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

TO ADMIT TO GUARD

Head of the Department

____________O.I. Lapenko

"_____" _____________ 2020

MASTER THESIS

(EXPLANATORY NOTE)

Topic: ***Modern methods of strengthening the foundation of shallow secondary school***

Performed by: Student of group 205ma Nechuporchuk V.S __________
(student, group, last name, first name, patronymic)

Scientific adviser:__ Ph. D, Candidate in Engineering Bilokurov P.S
(academic degree, academic rank, last name, first name, patronymic)

Adviser of the chapter «Labour protection»: ___________ Kovalenko V.V.
(signature) (Surname, initials)

Adviser of the chapter «Environment protection»: ___________ Radomskya M.M.
(signature) (Surname, initials)

Design rule check: ___________ Rodchenko O.V.
(signature) (Surname, initials)

Kyiv 2021

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

ДОПУСТИТИ ДО ЗАХИСТУ

Завідувач випускової кафедри

____________О.І. Лапенко

"_____" _____________2020 р.

ДИПЛОМНА РОБОТА

(ПОЯСНЮВАЛЬНА ЗАПИСКА)

ВИПУСКНИКА ОСВІТНЬОГО СТУПЕНЯ МАГІСТРА

ОСВІТНЬО-ПРОФЕСІЙНА ПРОГРАМА «ПРОМИСЛОВЕ І ЦИВІЛЬНЕ БУДІВНИЦТВО»

Тема: : " Сучасні методи підсилення фундаментів мілкого закладання середньої загальноосвітньої школи".

Виконавець: студент групи 205м Нечипорчук Владислав Сергійович
(студент, група, прізвище, ім'я, по батькові)

Керівник: : ____________ к.т.н. доцент Білокуров П.С
(науковий ступінь, вчене звання, прізвище, ім'я, по батькові)

Консультант розділу «Охорона праці»: __________ Коваленко В.В
(підпис) (ПІБ)

Консультант розділу
«Охорона навколишнього середовища»: __________ Родомська М.М.
(підпис) (ПІБ)

Нормоконтролер: __________ _Родченко О.В.____
(підпис) (ПІБ)

Київ 2021

CONTENT

Part 1

Introduction

1.1. Analytical review

Generation education is one of the most important components of human function society. The development of modern civilization is unthinkable without the upbringing of the younger generation, obtaining the necessary level of educational knowledge, developing a certain system of views and formation new personal life settings. The school is the main tool, the basic link in educational

Ukrainian education policy, which is one of the most important factors in national security and the welfare of the country, the well-being of every citizen.

Recently, the problem of reconstruction of both schools and schools has become of particular importance throughout the network of general education institutions.

The urgency of reconstruction of school buildings has the following main reasons:

• The vast majority of school buildings are in the physical category (more than 50%) and increased moral (up to 80%) wear.

• The possibility of allocating new land for construction is almost exhausted, and the new economic conditions do not allow to attract significant funds for new construction.

The reconstruction of buildings and structures, including schools, is less expensive than the construction of new ones

buildings.

• In the practice of design decisions reconstruction of school buildings use methodical and normative indicators developed in the Soviet period that do not fully take into account a set of socio-economic and urban conditions that have changed significantly since then.

Therefore, analyzing the current state of the material-spatial environment of the average education in Ukraine, there are several groups of its characteristics that do not correspond the requirements:

1. Town-planning requirements:

• Uneven development of the school network.

• School network congestion due to compacting of residential buildings.

• The reorganization of the different territories of the city for housing needs appropriate development of the school network.

• As a result of motorization, the city's transport frame changes. Separate residential streets become the main roads. This requires adjustment of the school network. There is a need development of a new principled model of organization of schools in a city not tied to the concept of "radius service".

Typological requirements:

• Insufficient area of the main premises due to the increase in the standard of space per student.

• Incomplete composition of premises.

• Imperfect connections between individual elements of the school's compositional structure.

• The emergence of new groups of premises (bedrooms, junior high school entrance, etc.).

• Mandatory requirement for segregation of different age streams of pupils.

• Architecture obsolescence impedes the transition to active forms of learning and the use of technical training tools.

The nomenclature of school buildings does not reflect the real variety of school types.

3. Socio-demographic requirements:

• Overcrowding due to the inverse relationship between the number of schools and the population.

• Lack of primary school premises due to reduced school age.

• Lack of institutions for temporary stay of children.

4. Pedagogical requirements:

• Ignoring the child's age characteristics in existing school buildings.

Grayness, ugliness of school buildings.

- Lack of facilities for active upbringing in both small and large groups.
- Lack of recreational space, including school-wide spaces.
- Improper recreation facilities.
- Insufficient sharpness of contrast between training areas and recreation.
- Closure of the school building to the public.
- Lack of facilities for creative development of the child, demonstration of amateur art, etc.

Features of reconstruction of school buildings

At the level of an individual room, transformation is accomplished by enlarging one room at the expense of others, or dividing a large space into several smaller ones by means of sliding partitions, curtains, shift screens, etc. Reception of space division is an effective means of bringing premises, buildings and complexes in line with new needs.

At the level of premises and buildings, this means the expansion of one room or building at the expense of another adjacent to it. At the building level, the use of this technique makes it possible to increase the area and volume of the building by using the space provided for expansion (galleries, verandas, terraces, patios, etc.), or by adding, upgrading or annexing the building.

The decision of the school territory was also based on child psychology, takinginto account the peculiarities of the codification of the educational environment.

The project provides for the possibility of development of the object and its adaptation to the changing technical, economic and social conditions. The construction of the facility will use the latest eco-friendly building materials, implemented energy-saving lighting devices based on LEDs, efficient technological equipment of the power unit and pool, multi-tariff electricity meters, heating system based on heat pumps, air recuperation system.

In the rooms of the assembly hall, swimming pool, gyms there will be installed ventilation. The classrooms will have modern certified equipment and furniture, classrooms equipped with interactive whiteboards, computer classes - modern computers. The project provides for a two-pipe heating system with installation of panel radiators, inlet and exhaust ventilation for air cooling in the summer, the pool provides air drying.

The security system provides access control, video surveillance, burglar alarms and alarms. With the commissioning of the facility, school staff will have the opportunity to introduce the best domestic innovations in the educational process on a new modern basis.

2. Architectural Part

2.1 Output. The basis for the project design.

Working project «Overhaul Preschool Institution Alexander district of Kirovograd region », developed on the basis of the following regulatory documents:

1. Law of Ukraine from February 17, 2011 No. 3038 - \ / AND "On Regulation of Urban Planning Activity".

2. Law of Ukraine of May 20, 99 No. 687-X \ / I "On Architectural Activity". OF THE LAW OF UKRAINE of 09.04.2015 «On Amendments to Certain Legislative Acts of Ukraine on decentralization of authority in the field of architectural and construction control and improvement town planning legislation »

3. DSTU B. V. 2.6-189: 2013 Methods of choosing thermal insulation material for insulation buildings.

4. Energy Saving Law of Ukraine

5. Law of Ukraine “On metrology and metrological activity”

6. DBN A.2.2-3-2014 Composition and content of project documentation for construction

7. DBS A.3.2-2-2009 "Occupational Safety and Industrial Safety in Construction".

8. DBN A.3.1-5-2009 Organization of construction production

9. DSTU-N B. V. 1.1-27: 2010 "Building climatology"

10. DBN V. 1.1.7-2016 Fire safety of construction sites.

11. DBN V. 2.6-33: 2008 Exterior wall structures with front thermal insulation. Requirements for

design, arrangement and operation

12. DSTU B D. 1.1-1: 2013 “Rules for determining the cost of construction”.

13. On approval of Amendments to the Procedure for development of project documentation for construction of objects. Ministry of Regional Development of Ukraine; Order No. 492 of 11.10.2013

14. DBN B.1.1-31: 2013 Noise protection of territories, buildings and structures

15. DSTU BA 2.2-8: 2010 Section "Energy Efficiency" in the Design Documentation objects

The object of construction belongs to the class of consequences (responsibility) CC1 and is developed into one the stage with the consent of the parties and on the basis of "Tasks for design" from 29.09.2017, approved customer.

2.2. General characteristics of the construction site

According to the normative data of DSTU-N Б B.1.1-27: 2010 "Building climatology" building

The facility is located within the 1st Northwest Architectural and Building Climate

The main climatic characteristics of the area are as follows:

The temperature of the hottest five days is +24 ° C

The coldest five-day air temperature is 25 ° C

Regulatory depth of seasonal freezing of soil 1 -1,2 m

The average annual wind speed is 3.9 m / sec

The characteristic value of the wind pressure is 0.45 KPa

The standard weight of the snow cover is 1.4 KPa

On tectonic zoning with. Krasnoselia, Oleksandrivs'kyi district, Kirovograd region.is located on the Dnieper height with an average height of 160 m. Kirovograd megablock of the Ukrainian Shield of the Eastern European Platform.

Physical-geographical zoning - forest-steppe, insufficiently moistened warm zone, South Dnieper highlands.

Hydrogeological zoning - platform hydrological province, hydrological region - Ukrainian Shield. In the geological structure of the region involved crystalline

Precambrian rocks, sedimentary deposits of Paleogene, Neogene and Quaternary periods, which represented by granites, gneisses, labradorites, amphibolites, migmatites, metabasites. At the top, the granites were blown. Cover rocks are presented in mainly such layers: technogenic layer, loam, loam, clay, sand.

The terrain is calm.

According to engineering-geological conditions highlighted the following main engineering-geological elements:

IGE-1. Silty sand, medium density, small and medium level water saturation. The power of layers – 1.2-2.7 m.

IGE-2. Clay loam Brown, plastic, microporous, with the inclusion of carbonate 1-2 silty sand layers, 30-40%. Power layers is 0.5-4.4 m.

IGE-3. The sand is finer, medium-density, plastic, the average degree of water saturation, the power of layers – 0.3-2.2 m

IGE-4. Sand is smallr, plastic, dense, the averager degree of water saturation, the power of layers – 1.2-1.8 m

IGE-5. Silty clay loam, grayish brown, plasticr, with lens-shaped streaks of silty sand 10-30%. Power layersr-0.7-1.8 m.

IGE-6. Very soft sandry loam Power layers is 0.8-1.9 m.

IGE-7. Clay semi hard, yellowr-brown, with lens-shaperd layers silty sand 15-30% Power segments – 1.3-2.7 m.

IGE-8. Low-plastic clary, yellow-browrn, with lens-shaped layers silty sand 15-30% Power segmenrts – 0.56-1.7 m.

Groundwater occurs at a depth of 3.5-4.5m and does not have aggressive properties with respect to normal density concrete. Possible fluctuation of groundwater at 1m.

Normative depth of seasonal freezing of soils in the area of survey - 1.2m.

The approaching fire truck uses the existing carriageway of the surrounding streets and the existing yard pass.

At the site adjacent to the territory of the site on the street Nova for temporary.

Car parking is possible at 5 parking places. Pedestrian movement provided along the tracks along the facades of the building. The driveway and pedestrian area are solid asphalt concrete coating. The area adjacent to the building is planted with trees, shrubs and trees perennial herbs in organized lawns.

