory fencing of window openings is its motivation. Braces are utilized to connected the wall to the lower part of the window opening

3.7 Selection of installation methods and installation cranes.

In the creation of works, the establishment technique utilized is the different component by-component.

A free and restricted free establishment technique is utilized when introducing load-bearing structures. The establishment is completed either by methods for gadgets that give restricted limitation of the development of the structure from the activity of its own weight and outside burdens, or without such gadgets in this strategy. Instrumental change of the situation of the mounted components during the fitting is vital in this strategy

Figure 3.3. Fitting Crane

Portable cranes commonly run a blast from the finish of which a hook is hung by wire rope and sheaves. The wire ropes are worked by prime movers the fashioners have nearby which work through an assortment of transmissions.

It Doesn't Require a Lot of Space –Usually the building destinations are huge enough for the weighty gear that is being utilized to move without any problem.

Intense Enough to Handle Various Lifting Tasks –When contrasted with other crane types the versatile crane is thusly more modest, it is able and adequately amazing to lift substantial items like the pinnacle crane. With its numerous axles and progressed water driven force, the portable crane can at present lift weighty items and materials to incredible statures.

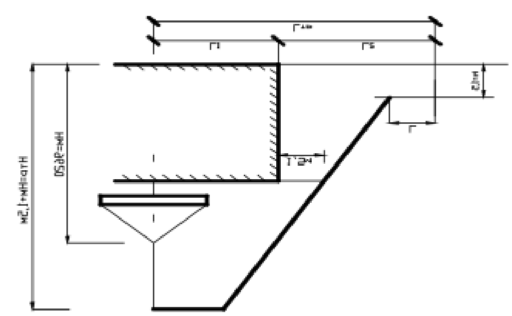


Figure 3.4

Determination of the required parameters of the boom crane

The following parameters must be provided:

Required crane lifting capacity:

$Q_к = m_э + m_{ос} + m_{гр} = 3,33+0+0,1=3,34$

Required hook radius:
$L_к$ = 9,25 м
Hook lifting height:
$H_к$=9,62 м, (Нм=hо+hз+hэ+hс=5,3+0,5+0,22+3,6=9,6м)
Length of boom:$L_{ст}$ = 11,1м
We choose cranes: КС-4561А and МКА-16

Table 3.1 - Technical specifications of cranes

Crane	Carrying capacity, t		Departure, m		Lifting height, m	
	The least	The greatest	The least	The greatest	The least	The greatest
KS-4561A boom 14m with a goose 5m	1	10,7	4,2	13	16	17,8
MKA-16 boom 23 m with a jib 2,3 m	0,3	4	7,5	20	18,8	26

3.8 Safety in the manufacture of stone-installation works.

Collapsed materials and introduced hardware should leave a section width of at any rate 60 cm during platform between dividers. Window and entryway openings of spread out dividers should be fenced with uncommon wall before the establishment of carpentry work and remembered for the standard set.

The laying of walls (borts) at the degree of cover, set from pre-assembled strengthened solid pieces, should be produced using the platforms of the fundamental floor. Pieces ought not be introduced without a formerly spread out blocks on two columns of block over the sections level to be laid. From the site for the installer the primary section should be introduced, which is remembered for the standard set.

Before they are taken care of to the floors the cushioning of the voids of the chunks should be done. Subsequent to laying two lines the external joints of the brickwork should be cut from the roof or frameworks. During this activity, laborers are not permitted to be on the divider.

When setting dividers from inward platforms, it is mandatory to orchestrate outside defensive stock admittance to the whole perimeter of the structure as a deck on sections held tight steel snares that are lowered in the brick work as it is raised close to 3 m separated from one another.

When setting dividers from the inner framework should be organized shades the size of the arrangement in any event 2x2 over the doors.

To leave apparatuses and materials on the dividers during a rest in the laying is disallowed. It is taboo to perform establishment works with a breeze of in excess of 6 focuses. The accompanying commitments should be met in the assembling of establishment work:

Unapproved personals are not permitted on the site while establishment work is being done on the site.

During development preforming business related in discovering individuals when moving and establishment is going on isn't permitted. When developing single segment structures, the establishment work is executed at similar span on various floors is thought of if there are reliable moderate floors among them and there should be a sure request composed from the main specialist in the wake of guaranteeing the protected lead of work and the individual responsible for the for the protected assembling of establishment and to move merchandise by crane and guaranteeing the presentation of the crane administrator and adhering to the modern guidelines for work insurance.

The strategies for throwing the primary components and gear should guarantee their inventory to the establishment site in a position near the plan one. Lifting of prefabricated reinforced concrete structures is not allowed when it doesn’t have loops or marks, which helps in slinging and assembling.