The project foresees the overhaul of the building preschool educational institution in the part of replacement of filling of window apertures, external and interior doorways, facade insulation, sloping arrangements, replacement of visors above entrances into the building.

The project envisages a complex of works on replacement of filling of window openings, installation of slopes, repair of peaks above entrances to the building, insulation of the facade around the perimeter buildings, replacing the filling of exterior and interior doorways as required optimization of energy costs.

These works are done to improve the climate, sanitary-epidemiological regime, aesthetic appearance.

The decisions made are based on comprehensive consideration of versatile requirements - functional, physical, technical, constructive, architectural, artistic and economic.

Volume-planning decisions of buildings are formed determined by the following factors:

-functional process, geometric parameters, requirements for them

-grouping, relationship with the conditions of unification of planning and constructive elements;

-town-planning and climatic conditions;

-structural features of the building related to the size of the spans, height and

-other geometrical parameters, the material of the bearing / enclosure designs;

-architectural and artistic tasks in connection with the social content and importance of the building preschool educational institution;

-cost-effectiveness of space-planning and design solutions;

- features of functional and technical operation.

The overhaul of the Krasnosilsky DNZ building envisages the following types works: Dismantling of existing window and door blocks;

Filling of window openings with blocks of metal plastic according to DSTU B. V. 2.6-15: 2011 Blocks windows and doors polyvinyl chloride. General specifications.

Window sills - plastic, low tides - galvanized metal;

Dismantling of reinforced concrete visors over entrances, dismantling and repairing of fire escape ladder;

Arrangement of visors of metal frames covered with galvanized metal profile type T14, metal thickness 0.5 mm;

External thermal insulation of walls with basalt mineral wool plates thickness 130 mm (50 mm; 20 mm), specific gravity - 90 kg / m3 (110 kg / m3);

Exterior decoration of walls, window and door slopes with plaster mixes, with subsequent staining;

Arrangement of the system of the organized drainage of a roof of so m. 100 mm;

Repair of asphalt concrete covering of scaffolding.

Filling of window openings of walls is designed by modern PVC windows, since unlike from wooden they do not rot and do not dry up, do not need regular coloring and aesthetic. The foreseen structures are made of multi-chamber profiles based on PVC. The windows can be used in wet environments, retaining physico-mechanical properties for a long time, keeping the temperature within ± 45 ° C. The color of the frames is the same across in the profile area.

The project provides a profile system H8, accessories A ipkNaiz Window sill consists of three sheets of glass 4 mm thick (outer and inner with which are energy saving), located at a distance of 10 mm from each other, forming double-glazed window, hermetically insulated on the outer circumference of butyl rubber mastic. The parallelism of the 4 mm glass planes provides a hollow, rectangular cross-section, aluminum profile filled with bulk silica gel, which absorbs moisture. No windows "Sweat" and do not freeze, reduce heat losses by 30%.

Reliable sealing provides high soundproofing and dustproof qualities. The PVC does not burn or emit toxic gases. The project provides window blocks of the following symbols and numbering, used to identify window products on sheets 33/17-AB-2 ... 33/17-AB-5:

Given the climatic conditions and the construction and climatic area of the project provided triple glazing windows. Fastening of double-glazed windows in weaving is carried out by means of shtapik.

For sealing joints of glass blocks with openings / 'shutters', use seals. Pairing the window unit with the lower horizontal the slit plane has downpours, elastic gaskets and air-tightening polyurethane foam, they are sealed with a cement-sand solution, resistant to weathering.

The materials / components must be subject to entry control in accordance with DSTU B. V-2.6-23: 2009 and DSTU B.V-2.6-15: 2011, meet the requirements of regulatory documents and be confirmed by the quality documents of the suppliers. \Materials and components the products must be authorized for use by the health authorities of the Ministry of Health of Ukraine.

Materials and components used for the manufacture of window blocks and, Doors, should be resistant to climatic influences. The main components are: glass packs, seals, circuit breakers, and trimmings materials (coatings) should be tested for durability (reliability) by accredited labs.

According to item 6.8.2 of DBN V. 2.6-33: 2008 protective exits must be erected above the exits of the house. canopies of non-combustible materials with a departure from the facade of not less than 1.2 m at the height of the house up to 15 m. Sheds designed frame steel with a limit of fire resistance 15, flammability group - NG. The cover of the canopy is provided with metal profile T14, metal thickness 0.5 mm.

The project provides a prefabricated plastering system (Class A according to DSTU B B.2.6-34), which is made with thermal insulation, which is fixed on the bearing part walls, with the application of a dressing layer on the surface of the layer of thermal insulation.

Kit consists of adhesive materials, insulation material, mechanical fasteners thermal insulation, reinforcement mesh, finishing coating. As a mineral wool wall insulation FRONTROCK MAX E 130 mm thick, for plinth FRONTROCK S 50mm thick, for window and door slopes FRONTROCK S 30mm thick Rock Wool brand with the following features: Length -1000 mm, width - 600 mm - dimensions of plates.

3. Structural part

3.1. Calculation of the brick wall

Necessary to calculate the load-bearing walls of the administrative building, which is made of mud brics of plastic pressing M75. The building belongs to category 1 by the reliability.

Since the distace between the lateral walls $l_{cm} = 113,5м$, then the building, has a rigid structural scheme.

<u>Collection the load on the wall</u>

Calculation of lod 1m2 coverage and overlap summarized in the table.

For calculatig take pier width 182 cm (quarter 2x6,5=13 cm leave in margin of safety). His section 1,82x0,51=0,93 m^2. The distace between the axes of adjacent with pier windos 335 cm, and between the inner edges longitudinal walls – 516 cm. The cargo area, from which transferred the load from the cover and overlap, will constitute:

$$F = 0.5 \times 3.35 \times 5.16 = 8.6 м^2$$

The value of ths load is equal:

From the coveing:

constant 313x8,6=260 kg = 2,66 t;

teporary 20x8,6=170 kg = 1,75 t;

comlete P_1=2,66+1,75=4,41 t;

From the overlap:

constnt 406x8,6=3490 kg = 3,49 t;

temporary 210x8,6=1820 kg = 1,82 t;

complete P_1=3,49+1,82=5,31 t.

Weight of 1m2 wall thickness of 51 cm consists of weight of masonry 0,51x1x1800=918 kg/m^2 and the weight of the plaster 0,02x1x2200=24 kg/m^2, that is equal 942 kg/m^2. Taking into account overload factor is the weight 918x1,1+24x1,2=1040 kg/m^2.

Calculate constnt load consists:

- From the area above the bottom wall covering that is above the level $13.7 - Q_3^1 = 1040 \times (15.95 - 13.70) \times 3.55 = 8180\,kg = 8{,}13t$
- from the area of the wall from the bottom of covering down to jumper: $Q_1^1 = 1040 \times 3.55 \times (13.70 - 13.47) = 850\,kg = 0{,}85t$
- from the pier: $Q_2 = 1040 \times 1.82 \times 1.45 = 2740 kg = 2{,}47t$
- from the area of the wall from the bottom overlap to the bottom crosspiece: $Q_1 = 1040 \times 3.55 \times 0.23 = 1110 kg = 1{,}11t$
- from the area of the wall from the bottom overlap to the bottom armhole: $Q_3 = 1040 \times 3.55 \times 1.05 = 3870\,kg = 3{,}87t$
- from the area of the wall from the bottom of the first floor to the bottom overlap over basement: $Q_3^{11} = 1040 \times 3.55 \times (0.38 + 0.75) = 4170\,кг = 4{,}17\,m$

Table 3.1.

№	Type of load	Normative load, kN/m^2	Reliability factor by the load	Calculated load, kN/m^2
		Coatings		
1	S. panels «Simo – 200»	0,268	1,1	0,3
2	Purlins covering	0,1	1,1	0,11
3	Elms on the cover	0,1	1,1	0,11
4	Frames	0,3	1,1	0,33
5	Plumbing equipment on the roof			0,25
	Total			1,1
		Overlappings		
6	R/c panel	2,1	1,1	2,31
7	Soundproofing t=3cm	0,06	1,2	0,08
8	Waterproofing	0,02	1,1	0,02
9	Strainer t=3,7cm	0,08	1,2	0,1
10	Fiberboards t=0,8cm	0,06	1,2	0,08
11	Linoleum on mastic	0,05	1,2	0,06
12	Partitions	1,2	1,2	1,44
13	Temporary load	1,5	1,4	2,1
	Total			6,16
		Temporary load		
6	Snow I the snow region	0,5	1,4	0,7
7	Wind load III wind region Type of terrain B	0,38	1,2	0,45
	Total			1,15

Depth of laying overlap in the wall c=11 cm, then equinox of effort from overlap will be applied at a distance 11 cm: 3,7 cm from the internal fases of wall, and eccentricity of application will be equal e=0,5x51-3,7=21,8 cm.

Bending moment, in section 1-1:

$$M_1 = P_1 e = 5.31 \times 0.218 = 1.55 mm$$

Considering, that the wall has openings considerable size and that section 2-2 is located close to the section 1-1 (bending moment M_{11} approximately equal to the moment M_1), the estimated can take only sections 2-2 and 3-3. The distance between sections 2-2 and 1-1 are equal 0,23 m, but between 2-2 and 3-3 equal 0,7x0,93x1,8=1,17 m.

<u>Static calculation</u>

According to the **DBN B.1.2-2:2009** when calculating the walls is useful (temporary) the load in premises may reduce by multiplying on the coefficient: $\eta_1 = 0.3 + \frac{0.6}{\sqrt{m}}$, where m – number of overlap over section.

In our case, coefficient is : for 1-st floor – 0,6; for 2-nd – 0,65; for 3-rd – 0,73; for 4-th – 0,9.

<u>The construction calculation</u>

The calculation start from the most loaded first floor in the section 2-2, in which acting longitudinal forces N=66,66 and bending moment M=1,42 .

Eccentricity of application of longitudinal force:

$$e_0 = \frac{M}{N} = \frac{142000}{66660} = 2.1 sm$$

Estimated height pier will be equal l_0=2,8 m.

Since the wall thickness 51 cm >30 cm, then the m_{del}=1 and removing from the full longitudinal force its long-term componentis not required.

Elastic characteristics of masonry α=750 and calculated resistance R=9 kg/cm^2.

Determine the resulted flexible wall

$$\lambda_{np}^{h} = \frac{l_0}{h}\sqrt{\frac{1000}{\alpha}} = \frac{280}{51}\sqrt{\frac{1000}{750}} = 6.33$$

coefficient of longitudinal bending in anticipation of the central compression α=0,953 and taking into account no central compression:

$$\varphi_1 = \varphi\left[1 - \frac{e_0}{h}\left(0.06\frac{l_0}{h_e} - 0.2\right)\right] = 0.953\left[1 - \frac{2.1}{51}\left(0.06\frac{280}{51} - 0.2\right)\right] = 0.948$$

Coefficient $\varphi_1 = 0.948$ can use for the average height of the third floor. Section 2-2 goes beyond the limits of this area and is located from it at a distance 70 см. For it section: $\varphi_1 = 0.948 + (1 - 0.948)\frac{70}{93} = 0.987$

The plane of compressed zone section $F_c = F\left(1 - \frac{2e_0}{h}\right) = 182 \times 51\left(1 \times \frac{2 \times 2.1}{51}\right) = 8520\, sm^2$

and coefficient $\omega = 1 + \frac{e_0}{1.5h} = 1 + \frac{2.1}{1.5 \times 51} = 1.003 < 1.25$

Needed calculated resistance determined from the formula:

$$R = \frac{N}{\varphi_1 \times m_{\partial л1} \times \omega \times F_c} = \frac{66660}{0.987 \times 1 \times 1.003 \times 8520} = 7.9 kg/cm^2 < 9 kg/cm^2$$

That is, based on the calculation possibly to take a brand solution 10.

Bearing capacity of the wall in section 2-2:

$$N_{сеч} = \varphi_1 \times m_{дл1} \times \omega \times R \times F_c = 0.987 \times 1 \times 1.003 \times 9 \times 8520 = 75600\,kg = 75.6t > N = 66.66t$$

For the section 3-3 value ω and F_c do not change significantly, and in the ascending and φ_1=0,948.

Then the bearing capacity of this section:

$$N_{сеч} = 0.948 \times 1 \times 1.003 \times 8520 = 72500\,kg = 72.5t > N = 67.95t$$

Thus, when the brand of brick 75 and mark of solution 10 bearing capacity of the wall on the first floor is provided

Because $e_0 = 2.1cm < 0.7y = 0.7 \times 0.5 \times 51 = 17.8cm$, calculation on fracture is not required. Floors that are above, are less load, that whay their calculation unnecessary.

3.2. Calculation of strengthening of precast concrete floor slabs with circular voids

Due to the overbuild of two floors over the school is necessary to strengthening some precast concrete plates with round voids over the third floor of the existing building due to the increased payload on the plate.

Parameters of the plate before strengthening: nominal size of the plate in the plan 1,2x6,0 m; height $h = 220mm$; heavy concrete, subjected to heat treatment, class B25 ($R_b = 14{,}5MPa$); Working longitudinal reinforcement rod: 4 Ø10 A 600C ($R_s = 510MPa$, $A_s = 3{,}14cm^2$). The actual cross-section of the plate is shown in Fig. 3.1.

Load of overlap accepted as when calculating the floor slabs: normative $q^n = 8{,}1$, calculated $q = 9{,}6$.

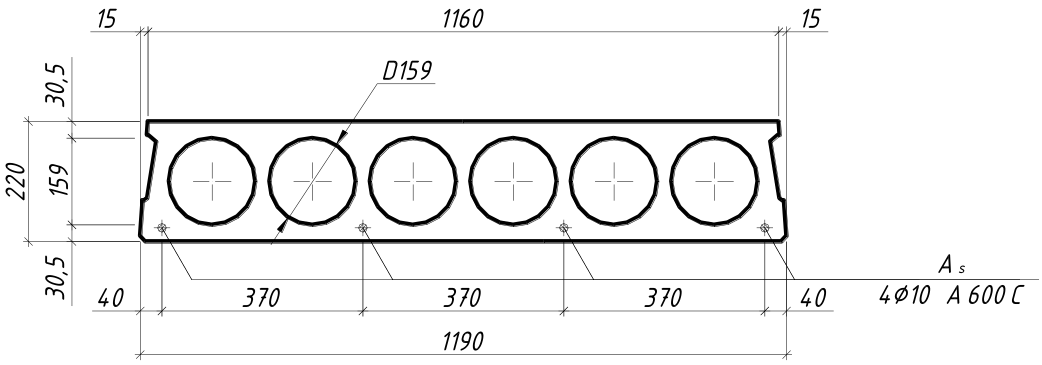


Fig. 3.1. The actual cross-section of the plate

Determination of the design and constructive length

Leaning the plate on the wall (fig. 3.2.) $\ell_{on} = 130\,мм$, $\ell'_{on} = 180\,mm$.

Estimated length plate:

$$\ell_0 = \ell - 20 - \frac{\ell_{on}}{2} - \frac{\ell'_{on}}{2} = 6000 - 20 - \frac{130}{2} - \frac{180}{2} = 5835\,mm\,.$$

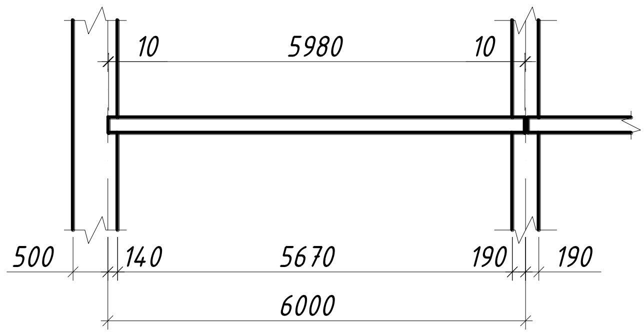


Fig. 3.2. Scheme of leaning the plate

Determination of pressure on the one meter and internal efforts

The load on 1 m length of the plate acting along the normal to its axis, with a nominal width of the plate $b_n = 1200$ mm:

- the total estimated

$q = 9{,}6 \cdot 1{,}2 = 11{,}52 (\kappa N/m)$;

- the total normative

$q^n = 8{,}1 \cdot 1{,}2 = 9{,}72 (\kappa N/m)$.

The calculated scheme of the plate (fig. 3.13.) adopted in the form of one statically defined beam.

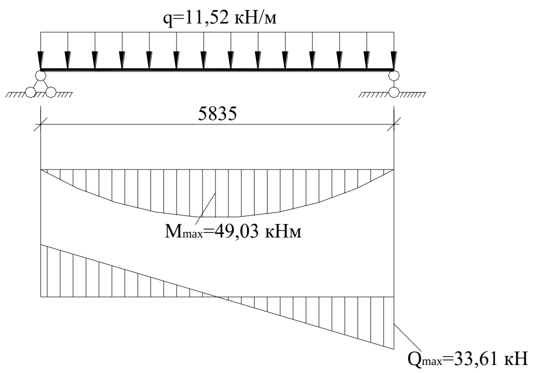


Fig. 3.3. The calculative scheme of plate

The efforts of the estimated load:

- moment that bending

$$M_1 = \frac{q\ell_0^2}{8} = \frac{11{,}52 \cdot 5{,}835^2}{8} = 49{,}03 kN \cdot m;$$

- transverse forse

$$Q = \frac{q\ell_0}{2} = \frac{11{,}52 \cdot 5{,}835}{2} = 33{,}61 \kappa N.$$

The efforts from the normative load:

$$M^n = \frac{q^n \ell_0^2}{8} = \frac{9{,}72 \cdot 5{,}835^2}{8} = 41{,}37 kN \cdot m;$$

$$Q^n = \frac{q^n \ell_0}{2} = \frac{9{,}72 \cdot 5{,}835}{2} = 28{,}36 kN.$$

When calculating strength of plate constructive cross section replacing on the calculated in the form of T beams (fig 3.14.).

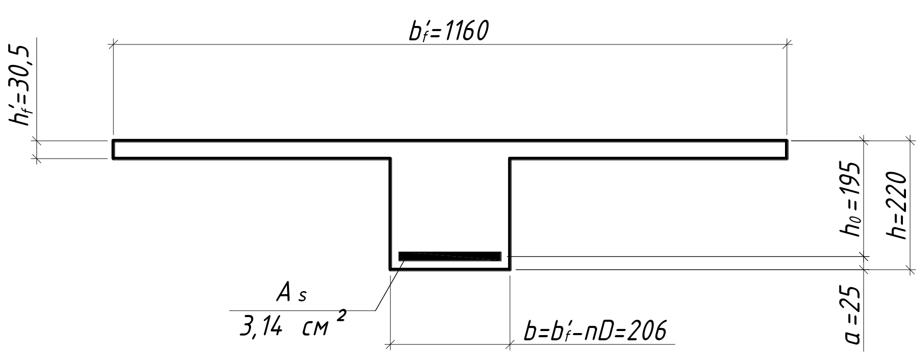


Fig. 3.4. The calculative scheme of plate

Determine the bearing capacity of normal cross section plate.

Working height of plate section $h_0 = h - a = 220 - 25 = 195mm$.

Determine the position of the neutral axis from the conditions

$R_s \cdot A_s \le \gamma_{b_2} \cdot R_b \cdot b'_f \cdot h'_f$

$510 \cdot 10^3 \cdot 314 \cdot 10^{-6} = 160{,}14\kappa H < 0{,}9 \cdot 14{,}5 \cdot 10^3 \cdot 1{,}16 \cdot 0{,}0305 = 461{,}71\kappa H$

Condition is satisfied, the neutral axis is in the shelves.

Determine the height of the compressed zone section

$$x = \frac{R_s \cdot A_s}{\gamma_{b_2} \cdot R_b \cdot b'_f} = \frac{51 \cdot 3{,}14}{0{,}9 \cdot 1{,}45 \cdot 116} = 1{,}06cm$$

The relative height of the compressed zone section

$$\xi = \frac{x}{h_0} = \frac{1{,}06}{19{,}5} = 0{,}054 < \xi_R = 0{,}52$$

Determine the bearing capacity of normal cross section.

Find the coefficient $A_0 =$ when $\xi = 0{,}054$ (by interpolation).

ξ	A_0
0,05	0,048
0,054	0,052
0,06	0,058

$M = A_0 \cdot \gamma_{b_2} \cdot R_b \cdot b'_f \cdot h_0^2 = 0{,}058 \cdot 0{,}9 \cdot 14{,}5 \cdot 10^3 \cdot 1{,}16 \cdot 0{,}195^2 = 33{,}39kN \cdot M$

Check the condition

$M \ge M_1$; $33{,}39\kappa H \cdot м < 49{,}03kN \cdot m$

The condition is not met, therefore, need strengthening of plate.

Amplification coefficient $k = \frac{M}{M_1} = \frac{49{,}03}{33{,}39} = 1{,}468$, etc. necessary to increase the strength of plate in flight on the 46,8%.