Ensuring the structural element is clean from dirt or ice before lifting. Mounted element structure during movement should not be allowed to swing or rotate by flexible braces. People are not allowed to stay under the element during movement or ascending.

Element are not allowed to be left when raised during break period. Inventory ladders, and bridges are being used when there is transition of installers from one design to another.

Performing installation working during bad weather is not allowed. People are not allowed to be under mounted structures and equipment fitting them in the designed position. When in an explosive environment there must be tools and equipment in place to avoid spark. During installation there is no rum for error or mistake.

Installation work requirements should be met when dismantling. There must be a permission from the foreman after concrete has reached its strength before dismantling because it promote safe surfaces, corners and edges.

A professional welder who has the certificate is need to carry out the electric arc.

For electric work the must be electrician on duty for it

Temporary electric wires should be isolated and kept above 2.5m above work place. Closed type closure is needed to turn transformer on. There should be 15m between the length supply network and transformer. No electric welding during unfavorable weather in an open place.

4. RESEARCH AND DESIGN

4.1 STUDY OF REINFORCED CONCRETE STRENGTH

One of the techniques for improving the bearing limit of the development structures and designing developments is the use of development materials with the improved strength and adaptability attributes just as the capacity to scatter the vibration energy. It is of specific significance for the development structures being in the seismic areas, which are under powerful stacking during their activity. The shape Memory Alloys (SMA) are promising materials, which can recuperate their unique shape subsequent to transferring (the impact of superelasticity) or being under the temperature impact (the impact of shape memory) during numerous patterns of stacking – dumping.

4.2 PROBLEM OF RESEARCH

The mechanical conduct of a strengthened solid shaft with traditional fortification and a strengthened solid bar fortified with supplements of superelastic Nitinol (Ni-Ti) is recreated by the limited component technique. Bar measurements: h=140 mm; b=80 mm; L=1200 mm. The shaft is made of cement of the C20/25 class, armature A400c 2ø12mm L=1080 mm; mountings armature A240c 2ø6mm L=1200 mm, fortifying addition Ni-Ti 2ø12 mm L=120 mm. Conduct recreation occurred in the ANSYS Workbench 19 R2 PC climate. Fortified solid pillar is partitioned into limited components. Size of the Solid 186 components for the armature 12,5 mm, for the mountings armature 40 mm. The size of the Solid 186 components for the body of the pillar was consequently chosen by the product – 200 mm. Altogether, the fortified solid pillar comprised of 22872 limited components and 4730 hubs. Fortified solid bar with armature A400C is exposed to equally circulated load on the plane 120×80 mm (P = 20MPa).

It is uncovered that the progress of the yield strength in the reproduced shaft with armature A 400c happens at a heap of P = 9MPa. In this manner, the investigation of the conduct of the fortified solid pillar with old style fortification (armature A 400C) and the strengthened solid bar fortified with supplements of superelastic Nitinol (Ni-Ti) happened when stacking shafts to the estimation of P = 9MPa and their total dumping. The supplement of nickel-titanium (Ni-Ti) amalgam supplanted the plastically twisted part of the working support A400C, where the burdens surpassed the yield strength (ζt 0.2 = 365 MPa

The estimations of relocations, greatest anxieties and lingering stresses of the bars by thought about. It was inferred that the supplements made of superelastic Ni-Ti composite multiple times diminished the εres of the working fortification, expanded the greatest relocation of the pillar by 9,7%, expanded the εmax by 47,8% contrasted with the working support A400C

4.3 Analysis of the available results of investigation.

The shape memory compounds (SMA) were found in late 60-s of the only remaining century. Uneven and two-sided shape memory impacts (SME), superelastic conduct (SE) were researched. Because of high damping properties SMA are utilized as the fundamental components in the gadgets to diminish the dynamic loadings of the developments structures and designing developments, connects specifically. Plus, in the development SMA are viewed as the elective fortifying of the structures or their components being in activity in the seismic districts. Because of the SE these amalgams can recuperate after adequate disfigurements (at times up to 10%) under dumping, which brings about the steady leftover distortions during the steel alloying.

Little fortified solid bars with the NiTi inclusions were tried under the monotonic stacking by the three-point dislodging before crack. The conduct of regular supporting strengthened shafts with the crossover fortification (steel support with NiTi inclusions) and the control pillar were tried tentatively. It was discovered, that the pillar with SMA addition being joined with the high-strength steel exhibits improved break recuperation and disfigurement properties. That is the reason the use of the cross breed NiTi with steel can adequately diminish the danger of crack under seismic tremors just as reduction the loses brought about by it.

Considering adequate material and work consumptions to complete comparative full-scale tests to improve the fortified structures the limited – components strategy merits being utilized for the demonstrating of the pressure strain state.