Calculation of strengthening plate by method increasing section

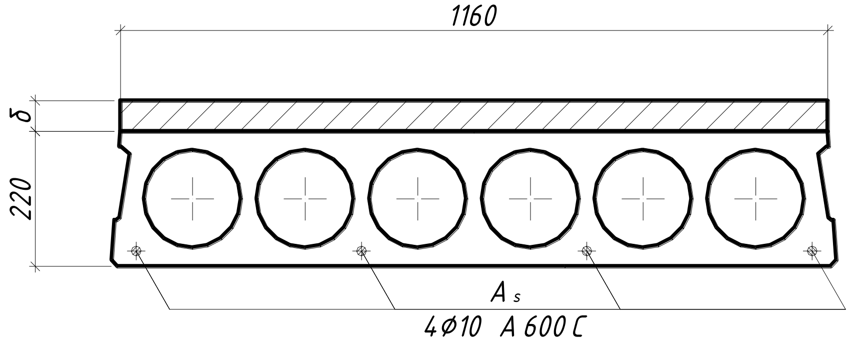


Fig. 3.5. The constructive cross section of plate with the strengthening

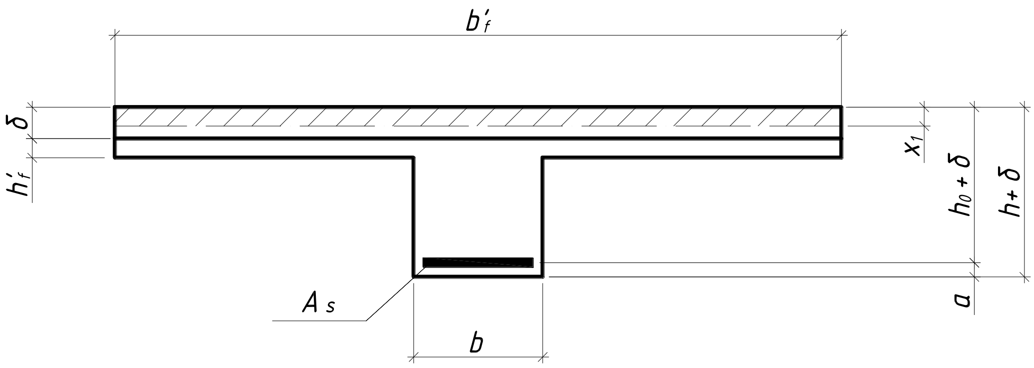


Fig. 3.6. The calculative scheme of plate with the strengthening

Take the class of concrete strengthening. Accept concrete class B30 (for a class higher than concrete of plate $R_b = 17MPa$).

Determine the height of the compressed zone, assuming, that the neutral axis lies within the thickness of the new concrete:

$$x_1 = \frac{R_s \cdot A_s}{\gamma_{b_2} \cdot R_{b1} \cdot b'_f} = \frac{51 \cdot 3{,}14}{0{,}9 \cdot 1{,}7 \cdot 116} = 0{,}9cm.$$

Determine the thickness of add concreting taking into account of it weigh actions in to the expression:

$$M_1 = \gamma_{b_2} \cdot R_{b1} \cdot b'_f \cdot x_1 \left(h_0 + \delta - 0{,}5x_1\right) - \frac{\rho \cdot \delta \cdot b'_f \, l_0^2 \cdot \gamma_f}{8};$$

$$\delta = \frac{M_1 - \gamma_{b_2} \cdot R_{b1} \cdot b'_f \cdot x_1 \left(h_0 - 0{,}5x_1\right)}{\gamma_{b_2} \cdot R_{b1} \cdot b'_f \cdot x_1 - \dfrac{\rho \cdot b'_f \, l_0^2 \cdot \gamma_f}{8}} = \frac{49{,}03 - 0{,}9 \cdot 17 \cdot 10^3 \cdot 1{,}16 \cdot 9{,}0 \cdot 10^{-3}\left(0{,}195 - 0{,}5 \cdot 9{,}0 \cdot 10^{-3}\right)}{0{,}9 \cdot 17 \cdot 10^3 \cdot 1{,}16 \cdot 9{,}0 \cdot 10^{-3} - \dfrac{25 \cdot 1{,}16 \cdot 5{,}835^2 \cdot 1{,}1}{8}} =$$

$$= 0{,}776 \text{м} = 776 mm$$

The thickness of the new concrete exceeds 100 mm, which is not good, because leads to a significant reduction of the useful height of the room. Perform strengthening by additional reinforcement.

Calculating strengthening of the plate by additional reiforcement

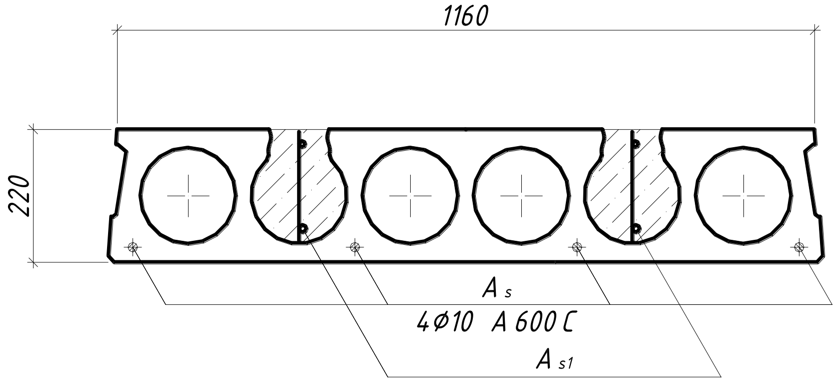


Fig. 3.7. Constructive section of the plate with strengthening

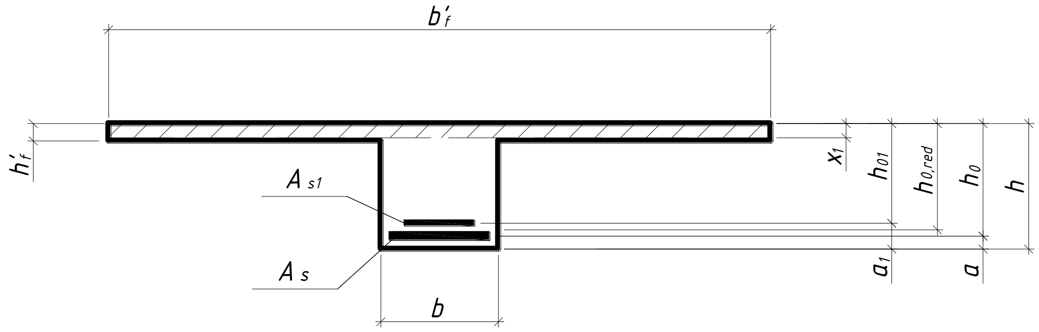


Fig. 3.8. Calculation section with strengthening plate

Check the condition

$$M_1 \le \gamma_{b_2} \cdot R_{b1} \cdot b'_f \cdot h'_f \left(h_{0,red} - 0{,}5h'_f\right),$$

де $h_{0,red} = \dfrac{h_0 + h_{01}}{2} = \dfrac{195 + 169}{2} = 182\,mm$

here to $h_{01} = h - a_1 = 220 - \left(30 + 8 + \dfrac{1}{2}25\right) \approx 169\,mm$;

$$49{,}03кН \cdot м < 0{,}9 \cdot 14{,}5 \cdot 10^3 \cdot 1{,}16 \cdot 0{,}0305\left(0{,}182 - 0{,}5 \cdot 0{,}0305\right) = 76{,}99 kN \cdot m .$$

Condition is satisfied, therefore, the neutral axis of amplified section is in the shelf.

Determine the coefficient A_0:

$$A_0 = \frac{M}{\gamma_{в_2} \cdot R_в \cdot b_f' \cdot h_{0,red}^2} = \frac{4903}{0{,}9 \cdot 1{,}45 \cdot 116 \cdot 18{,}2^2} = 0{,}098 < A_{0R} = 0{,}385$$

A_{0R} – required area of reinforcement.

Coefficient $\eta = 0{,}948$ (by interpolation).

η	A_0
0,95	0,095
0,948	0,098
0,945	0,104

Determine the required cross-sectional area of the total reinforcement

$$A_s^{nom} = \frac{M}{R_s \cdot h_0 \cdot \eta} = \frac{4903}{51 \cdot 18{,}2 \cdot 0{,}948} = 5{,}57 cm^2$$

Select the desired cross-sectional area additional of reinforcement class A 400C

$$A_{s1} = \left(A_s^{nom} - A_s\right)\frac{R_s}{R_{s1} \cdot m} = (5{,}57 - 3{,}14)\frac{510}{365 \cdot 0{,}95} = 3{,}57 cm^2,$$

where $m = 0{,}95$ - coefficient of working conditions of strengthening reinforcement in full discharge of overlap.

According to assortment of reinforcing steel accept: 2 Ø16 A 400C, $A_s = 4{,}02 cm^2$.

Determine the actual bearing capacity of normal cross section after amplification.

Check the condition

$$R_s A_s m_1 + R_{s1} A_{s1,f} m \le R_b \gamma_{b2} b'_f \, h'_f,$$

where $m = 1$ - coefficient (there is no welding strengthening rods to existing reinforcement);

$$510 \cdot 10^3 \cdot 314 \cdot 10^{-6} \cdot 1{,}0 + 365 \cdot 10^3 \cdot 402 \cdot 10^{-6} \cdot 0{,}95 = 299{,}53 кN < 14{,}5 \cdot 10^3 \cdot 0{,}9 \cdot 1{,}16 \cdot 0{,}0305 = 461{,}71 кN$$

Since the condition is satisfied, the neutral axis is in the shelf.

The height of the compressed zone

$$x_1 = \frac{R_s \cdot A_s \cdot m_1 + R_{s1} \cdot A_{s1,f} \cdot m}{\gamma_{b_2} \cdot R_b \cdot b'_f} = \frac{510 \cdot 10^3 \cdot 314 \cdot 10^{-6} \cdot 1{,}0 + 365 \cdot 10^3 \cdot 402 \cdot 10^{-6} \cdot 0{,}95}{0{,}9 \cdot 14{,}5 \cdot 10^3 \cdot 1{,}16} = 0{,}02 m$$

Working height amplified section

$$h_{0,red}^{(f)} = \frac{A_s \cdot m_1 \cdot h_0 + A_{s1,f} \cdot h_{01}}{A_s \cdot m_1 + A_{s1,f}} = \frac{314 \cdot 1{,}0 \cdot 195 + 402 \cdot 169}{314 \cdot 1{,}0 + 402} = 180\,mm$$

The relative height of the compressed zone

$$\xi = \frac{x_1}{h_{0,red}^{(f)}} = \frac{20}{180} = 0{,}111 < \xi_R = 0{,}52 .$$

Find the coefficients A_0 (by interpolation).

ξ	A_0
0,11	0,104
0,111	0,105
0,12	0,113

The actual bending moment

$$M_f = A_0 \cdot \gamma_{b_2} \cdot R_b \cdot b'_f \cdot h_{0,red}^{(f)\,2} = 0{,}105 \cdot 0{,}9 \cdot 14{,}5 \cdot 10^3 \cdot 1{,}16 \cdot 0{,}182^2 = 52{,}65 kN \cdot m > 49{,}03 kN \cdot m$$

Minimal margin of strength

$$\frac{M_f - M_1}{M_1} \cdot 100\% = \frac{52{,}65 - 49{,}03}{49{,}03} \cdot 100\% = 7{,}38\% .$$

Is generally recommended perform strengthening with the prospect of subsequent increased pressures. So, in this case it is necessary to predict such a way strengthening, which will allow to create larger margin of safety. This strengthening an additional reinforcement at simultaneous increasing cross section, that is combined method.