Objective of the work is to demonstrate and research the pressure strain condition of the strengthened pillar with the nickel-titanium amalgam inclusion with the superelasticity impact under monotonic stacking and dumping from the stacking appropriated on the square 120 × 80 mm utilizing the limited components strategy.

Proclamation of the errand. The fortified C25/30 solid pillar was picked for the examination (Fig. 4.1). The attributes of the structure are: fortified bar b = 80 mm, h = 140 mm, L = 1200 mm; support A400c 2ø12 mm; gathering fortification A240c 2ø6 mm.

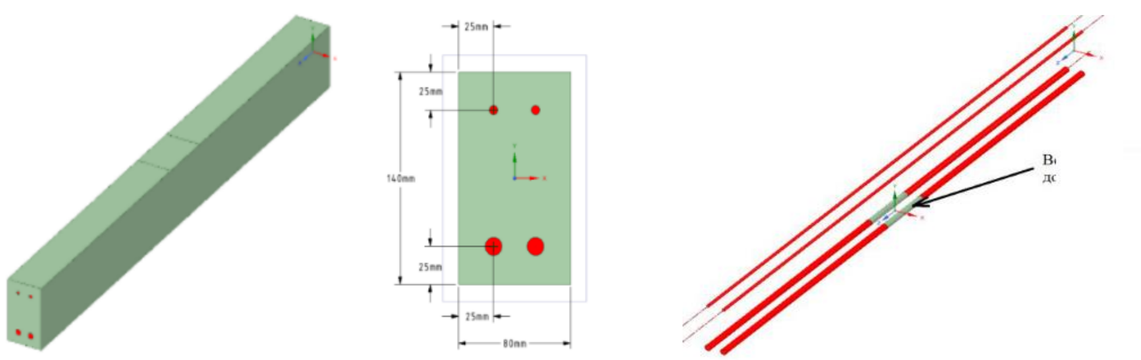
Fundamental qualities of mechanical properties of shaft components utilized for the displaying are introduced on

Table 3.2

Elements	$\zeta_{t\,0.2}$, MPa	$\zeta_{t\,max}$, MPa	E, GPa
A 400C	365	460	210
NiTi	450*	1200*	52,7*
Concrete C20/25	–	2,2	23

Features of the nitinol mechanical qualities were found under the tensile shear at the temperature 18°C.

Here $\zeta_{t\,0.2}$ – is the material yield limit under strain (for the Ni-Ti; alloy – starting stress value for the forward phase transformation) $\zeta_{t\,max}$ – is the material tension strength limit; E – is the material 1-st level modulus of elasticity (the Young‘s modulus), (for the Ni-Ti alloy –austenite elasticity modulus).



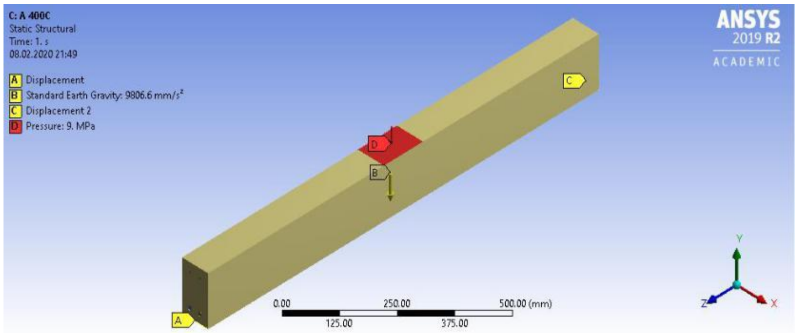
a b

Figure 4.1 The spatial model of reinforced concrete beam: a) the main view; b) the location of Ni-Ti insertion

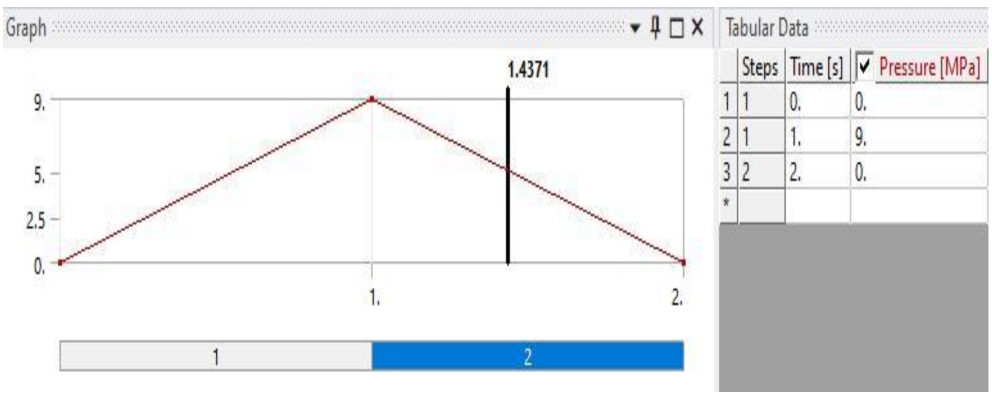
It should be noticed, that the estimations of the restrictive yield limit and the nitinol strength surpass adequately the comparing qualities of solidarity of the steel fortification A400c.

The concrete strength data and that of the reinforcement meet the standards of Building code .2.6-98:2009 [and National standard of Ukraine B.2.6-156:2010.

All counts of the free-uphold shaft on two backings (Fig. 4.2a) are performed for the power P = 9 MPa being uniformly scattered in the territory D of the 120 × 80 mm. The estimations of the power are picked in such a manner, that the weight on the working fortification A 400c has surpassed the yield pressure of the working support A400c (ζt 0,2 = 365 MPa). With this reason the strengthened shaft with the working support A400c is stacked progressively up to the worth P = 20 MPa (Fig. 4.3). The power circulated in the zone D is symmetric generally the mathematical focus of the upper side and is coordinated to – Y. Furthermore, the power of gravity following up on the bar and coordinated to - Y is considered.



a



b)

Figure 4.2 The design scheme of the beam: a) freely supported state, where A and C are the locations of the beam support; B - application of gravity $g = 9.8066\ m/s^2$ to the center of mass of the structure; D - the area of application of force P = 9MPa; b) beam loading-unloading scheme

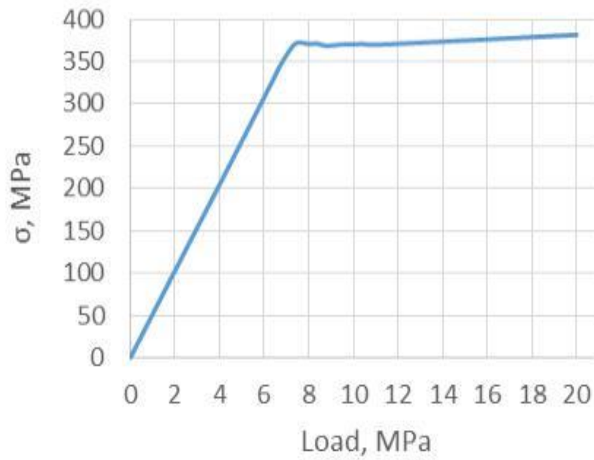
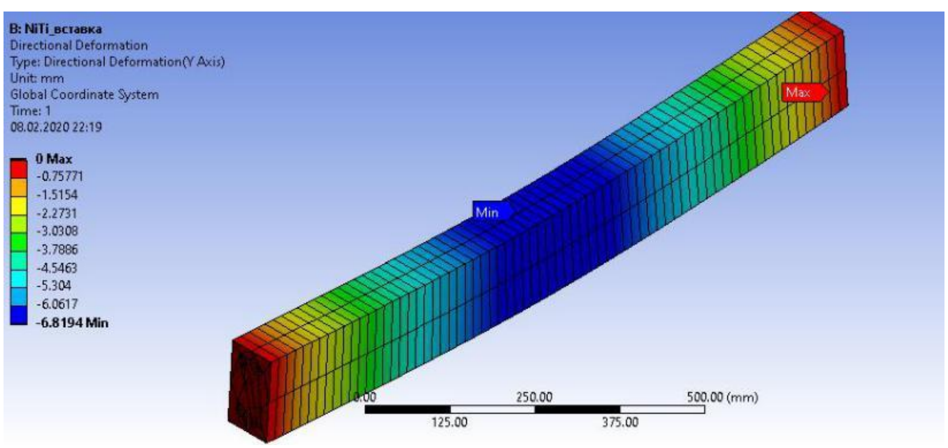


Figure 4.3 Dependence of stress in the amature A

The pressure strain state is displayed in the medium ANSYS 2019 R2. To compute everything groups of the strengthened pillar are isolated into limited components. The size 3D of the Solid 186 components for the working fortification is equivalent to 12,5 mm, for the mounting support Solid 186 – 40 mm. The Solid 186 components size for the bar body were chosen consequently by the product being of 200 mm. All in all, the strengthened pillar comprised of 22872 limited components and 4730 units.