Calculation of strengthening plate by combined method

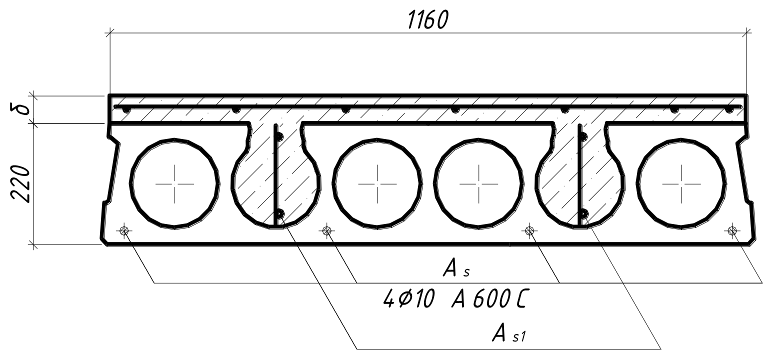


Fig. 3.9. Constructive section of the plate with strengthening.

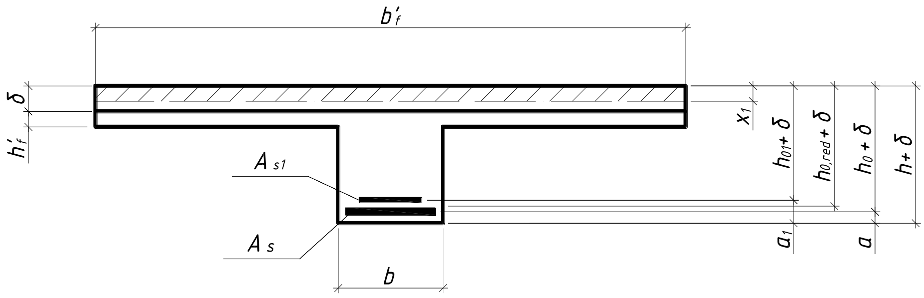


Fig. 3.10. Calculation section with strengthening plate

Assign additional concreting the minimum thickness $\delta = 50mm$. Accepted concrete class B30 (on class above the concrete plate $R_b = 17MPA$).

Check the condition

$$M_1 \le \gamma_{b_2} \cdot R_{b1} \cdot b'_f \cdot \delta\left[\left(h_{0,red} + \delta\right) - 0,5\delta\right];$$

$$49,03кН \cdot м < 0,9 \cdot 17 \cdot 10^3 \cdot 1,16 \cdot 0,05\left[\left(0,182 + 0,05\right) - 0,5 \cdot 0,05\right] = 183,69 kN \cdot m$$

Condition is satisfied, therefore, the neutral axis is within the new concrete which is goodbecause should endeavor to ensure that the neutral axis was held in additional concreting).

Determine the coefficient A_0:

$$A_0 = \frac{M_1}{\gamma_{b_2} \cdot R_{b1} \cdot b_f' \cdot \left(h_{0,red} + \delta\right)^2} = \frac{4903}{0,9 \cdot 1,7 \cdot 116 \cdot \left(18,2 + 5\right)^2} = 0,051 < A_{0R} = 0,413$$

$A_{0R} = 0,413$ – required area of reinforcement.

Find the coefficients η (by interpolation).

η	A_0
0,975	0,048
0,9735	0,051
0,97	0,058

Need a total area of reinforcement

$$A_s^{nom} = \frac{M_1}{R_s \cdot \left(h_{0,red} + \delta\right) \cdot \eta} = \frac{4903}{51 \cdot \left(18,2 + 5\right) \cdot 0,9735} = 4,26 cm^2$$

Select the desired cross-sectional area additional of reinforcement class A 400C

$$A_{s1} = \left(A_s^{nom} - A_s\right)\frac{R_s}{R_{s1} \cdot m} = \left(4,26 - 3,14\right)\frac{510}{365 \cdot 0,95} = 1,65 cm^2,$$

Accepted 2 Ø12 A 400C, $A_s = 2{,}26cm^2$.

Determine the actual bearing capacity of normal cross section after amplification.

The height of the compressed zone

$$x_1 = \frac{R_s \cdot A_s + R_{s1} \cdot A_{s1,f} \cdot m}{\gamma_{b_2} \cdot R_{b1} \cdot b'_f} = \frac{510 \cdot 314 + 365 \cdot 226 \cdot 0{,}95}{17 \cdot 0{,}9 \cdot 1160} = 13{,}44mm$$

Working height amplified section

$$h_{0,red}^{(f)} = \frac{A_s \cdot h_0 + A_{s1,f} \cdot h_{01}}{A_s + A_{s1,f}} = \frac{314 \cdot 195 + 226 \cdot 169}{314 + 226} = 184mm$$

The relative height of the compressed zone amplified cross section

$$\xi = \frac{x_1}{h_{0,red}^{(f)} + \delta} = \frac{13{,}44}{184 + 50} = 0{,}06 < \xi_R = 0{,}582 \ .$$

Coefficients $A_0 = 0{,}058$

The actual bending moment which is perceived by plate section, which is strengthening by combined method

$$M_f = A_0 \cdot \gamma_{b_2} \cdot R_{b1} \cdot b'_f \cdot \left(h_{0,red}^{(f)} + \delta\right)^2 = 0{,}058 \cdot 0{,}9 \cdot 17 \cdot 10^3 \cdot 1{,}16 \cdot \left(0{,}184 + 0{,}05\right)^2 = 56{,}37\text{кН} \cdot \text{м} > 49{,}03\text{кН} \cdot \text{м}$$

Minimal margin of strength

$$\frac{M_f - M_1}{M_1} \cdot 100\% = \frac{56{,}37 - 49{,}03}{49{,}03} \cdot 100\% = 14{,}97\% .$$

Accepts two frames FR-1 with the bottom reinforcement ∅12 A 400 C ($A_s = 1{,}131\text{см}^2$)and upper reinforcement ∅6 A 240 C ($A'_s = 0{,}283cm^2$), transverse rods with reinforcement ∅6 A 240 C with a step ¼ span - 100 mm, in the middle of the span – 200 mm. Additional concreting is reinforced grid C-1 with a armature ∅5 Bp-I, ($A'_s = 0{,}196cm^2$).

3.3. Evaluation of existing foundations and conditions of the site

Engineering and geological conditions of the site

Engineering and geological site conditions characterized by sustained horizontal bedding layers of soil. Make the three wells, distance between them is 30-50 m. The basic physical parameters of soil are given in Table 4.1., 4.2.

Table 3.3.

The geological conditions of the construction site

№ IGE	Name of soil	№ and mark the well bore and the power layer		
		WS 1 132,05	WS 2 131,75	WS 3 131,30
1	Backfill	1,20	1,10	0,80
2	Fine sand	3,60	3,90	4,00
3	Medium grained sand	2,50	2,20	2,00
4	Loam yellowish-gray	3,80	3,60	3,50
	Depth to groundwater	7,80	7,90	7,70

Table 3.4.

Characteristics of soil properties

№ r.n.	Name	Cond. Mark.	Data unit	Номер шару			
				IGE -1	IGE -2	IGE -3	IGE -4
1	Density	ρ	t/m^3	1,67	1,91	1,95	1,85
2	The density of particles	ρ_s	t/m^3	–	2,72	2,71	2,73
3	Natural moisture	W	–	–	0,09	0,12	0,24
4	Moisture on the the boundary fluidity	W_m	–	–	–	–	0,29
5	Moisture on the boundary of rolling	W_r	–	–	–	–	0,19
6	Coefficient of the filtration	k_f	cm / s	–	–	–	–
7	The angle of internal friction	φ	grad.	–	32	34	22
8	Specific adhesion	C	kPa	–	4	2	29
9	Module of deformation	E	MPa	–	37	38	19

Evaluation of soil conditions of the construction site

Conclusions on soil conditions of the construction site:

1. The soil IGE-1 as a natural basis can not be used;

2. The soil IGE-2, IGE-3, suitable for their use as a natural basis of the calculated values, the provided in table. Moreover as a base layer for shallow foundations necessary to use fine sand IGE-2;

3. Groundwater lie at depths 7,3-7,9 m from the surface and on the base and foundations do not affect.

Checking the sufficiency the size of the foundation which is operated

Check the adequacy of the depth of laying.

Depth of laying the foundations for building with technical underground or basement depends, basically, from their height, ie. adopted by constructive reasoning. In our case the depth of laying the foundation from the level of pure floor 1st floor

is: $d_к = 0{,}3 + 1{,}6 + 0{,}5 = 2{,}4m$, where 0,3 m – height of the overlapping above technical floor; 1,6 m – height of the technical floor; 0,5 m – distance from the level technical floor to the foundation base. Determine an altitude of the sole foundation: $d_a = 132{,}50 - 2{,}4 = 130{,}10m$, where 132,50 m – an altitude of pure floor 1st floor of the existing building. Thus, as the largest the depth of occurance of a bulk soil is situated on the mark 130,50 m, thus the base for foundation serve fine little wet sand, of dense bedding, with the calculated resistance $R_0 = 400kPa$.

Determine the load on at the sole of foundation.

First determine the load on the top ledge of foundation.

Load from covering, overlap and walls accept from preliminary calculations with the necessary corrections. Since we have the shallow foundation calculate the area of 1 r.m. of foundation. The cargo area: $A_в = 1{,}0 \cdot 6{,}0 = 6{,}0m^2$.

Load on the 1 running meters of foundation:

- from covering:

normative at $q^n_{\text{cov}} = 6{,}6\,kN/m^2$; $N^n_{\text{cov}} = q^n_{\text{cov}} \cdot A_в = 6{,}6 \cdot 6{,}0 = 39{,}6\,kN/m$,

estimated at $q_{\text{cov}} = 8{,}1\,kN/m^2$; $N_{\text{cov}} = q_{\text{cov}} \cdot A_в = 8{,}1 \cdot 6{,}0 = 48{,}6\,kN/m$;

- from the overlap:

normative $q^n_{\text{ove}} = 8{,}1\,kN/m^2$; $N^n_{ove} = q^n_{ove} \cdot A_в = 8{,}1 \cdot 6{,}0 = 48{,}6\,kN/m$,

calculated $q_{\text{ove}} = 9{,}6\,kN/m^2$; $N_{ove} = q_{ove} \cdot A_в = 9{,}6 \cdot 6{,}0 = 57{,}6\,kN/m$;

- from its own weight the wall

normative $N^n_w = n \cdot h \cdot H_{tot} \cdot \rho \cdot 1{,}3 = 3 \cdot 0{,}38 \cdot 3{,}3 \cdot 18 \cdot 1{,}3 = 88{,}0\,kN/m$,

calculated $N_w = n \cdot h \cdot H_{tot} \cdot \rho \cdot \gamma_f \cdot 1{,}3 = 3 \cdot 0{,}38 \cdot 3{,}3 \cdot 18 \cdot 1{,}1 \cdot 1{,}3 = 96{,}8\,kN/m$.

- total value of the longitudinal force on the trim of the foundation:

normative $N^n_1 = N^n_{\text{cov}} + n \cdot N^n_{ove} + N^n_w = 39{,}6 + 3 \cdot 48{,}6 + 88{,}0 = 273{,}4\,kN/m$,

calculated $N_1 = N_{\text{cov}} + n \cdot N_{ove} + N_w = 48{,}6 + 3 \cdot 57{,}6 + 96{,}8 = 318{,}2\,kN/m$.

Determine the gravity load of the foundation:

normative $N^n_2 = 1{,}8 \cdot 0{,}4 \cdot 25 + 0{,}3 \cdot 1{,}2 \cdot 25 = 27{,}0\,kN/m$.

Determine the load on the weight of soil on ledges of foundation:

normative $N^n_3 = 0{,}2 \cdot (1{,}2 - 0{,}4) \cdot 22 = 3{,}5\,kN/m$.

The total regulatory load on the level of sole foundation:

$$N^n = N^n_1 + N^n_2 + N^n_3 = 273{,}4 + 27{,}0 + 3{,}5 = 303{,}9\,kN/m.$$

The average stress at the level of sole foundation:

$$\sigma_{mt} = \frac{N^n}{b \cdot 1{,}0} = \frac{303{,}9}{1{,}2 \cdot 1{,}0} = 253{,}25\,kPa,$$

where $b = 1{,}2m$ - width of the soles existing foundation.

Estimated resistance of soil:

$$R = R_1 = \frac{\gamma_{c1}\gamma_{c2}}{k}\left[M_\gamma k_z b\gamma_{II} + M_q d_1 \gamma'_{II} + \left(M_q - 1\right) d_b \gamma'_{II} + M_c c_{II}\right] =$$

$$= \frac{1{,}3 \cdot 1{,}1}{1{,}0}\left(1{,}34 \cdot 1{,}0 \cdot 1{,}2 \cdot 19{,}1 + 6{,}34 \cdot 0{,}56 \cdot 18{,}6 + \left(6{,}34 - 1\right)0{,}7 \cdot 18{,}6 + 8{,}55 \cdot 4{,}0\right) = 286{,}9 kPa,$$

where:

$\gamma_{c1} = 1{,}3$

$\gamma_{c2} = 1{,}1$, when

$L/H = 52{,}4/12 = 4{,}4$

} - coefficients of working conditions,

$k = 1$ - coefficient, at the strength characteristics of the soil (φ and c) determined by direct testing,

$M_\gamma = 1{,}34$

$M_q = 6{,}34$

$M_c = 8{,}55$

} - coefficients,

$k_z = 1$ - when $b < 10$m,

$b = 1{,}2m$ - width sole foundation,

$\gamma_{II} = 19{,}1 kN/m^3$ - the average estimated value of the share of of soil, that lying below the foundation base,

$\gamma'_{II} = \frac{\gamma_1 \cdot h_1 + \gamma_2 \cdot h_2}{h_1 + h_2} = \frac{16{,}7 \cdot 1{,}0 + 19{,}1 \cdot 3{,}8}{1{,}0 + 3{,}8} = 18{,}6 kN/m^3$ - the same as lying above the soles,

$c_{II} = 4kPa$ - the calculated value of the specific adhesion of soil, which lies directly under the sole foundation,

$d_1 = 0{,}15 + 0{,}35\frac{22{,}0}{18{,}6} = 0{,}56m$ - the depth of occurance foundations from the basement floor, where $0{,}15m$ - the thickness of the soil layer above the soles,

$0{,}35m$ - the thickness of the constructions basement floor,

$22{,}0\,kN/m^3$ - calculated value of the share of the construction basement floor,

$d_b = 0{,}7m$ - basement depth, distance from the level of planning to the floor basement.

Check the condition:

$\sigma_{mt} \le R$, $253{,}25\,кПа < 286{,}9\,kPa$

Condition is satisfied, the building can be operated.

Calculat the sedimentation of the foundation:

$$S = A_0 \cdot b \cdot \frac{\sigma_{mt}}{E} = 2{,}1 \cdot 1{,}2 \cdot \frac{253{,}25}{37 \cdot 10^3} = 0{,}007\,м = 0{,}7cm,$$

where $A_0 = 2{,}1$ - coefficient that depends on the lateral expansion of the soil, form and brutality of foundation and the method for determining E, adopted as a cruel strip reinforced concrete foundation.

Check the condition:

$S \le S_u$, $0{,}7см < 8{,}0cm$,

where $S_u = 8{,}0cm$ - allowable values of subsidence.

Condition is satisfied. Subsidence does not exceed the permissible value.

3.4. Calculation of strengthening existing foundations

Conditions of reconstruction, which influence on strengthening the base and foundation of structure

Subject to reconstruction the load on the top ledge of foundation significantly increased by increasing the number of floors.

Gravity load the walls will be:

normative $N_w^n = n \cdot h \cdot H_{tot} \cdot \rho \cdot 1{,}3 = 5 \cdot 0{,}38 \cdot 3{,}3 \cdot 18 \cdot 1{,}3 = 146{,}7\,kN/m$,

calculated $N_w = n \cdot h \cdot H_{tot} \cdot \rho \cdot \gamma_f \cdot 1{,}3 = 5 \cdot 0{,}38 \cdot 3{,}3 \cdot 18 \cdot 1{,}1 \cdot 1{,}3 = 161{,}4\,kN/m$.

- total value of the longitudinal force on the top ledge of foundation:

normative $N_1^n = N_{\text{cov}}^n + n \cdot N_{ove}^n + N_w^n = 39{,}6 + 5 \cdot 48{,}6 + 146{,}7 = 429{,}3\,kN/m$,

calculated $N_1 = N_{\text{cov}} + n \cdot N_{ove} + N_w = 48{,}6 + 5 \cdot 57{,}6 + 161{,}4 = 498{,}0\,kN/m$.

The total regulatory load on the level of sole foundation:

$$N^n = N_1^n + N_2^n + N_3^n = 429{,}3 + 27{,}0 + 3{,}5 = 459{,}8\,kN/m.$$

The average stress at the level of sole foundation:

$$\sigma_{mt} = \frac{N^n}{b \cdot 1{,}0} = \frac{459{,}8}{1{,}2 \cdot 1{,}0} = 383{,}2\,kPa$$

Estimated resistance of soil:

$$R = R_1 = \frac{\gamma_{c1}\gamma_{c2}}{k}\left[M_\gamma k_z b \gamma_{II} + M_q d_1 \gamma'_{II} + \left(M_q - 1\right) d_b \gamma'_{II} + M_c c_{II}\right] =$$
$$= \frac{1{,}3 \cdot 1{,}1}{1{,}0}\left(1{,}34 \cdot 1{,}0 \cdot 1{,}2 \cdot 19{,}1 + 6{,}34 \cdot 0{,}56 \cdot 18{,}6 + \left(6{,}34 - 1\right)0{,}7 \cdot 18{,}6 + 8{,}55 \cdot 4{,}0\right) = 286{,}9\,kPa,$$

Check fulfill the condition:

$\sigma_{mt} \le R$, $383{,}2\,kPa > 286{,}9\,kPa$

The condition is not met, requires strengthening of foundation.

Amplification coefficient $k = \frac{\sigma_{mt}}{R} = \frac{383{,}2}{286{,}9} = 1{,}336$, ie. necessary to increase the bearing capacity of foundation on the 33,6%.

Possibe options to strenthen the foundations

Considering the overstrin on the sole existing founation, it can be strengthned in several ways. The choice of method strengtening and reconstruction of shallw foundations depends on the cause, which requires such strengthening, design features of existing foundations and soil conditions of the site. As a rule, applying such methods:

- strengthening the foundations by sylicatisation,

- by increasing the width of the sole,
- by increasing the depth of laying,
- by transfer to the pile,
- Placing of new foundations.

In our case, accept strengthening strip foundations by increasing the width of the sole, because it is the easiest to performance.

Strengthening of the shallow foundation by expansion of its sole.

Strengthening of the foundation is made by extending its foot on both sides at the concreting reinforced concrete strips. For the, to make these new areas involved in the work of foundation, over them impose traverse - double cantilever beam, embedded on fine concrete to the body of foundation. In advance over existing foundation pillow in blocks punch holes , usually with a step 1,0-1,5 m, through which the wind traverses. They are made of a pair of channels or T beams and after concreting bands also concreted so they are not subjected to corrosion.

Calculation of strengthening of foundation.

Since the foundation is tape, counting area of foundation with length $l = 100 cm$.

Determine the desired width of the sole foundation:

$$b_1 = \frac{N^n}{R \cdot l} = \frac{459,8}{286,9 \cdot 1,0} = 1,60 m.$$

Specify regulatory load from its own weight of foundation:

$$N_2^n = 1,6 \cdot 0,4 \cdot 25 + 0,5 \cdot 1,6 \cdot 25 = 36\, kN/m.$$

Load from the weight of the soil on ledges of foundation not will $N_3^n = 0$.

The total regulatory burden at the foot of foundation:

$$N^n = N_1^n + N_2^n + N_3^n = 429,3 + 36,0 + 0 = 465,3\, kN/m.$$

The average strain at the foot of foundation:

$$\sigma_{mt} = \frac{N^n}{b \cdot 1{,}0} = \frac{465{,}3}{1{,}6 \cdot 1{,}0} = 290{,}8kPa$$

Estimated resistance of the soil at the $d_1 = 0{,}5m$:

$$R = R_1 = \frac{\gamma_{c1}\gamma_{c2}}{k}\left[M_\gamma k_z b\gamma_{II} + M_q d_1\gamma'_{II} + (M_q - 1)d_b\gamma'_{II} + M_c c_{II}\right] =$$
$$= \frac{1{,}3 \cdot 1{,}1}{1{,}0}(1{,}34 \cdot 1{,}0 \cdot 1{,}6 \cdot 19{,}1 + 6{,}34 \cdot 0{,}5 \cdot 25 + (6{,}34 - 1)0{,}7 \cdot 18{,}6 + 8{,}55 \cdot 4{,}0) = 320{,}2kPa,$$

Check fulfill the condition:

$\sigma_{mt} \le R$, $290{,}8kPa < 320{,}2kPa$.

Condition is satisfied, the width of the sole foundation is sufficient.

The safety margin is $\frac{R - \sigma_{mt}}{\sigma_{mt}} \cdot 100\% = \frac{320{,}2 - 290{,}8}{290{,}8} \cdot 100\% = 10{,}11\%$.

Calculates subsidence of foundation:

$$S = A_0 \cdot b \cdot \frac{\sigma_{mt}}{E} = 2{,}1 \cdot 1{,}6 \cdot \frac{290{,}8}{37 \cdot 10^3} = 0{,}026m = 2{,}6cm.$$

Check the fulfill condition:

$S \le S_u$, $2{,}6cm < 8{,}0cm$,

where $S_u = 8{,}0cm$ - allowable values of subsidence.

Condition is satisfied. Draught does not exceed the permissible value.

We develop the construction of foundations strengthening.

Accept a step travers $l_1 = 1{,}2m$, the height of the amplifying concreting 0,5 m.