Analysis of data. In Fig. 4.4 the distribution of displacement (bending) fields in the beam with the operating reinforcement A400C (a) and with the SMA insertion (b) under the maximum loading, taking into account the beam weight, are presented.

a)



b)

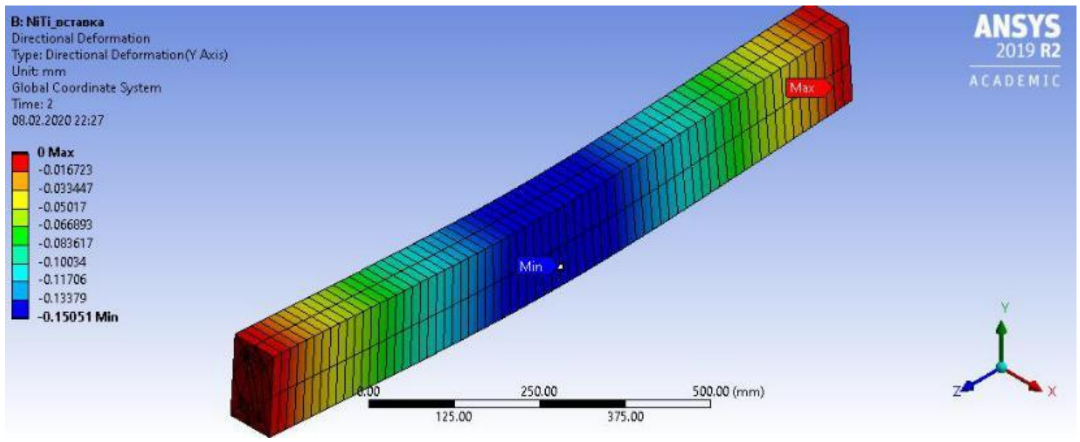
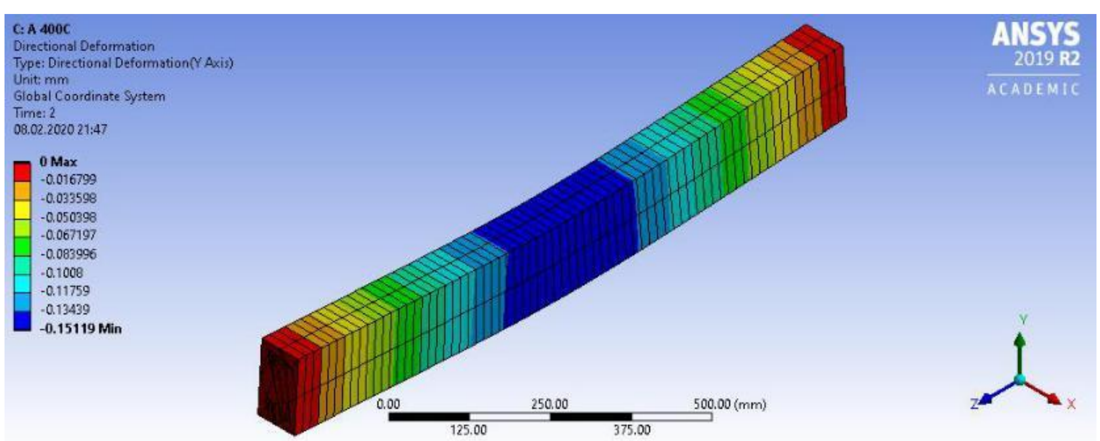


Figure 4.4. The maximum displacement of beam: a) – with operating reinforcement bar A 400C; b) – with SMA insertion

As it follows from the outcomes investigation, the bar with the SMA inclusion has been dislodged by 9,2% more than that with the working fortification 400C. It is brought about by the less estimation of the NiTi modulus of flexibility in the territory of disfigurement of austenite and in the region of austenite-martensite change as contrasted and that of the steel fortification and the superelastic conduct impact.

Yet, in the wake of emptying the remaining relocations of the shafts with the working support 400C (a) and that with the SMA addition (b) are, truth be told, the equivalent

a)



b)

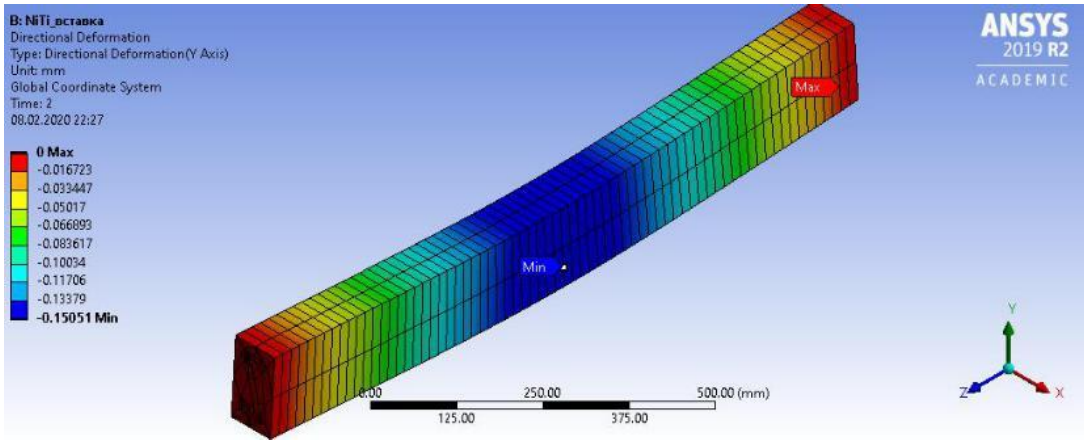


Figure 4.5 Residual displacement after unloading: a) – with the operating armature bar A 400C; b) – with SMA insertion