The width bands concreting of foundation on each side:

$b_c = 0{,}5(b_1 - b) = 0{,}5(1{,}60 - 1{,}20) = 0{,}20м = 20{,}0cm$,

The load, that is perceived a foundation from the reactive soil pressure $\sigma_{гр} = R = 290{,}8кПа = 290{,}8 \cdot 10^{-4}\ kN/cm^2$ on the width $b_c = 20{,}0cm$ and length $l_1 = 120cm$ equal:

$R_{b_c} = \sigma_{гр} \cdot l \cdot b_c = 290{,}8 \cdot 10^{-4} \cdot 120 \cdot 20 = 69{,}8kN$.

This load is perceived by each console traverse and causes in it bending moment:

$$M_{b_c} = R_{b_c} \cdot l_n = 69{,}8 \cdot \left(\frac{1{,}6 - 0{,}4}{2} \right) = 41{,}88 kN \cdot m.$$

Accept the cross section of traverses with T beam. Required moment of resistance Wtr equal:

$$W_{tr} = \frac{M_{b_c}}{R} = \frac{418800}{2350} = 178{,}2 cm^3,$$

where R - calculated resistance of steel VSt3ps.

Accept traverse of two channel bar №16:

$$W_x = 93{,}4 \times 2 = 186{,}8 cm^3.$$

New band of foundation with width b_c work as a continuous reinforced-concrete beams. They perceive reactive ground pressure and lean on top of traverse.

Estimated moment in this beams is equal:

$$M = \frac{q_{gr} \cdot l_1^2}{12} = \frac{58{,}16 \cdot 1{,}2^2}{12} = 6{,}98 kN \cdot m,$$

where $q_{gr} = \sigma_{gr} \cdot b_c = 290{,}8 \cdot 0{,}2 = 58{,}16\, kN/m$.

We set the height of the of foundation strengthening (reinforced concrete strips) 30 cm and a protective layer of concrete to the working reinforcement 70 mm, concreting from concrete class B15 ($R_b = 0{,}9 \cdot 8{,}5 = 7{,}65 MPa$), armature class A 400C ($R_s = 365 MPa$).We have a working the height of the cross section beam $h_0 = 300 - 70 = 230 mm$.

Determine $A_0 = \frac{M}{R_b \cdot b_c \cdot h_0^2} = \frac{698}{0{,}765 \cdot 20 \cdot 23^2} = 0{,}086 < A_R = 0{,}44$.

Find the coefficients $\eta = 0{,}9545$ when $A_0 = 0{,}086$.

Required sectional area of armature:

$$A_s^{nes} = \frac{M}{R_s \cdot h_0 \cdot \eta} = \frac{698}{36{,}5 \cdot 23 \cdot 0{,}9545} = 0{,}87 cm^2$$

From constructive reasons when $b_c > 150 mm$ accept two frames with the upper and lower armature from ∅8A 400 C ($A_s = 2 \times 0{,}503 = 1{,}01 mm^2$),transverse rods of the armature from ∅6 A 240 C with a step 250 mm.

4. Organization of construction

4.1. Abstract

The uncertainty in undertaking a construction project comes from many sources and often involves many participants in the project. Since each participant tries to minimize its own risk, the conflicts among various participants can be detrimental to the project. Only the owner has the power to moderate such conflicts as it alone holds the key to risk assignment through proper contractual relations with other participants.

Failure to recognize this responsibility by the owner often leads to undesirable results. In recent years, the concept of "risk sharing/risk assignment" contracts has gained acceptance by the federal government. Since this type of contract acknowledges the responsibilities of the owners, the contract prices are expected to be lower than those in which all risks are assigned to contractors.

In approaching the problem of uncertainty, it is important to recognize that incentives must be provided if any of the participants is expected to take a greater risk. The willingness of a participant to accept risks often reflects the professional competence of that participant as well as its propensity to risk.

However, society's perception of the potential liabilities of the participant can affect the attitude of risk-taking for all participants. When a claim is made against one of the participants, it is difficult for the public to know whether a fraud has been committed, or simply that an accident has occurred.

Risks in construction projects may be classified in a number of ways. One form of classification is as follows:

- Socioeconomic factors
  - Environmental protection
  - Public safety regulation
  - Economic instability
  - Exchange rate fluctuation
- Organizational relationships

Contractual relations

Attitudes of participants

Communication

Technological problems

Design assumptions

Site conditions

Construction procedures

Construction occupational safety

The environmental protection movement has contributed to the uncertainty for construction because of the inability to know what will be required and how long it will take to obtain approval from the regulatory agencies. The requirements of continued re-evaluation of problems and the lack of definitive criteria which are practical have also resulted in added costs.

Public safety regulations have similar effects, which have been most noticeable in the energy field involving nuclear power plants and coal mining. The situation has created constantly shifting guidelines for engineers, constructors and owners as projects move through the stages of planning to construction.

These moving targets add a significant new dimension of uncertainty which can make it virtually impossible to schedule and complete work at budgeted cost. Economic conditions of the past decade have further reinforced the climate of uncertainty with high inflation and interest rates. The deregulation of financial institutions has also generated unanticipated problems related to the financing of construction.

Uncertainty stemming from regulatory agencies, environmental issues and financial aspects of construction should be at least mitigated or ideally eliminated. Owners are keenly interested in achieving some form of breakthrough that will lower the costs of projects and mitigate or eliminate lengthy delays. Such breakthroughs are seldom planned. Generally, they happen when the right conditions exist, such as when innovation is permitted or when a basis for incentive or reward exists. However, there is a long way to go before a true partnership of all parties involved can be forged.

During periods of economic expansion, major capital expenditures are made by industries and bid up the cost of construction. In order to control costs, some owners attempt to use fixed price contracts so that the risks of unforeseen contingencies related to an overheated economy are passed on to contractors. However, contractors will raise their prices to compensate for the additional risks.

The risks related to organizational relationships may appear to be unnecessary but are quite real. Strained relationships may develop between various organizations involved in the design/construct process.

When problems occur, discussions often center on responsibilities rather than project needs at a time when the focus should be on solving the problems. Cooperation and communication between the parties are discouraged for fear of the effects of impending litigation. This barrier to communication results from the ill-conceived notion that uncertainties resulting from technological problems can be eliminated by appropriate contract terms. The net result has been an increase in the costs of constructed facilities.

The risks related to technological problems are familiar to the design/construct professions which have some degree of control over this category. However, because of rapid advances in new technologies which present new problems to designers and constructors, technological risk has become greater in many instances.

Certain design assumptions which have served the professions well in the past may become obsolete in dealing with new types of facilities which may have greater complexity or scale or both.

Site conditions, particularly subsurface conditions which always present some degree of uncertainty, can create an even greater degree of uncertainty for facilities with heretofore unknown characteristics during operation.

Because construction procedures may not have been fully anticipated, the design may have to be modified after construction has begun.

An example of facilities which have encountered such uncertainty is the nuclear power plant, and many owners, designers and contractors have suffered for undertaking such projects.

If each of the problems cited above can cause uncertainty, the combination of such problems is often regarded by all parties as being out of control and inherently risky.

Thus, the issue of liability has taken on major proportions and has influenced the practices of engineers and constructors, who in turn have influenced the actions of the owners.

Many owners have begun to understand the problems of risks and are seeking to address some of these problems.

For example, some owners are turning to those organizations that offer complete capabilities in planning, design, and construction, and tend to avoid breaking the project into major components to be undertaken individually by specialty participants.

Proper coordination throughout the project duration and good organizational communication can avoid delays and costs resulting from fragmentation of services, even though the components from various services are eventually integrated.

Attitudes of cooperation can be readily applied to the private sector, but only in special circumstances can they be applied to the public sector.

The ability to deal with complex issues is often precluded in the competitive bidding which is usually required in the public sector.

The situation becomes more difficult with the proliferation of regulatory requirements and resulting delays in design and construction while awaiting approvals from government officials who do not participate in the risks of the project.

4.2. Organization of major repairs.

Replacing window and door slots, sloping and facade insulation - a comprehensive event that requires building rules. In a comprehensive process the implementation of the work includes preparatory, basic and accompanying their transport processes.

Before starting work, the following steps must be taken: - agree volumes, technological sequence and timing of construction work; - to compile and agree the list of services of the customer and his technical means, which they can be used by builders in the execution of work; to define and agree terms of organization of complex and priority delivery materials, transportation and warehousing.

Capital repairs must be performed in conjunction with using mechanization. The project stipulates that construction is being carried out by forces construction organization, whose permanent staff is provided with housing and necessary cultural services.

The work performed on the scaffolding must be carried out using an installation belt to be in working order. The mounting belt must be locked in place specified in the JHA.

The design of the work must include hazardous areas to be identified according to Norms. Construction works during ice, fog, rain and heavy wind is forbidden. Concrete mixtures, finishing solutions, mastics, which manufactured on site, must comply with the requirements of applicable building codes.

Equipment, implements and tools must comply with the requirements of Norms. At work in hazardous areas requires the organization of an admission system. After the completion of the construction contractor transfers the object to the customer.

Expected construction time is 2 months

5. Technology of construction

5.1. Construction Process and Methods

The structure of the building is divided into two parts. The sub-structure and the super structure. The lower portion of the building which transmits the load of the super structure to the foundation soil is called sub-structure and the portion of the building which is above the substructure is called super structure. The weight of superstructure is borne by the foundation hence the foundation should be strong enough to carry the load of the super structure.

OBJECTIVES

After going through this lesson you will be able to:

- describe the working of various equipments used in construction work;
- explain the importance of foundation;
- explain about the super structure and its importance;
- enumerate the type of construction;
- describe the method of laying out the proposed construction plan.

REQUIREMENTS OF FOUNDATION

1. The foundation of sub-structure distributes the load of the building evenly

Certificate in Construction Supervision (CIVIL)

on the soil in such a way that at not below the foundation the soil pressure exceeds the maximum allowable bearing capacity of soil.

2. It helps in strengthening the building against the lateral forces caused due to tornado, earthquake, etc.

3. It provides strong surface for the construction of proposed structure.

4. To provide safety to the structure from flow of water and seepage.

AIM OF SUPERSTRUCTURE

The aim of providing super-structure is to provide support in the construction of building as per designed plan and various members of super-structure such as columns and beams are designed to provide strength for carrying the dead load and live load expected to come on the various parts of the structure in a safe and well distributed manner.

TYPES OF CONSTRUCTION

Construction can be of following types:

1. Building development/construction
2. Road construction
3. Electricity distribution
4. Water supply structure
5. Sewerage construction
6. Drains etc.

AIM OF SITE INSPECTION

Aims of site inspectoin are:

1. Inspection of site for foundation.
2. Behaviour of soil near proposed wall and thickness of layers of soil deposits.
3. Changes in soil behaviour and in depth of water Table.
4. Direction of flow of water and its drainage
5. Movement in earth layer due to any reason if any.

SITE CLEARANCE

Before starting any construction work it becomes necessary to clear the place from the unwanted grass, jungles, trees and plants etc. In case of any hill like appearance on the ground, that too needs to be cleared of the excess earth and if there is a pit, it is required to be filled up.