The burdens and relative prolongation along the hub of the working support are introduced in Fig. 4.6 and 4.7 correspondingly. In Fig. 6 it is seen, that the pressure state in the SE inclusion Ni-Ti combination is adequately more modest (by 69,3%) than that of the support A 400C. It is brought about by the reality, that the fortification A 400C is of more noteworthy solidness than that of the NiTi compound. In addition, it is seen, that when SMA inclusion is utilized, the remaining pressure in the working support in the wake of dumping diminishes in multiple times as contrasted and that of the working fortification A 400C.

It is found in Fig. 4.6, that disfigurements in the working fortification with the SE Ni-Ti combination inclusions are more noteworthy by 18,2% than those in the traditional working support A 400C. This conduct is brought about by the reality, that the fortification A 400C is of more noteworthy firmness than that of the Ni-Ti compound. The leftover disfigurements in the working support with the SE additions, indeed, are not accessible. Because of it the break ―treatment‖ in the strengthened pillar with the SE additions happens.

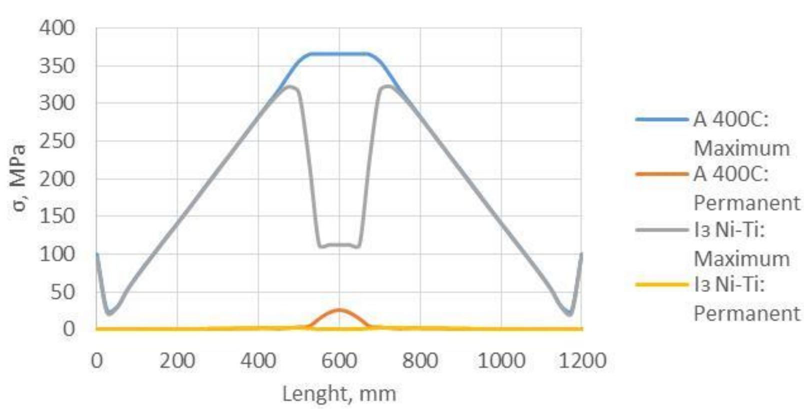


Figure 4.6 Stress distribution along reinforcement axis at *P* = 9 MPa

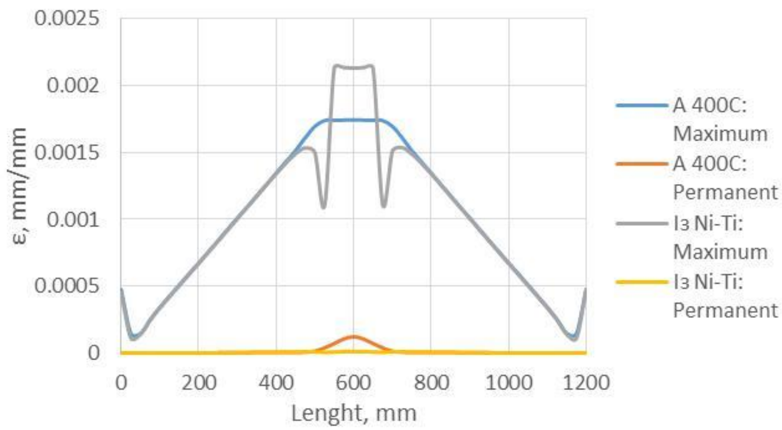


Figure 4.7 Strain distribution along the reinforcement axis after unloading

The obtained results of the digital modeling of the stress-stain state are presented on Table 2 and in Fig. 4.8.

Table 3.3. The values of displacements, maximum stresses and residual stresses obtained by FEM

The main reinforcement bars	Maximum displacement, mm	εmax, mm/mm	ζmax, MPa	εres, m/m	$ζ_{res}$, MPa
A 400C	6,25	1,76e-3	370,25	3,66e-4	76,80
The insertion of SMA	6,82	2,61e-3	377,63	2,16e-5	3,64

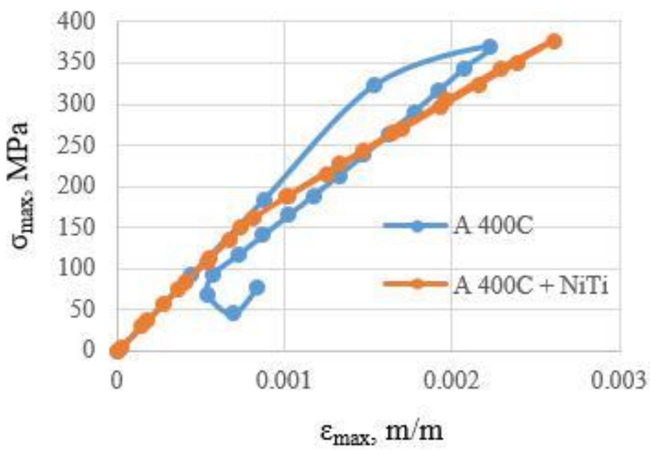


Figure 3.12 Stress-strain response for reinforced reinforcement

Having analyzed the obtained data it can be concluded:
Displacement of the beam with the SMA insertion under the maximum loading exceeds by 9,2% that with the operating reinforcement 400C. The maximum relative elongation of the sample with the SMA insertion is by 47,8% greater than that of the sample without insertion. It is caused by the smaller SMA stiffness as compared with that of the conventional reinforcement.
The value of the maximum similar stress in the beam with the SMA insertion equals the stress in the beam without insertion. But the SMA insertion in the reinforcement decreases the maximum residual stresses by 4,7% as compared with those conventional ones.

Conclusions. The pressure strain pressure of the regular strengthened bar and that on two backings with the SMA superelastic compound bar inclusions of 120 mm length and the relocation, the stacking being consistently appropriated in the focal zone, has been displayed utilizing the limited components strategy and the ANSYS complex.

The proficiency of the strategy for the abatement of stresses in the working support and the substitution of the region, where the burdens surpass the material yield limit on the SMA SE inclusion, has been deciphered.

The SMA SE additions of 12 mm breadth decline in multiple times the most extreme leftover relative extension of the working fortification as contrasted and that of the working support 400C. As indicated by the aftereffects of the pressure strain state demonstrating the expansion of relocation by 9,2% of the bar with the SMA SE inclusions was uncovered as contrasted and that of the working fortification 400C, just as the expansion by 47,8% of the greatest relative stretching of the SMA SE support under the most extreme stacking.

5. LABOUR PROTECTION

5.1 Initial data

Construction work is hazardous Land-Based job. Some construction site jobs include: building houses, roads, tree forts, workplaces and repair and maintain infrastructures. This work includes many hazardous task and conditions such as working with height, excavation, noise, dust, power tools and equipment. The most common fatalities are caused by the fatal four: falls, being struck by an object, electrocutions, and being caught in between two objects. With an increase in this type of work occupational fatalities have increased. Occupational fatalities are individuals who die while on the job or performing work related tasks. Within the field of construction it is important to have safe construction sites.

5.2 Hazards

Various workplace safety signs commonly used at construction sites and industrial work environments

The leading safety hazards on construction sites include falls, being caught between objects, electrocutions, and being struck by objects. These hazards have caused injuries and deaths on construction sites throughout the world. Failures in hazard identification are often due to limited or improper training and supervision workers.

Areas where there is limited training include tasks in design for safety, safety inspection, and monitoring safety. Failure in any of these areas can result in an increased risk in exposing workers to harm in the construction environment.

Falls are the leading cause of injury in the construction industry, in particularly for elder and untrained construction workers. In the Occupational Safety and Health Administration (OSHA) Handbook used by the United States, fall protection is needed in areas including but not limited to ramps, runways, and other walkways; excavations; hoist areas; holes; form-work; leading edge work; unprotected sides and edges; overhand bricklaying and related work; roofing; precast erection; wall openings; floor openings such as holes; residential construction; and other walking/working surfaces.Other countries have regulations and guidelines for fall protections to prevent injuries and deaths.

Motor vehicle crashes are another major safety hazard on construction sites. It is important to be cautious while operating motor vehicles or equipment on the site. A motor vehicle should have a service brake system, emergency brake system, and a parking brake system. All vehicles must be equipped with an audible warning system if the operator chooses to use it. Vehicles must have windows and doors, power windshield wipers, and a clear view of site from the rear window. All employees should be properly trained before using motor vehicles and equipment.

Employees on construction sites also need to be aware of dangers on the ground. Cables running across roadways were often seen until cable ramp equipment was invented to protect hoses and other equipment, which had to be laid out. Another common hazard that workers may face is overexposure to heat and humidity in the environment. Overexertion in this type of weather can lead to serious heat-related illnesses such as heat stroke, heat exhaustion, and heat cramps. Other hazards found on construction site include asbestos, solvents, noise, and manual handling activities.

5.3 Hazard controls

Temporary fencing on a building site in Ternopil Ukraine

Site preparation aids in preventing injury and death on construction sites. Site preparation includes removing debris, leveling the ground, filling holes, cutting tree roots, and marking gas, water, and electric pipelines. Another prevention method on the construction site is to provide a scaffold that is rigid and sufficient to carry its own weight plus four times the maximum intended load without settling or displacement.

5.4 Ways to prevent injuries and improve safety include:

-Management safety

-Digital Safety Management

-Integrate safety as a part of the job

-Create accountability at all levels

-Take safety into account during the project planning process

-Make sure the contractors are pre-qualified for safety

-Make sure the workers are properly trained in appropriate areas

-Have a fall protection system

-Prevent and address substance abuse to employees

-Make safety a part of everyday conversation

-Review accidents and near misses, as well as regular inspections

-Innovative safety training, e.g. adoption of virtual reality in training

-Replace some of the works by robots (many workers may worry that this will decrease their employment rate)

-Adoption of BIM with three-dimensional printing to make the building model first before put into real practice

The employees or employers are responsible for providing fall protection systems and to ensure the use of systems. Fall protection can be provided by guardrail systems, safety net systems, personal fall arrest systems, positioning device systems, and warning line systems.

Making sure that ladders are long enough to safely reach the work area to prevent injury. Stairway treads, and walkways must be free of dangerous objects, debris and materials.

A registered professional engineer should design a protective system for trenches 20 feet deep or greater for safety reasons. To prevent injury with cranes, they should be inspected for any damage. The operator should know the maximum weight of the load that the crane is to lift. All operators should be trained and certified to ensure that they operate forklifts safely.

5.5 Top 10 Safety tips for roof installation on our building

Always begin with your Pre-Start Talk

Make sure you always conduct a 5-10 minute pre-start talk with all workers before commencing work on a rooftop. Discuss common hazards present, assess the condition of the work area, confirm that proper permits have been secured, and encourage the team to verbalize the safety tips to follow. Using a pre-start toolbox talk template can help your team communicate and record their daily safety conversations.

Work only during good weather conditions and avoid extreme heat/cold

Not only does extreme weather cause slips and falls, it can also hinder proper execution of roofing work (roof shingles not sealing down). A wet roof is also a huge risk for slips and falls. Better side with caution and always wait for ideal weather before you begin roofing work.

Cranes should be stable and properly secured or tied off

Always make sure that there are enough cranes and Well Qualified operators for the job and that they're all safe to use. Check your cranes for safety as some of them may need repair or replacement to prevent fatal accidents or injuries.

Wear proper PPE

Everyone on the site should wearing proper PPE such as helmets, shoes with traction, and fall protection harnesses can help save you when slips and falls occur. Perform regular PPE checks to ensure your team is properly equipped.

Figure 5.1 – PPE example

Carefully position ropes and extension cords so they're not underfoot

When not properly handled, ropes and cords not only hinder workers' movements, they can also cause fatal accidents. Always follow proper use of ropes, cords, and safety harnesses.

Sweep the roof before and after work and make sure it is clear of dirt and debris

One random nail can cause slips while snow or leaves can hide areas of the roof that should be visible to workers. Always keep the roof clean and free of items that can cause accidents or materials that can hinder visibility of the roof.

Use guardrails whenever possible

Guardrails serve as a visual and physical barrier which protects workers from falls. It reduces the risk of injury and death from working on roofs.

Skylights should be guarded appropriately.

Skylights and other openings on roofs should be properly covered and labeled with visible warning signs to prevent workers from leaning on or falling into them.

Be careful of slate and tile roofs

Slate and tile roofing is a major slip hazard. Always make sure that workers are properly trained and have enough experience to work on slate and tile roofs.

Signage should be visible in your work area

People around the work area should always be made aware of roofing work in the vicinity by using visible warning signs to prevent injury or accidents with staff working on site or from falling debris.

CONCLUSION

In the design part the principle underlying components of the structure were thought of. The reason for the planned managerial structure, designing geographical and hydrogeological states of the development territory, just as compositional choices are examined. Prerequisites for imperviousness to fire, imperviousness to fire, lighting, warming and ventilation are additionally thought of. Created: veneers, areas, plans of a commonplace floor and specialized, land segments.

In the count helpful part were completed figuring of establishment and multi-empty plate. In the part on innovation and association of development creation, the meaning of the terminology and volumes of works, the selection of techniques for the execution of works, machines and components, the assurance of the quantity of vehicles, and the determination of the crane were conveyed out. We additionally utilized fortified solid chunk.

A development ground breaking strategy and a lattice diagram have likewise been created and examined. Advancement of a mechanical guide for establishment of structures . We likewise utilized brick walls which are solid and quick to introduce.

In the monetary part were created, a record of work and wages, object gauges for the fundamental structure, consolidated quotes of development costs, which decided the assessed cost as per the method for deciding the expense of development and free costs for development items in the advancement of market relations .The primary choices on work assurance and the climate are given.

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