This total job is called site clearance. Only after the site clearance lay out of the structure at site can be planned. At the time of clearing of the site it should be remembered that any plant whose girth is more than 30 cm above the ground is designated as tree, and no tree can be removed without taking permission from the appropriate authority.

In this way clearance of site of the unwanted jungles, shrubs, trees etc. and keeping of felled trees at a distance away upto 10 m or more forms the part of the agreement of the contractor for which payment are required to be made and all these things are written in the agreement paper, which is required for explaining the terms and conditions.

LAYING OUT THE BUILDING PLAN AT SITE FOR FOUNDATION

The total load of all the wall etc. including that of the beams and columns final come on the ground which is called foundation soil. Engineers at site and design office decide the size of foundation for their foundation i.e. depth, length and breadth etc. and type of foundation.

Work Methodology

1. In the layout plan you will observe the size of construction in the plot and also the distances which should be left out of construction from the boundaries. This is called set back distance from the boundary wall. This is clearly shown in the layout plan.

2. It is required to draw line on the ground of the proposed construction. It is done by putting lime powder along a string stretched along the proposed line of construction. These lines extend at least one meter away from the actual end lines and they are called reference lines. They remain even after the earth digging or cutting is over for foundation work.

3. A bench Mark pillar is also constructed at site which gives the level of plinth and foundation etc. permanently. Water level marks are used for this purpose. This bench mark is required to be secured till the end of the construction.

4. The map will be kept in proper orientation with respect to the site. Generally the longest wall of the building is considered as base line.

Everyone involved in construction work has health and safety duties when carrying out the work.

The primary duty under the WHS Act requires a person conducting a business or undertaking to ensure, so far as is reasonably practicable, that workers and other persons are not exposed to health and safety risks arising from the business or undertaking.

The complexity of construction work, however, means that there are a number of businesses or undertakings with duties relating to construction work, ranging from a person conducting a business or undertaking who:„ designs the building or structure „ commissions the construction work „ is a principal contractor „ has management or control of a workplace at which construction work is carried out „ carries out high risk construction work. There are also other duty holders that have responsibilities under the WHS Act and Regulations including: „ officers (e.g. company directors) „ workers „ other persons (e.g visitors to construction sites). It is common in the construction industry for a person to have dual roles. For example, contractors and subcontractors can be persons conducting a business or undertaking but they may also be workers.

This is recognised in the WHS Act, which provides that a person can have more than one duty by virtue of being in more than one class of duty holder.

The WHS Act provides that more than one person can have the same duty and requires that such persons comply with those duties to the standard required, even if another duty holder has the same duty. This is, however, qualified by the extent to which the person has the capacity to influence and control the matter or would have had that capacity but for an agreement or arrangement purporting to limit or remove that capacity.

The WHS Act requires such duty holders to consult, cooperate and coordinate activities with all other persons who have a duty in relation to the same matter, so far as is reasonably practicable. While this is a specific obligation under the WHS Act, it can also be seen as a practical way in which dual duty holders can ensure that they each fulfil their obligations under the WHS Act and Regulations.

At any one time there is generally a number of business operators working at a construction site. Some of these people will have the same duties under the WHS Act and Regulations. For example, each contractor or subcontractor at the site who is a person conducting a business or undertaking will have the same duties under the WHS Act and Regulations.

The WHS Act requires a designer to:

- so far as is reasonably practicable, ensure that the structure is designed to be without risks to the health and safety of persons who:

- at a workplace, use the structure for a purpose for which it was designed „ construct the structure at a workplace

- carry out any reasonably foreseeable activity at the workplace in relation to the manufacture, assembly or use of the structure for a purpose for which it was designed or the proper demolition or disposal of the structure

- are at or in the vicinity of a workplace and who are exposed to the structure at the workplace or whose health may be affected by a use or activity referred to in the preceding dot points

- carry out, or arrange for the carrying out of, any calculations, analysis, testing or examination that may be necessary for the performance of their duties

- give adequate information to each person who is provided with the design for the purpose of giving effect to it concerning:

- each purpose for which the structure was designed

- the results of any calculations, analysis, testing or examination

- any conditions necessary to ensure that the structure is without risks to health and safety when used for a purpose for which it was designed or when carrying out any activity referred to above

- on request, so far as is reasonably practicable, give current relevant information on the matters referred to above to a person who carries out or is to carry out any of the activities referred to above.

When measuring the slots, the window sill, ebb, mosquito nets, the alignment of window blocks vertically and horizontally. Measurement results make out a letter of measurement. The minimum slot size is taken as the basis. If the slot is not allows to provide a minimum clearance for the connecting seam around the perimeter, then about this fact must be notified in writing to the customer and a protocol must be drawn up approval for additional works, in accordance with DSTU-N B B.2.6-146: 2010. During measurement should determine the rectangle of the slot to account for possible warps.

Before installing the windows, prepare the holes and check aperture correspondence to the nominal dimensions, alignment of windows vertically and vertically horizontal, straightness of slits, perpendicularity of slit angles, quality of slit surface in the area of contact of windows to the wall of the house. If necessary, carry out work to adjust the size slits to the design requirements.

To perform these works use materials that compatible with wall and window block materials. The voids formed at replacement of windows should be filled with inserts of rigid insulation or antisept timber, the location of the spacer pads is determined depending on the design and size of the window block.

Mounting the window blocks to the walls must be done with three types of special mechanical means: construction dowels, self-tapping screws, construction plates. IN the ends of the work on installing mechanical fasteners need to be removed blades except pad pads. But again, you need to do a vertical and horizontal blocks, check the diagonals of the blocks.

Upon completion of the installation work mechanical fastening it is necessary to check the operational functions of windows. Installation technology door blocks similar to the technology of installation of window blocks.

Installation of facade thermal insulation is carried out after external inspection the surface of the load-bearing part of the exterior walls throughout the object where the façade is mounted thermal insulation: the presence of damage in the walls and the plinth, the connection points of the plinth and the walls, the places of contact window and door blocks; the presence of irregularities on the surface of the walls and plinth of a depth or height of more than 10 mm;

The present invention provides the construction method of a kind of shallow foundation stay in place form, to solve above-mentioned technology present in prior art Problem.

For solving above-mentioned technical problem, the present invention provides the construction method of a kind of shallow foundation stay in place form, including:

Step 1: earth excavation；

Step 2: construction bearing platform bed course set up steel reinforcement cage on described cushion cap bed course bottom the described earthwork；

Step 3: at the side installation form of steel reinforcement cage；

Step 4: backfill soil in the earthwork of template surrounding, pours cushion cap concrete.

As preferably, in described step 1: excavate the most from top to bottom, and earthwork both sides are side slope.

As preferably, described template uses steel plate, aluminium sheet or plastic plate.

As preferably, in described step 2: arrange protective layer cushion block, described protective layer cushion block while setting up steel reinforcement cage Region between steel reinforcement cage and template.

As preferably, described protective layer cushion block uses concrete to pile up and forms, and its concrete strength used and step 4 The concrete strength of middle employing is identical.

As preferably, in described step 4, when the height of backfill soil is to when flushing with the height of steel reinforcement cage, in steel reinforcement cage Pour cushion cap concrete.

6. Technical maintenance of structures.

6.1 Introduction

The operating regulations should include a set of inspection and repair measures, aimed at maintaining and restoring the proper working condition of the outer walls houses with front thermal insulation. Control over the technical condition of the facade insulation should be carried out balancer of the building in accordance with the regulations of operation. Maximum reduction measures should be envisaged during operation the probability of mechanical damage to the front thermal insulation.

To maintain the performance of the facade thermal insulation is necessary in a timely manner identify and eliminate any defects that occur. In the process of operation should be carried out technical inspections and routine repairs are preventive and unpredictable. By the results of the technical inspections constitute the act of defects and the cause that led to the defects is determined.

Maintenance entails much more than just fixing broken equipment. In fact, a well-designed facility management system generally encompasses four categories of maintenance: emergency (or response) maintenance, routine maintenance, preventive maintenance, and predictive maintenance. The one everyone dreads is emergency maintenance (the air conditioner fails on the warmest day of the year or the main water line breaks and floods the lunchroom).

When the pencil sharpener in Room 12 finally needs to be replaced, that is routine maintenance. Preventive maintenance is the scheduled maintenance of a piece of equipment (such as the replacement of air conditioner filters every 10 weeks or the semiannual inspection of the water fountains). Finally, the cutting edge of facility management is now predictive maintenance, which uses sophisticated computer software to forecast the failure of equipment based on age, user demand, and performance measures.

A good maintenance program is built on a foundation of preventive maintenance. It begins with an audit of the buildings, grounds, and. Once facilities data have been assembled, structural items and pieces of equipment can be selected for preventive maintenance. When designing a preventive maintenance program, heating and cooling systems are always a good place to start, but planners should think creatively because there may be other components that would be good candidates for preventive maintenance.

Once the items (structures, equipment, and systems) that should receive preventive maintenance have been identified, planners must decide on the frequency and type of inspections. Manufacturers' manuals are a good place to start when developing this schedule; they usually provide guidelines about the frequency of preventive service, as well as a complete list of items that must be maintained. Many manufacturers will assist customers in setting up preventive maintenance systems (if for no other reason than they get the additional business of selling replacement parts).

When planning preventive maintenance, decision-makers should consider how to most efficiently schedule the work-i.e., concurrently with academic breaks or other planned work. For example, preventive maintenance work such as boiler pipe replacements can be conducted while the boiler is out of commission for routine maintenance (such as when cleaning the scale and mud from inside the boiler or cleaning the manhole and handhold plates). Whereas emergency events demand immediate attention whenever they occur, preventive maintenance activities can be scheduled at a convenient time. Because a rigorous preventive maintenance system results in fewer emergency events, it tends to reduce disruptions to the school schedule.

Building maintenance is an ongoing, daily activity of the school and the school staff, which should be organized in a systematic and proactive manner so as to prevent the need for larger repairs. Generally speaking, maintenance can be divided into planned and unplanned.

Maintenance intervention (reactive - corrective), where measures are taken upon a malfunction or when more severe damage is detected. This is the most common way of maintenance, i.e. approximately 50% of the maintenance programs for the schools in Macedonia are focused on this kind of maintenance. Unplanned maintenance is basically corrective maintenance, i.e. reaction to unexpected, accidental or unintentional damages. The annual plans and budgets for school maintenance allocate approximately 2% for covering damages resulting from unintentional damages.

Preventative (proactive) maintenance aimed at preventing damages to the building or equipment malfunction. This maintenance is performed in planned regular time intervals during the school year, and not just as a reaction to the occurred damage.

As its name suggests, planned maintenance means that an action plan for the school maintenance is prepared which should be implemented in organized, coordinated and controlled manner. Approximately 30% of the maintenance in the schools in Macedonia is preventive maintenance. The schools are expected to adopt a pre-defined plan, rather than reactive approach to maintenance. Developing maintenance mentality and conscientious approach to performing maintenance and small repairs ensure the optimal utilization of school buildings.

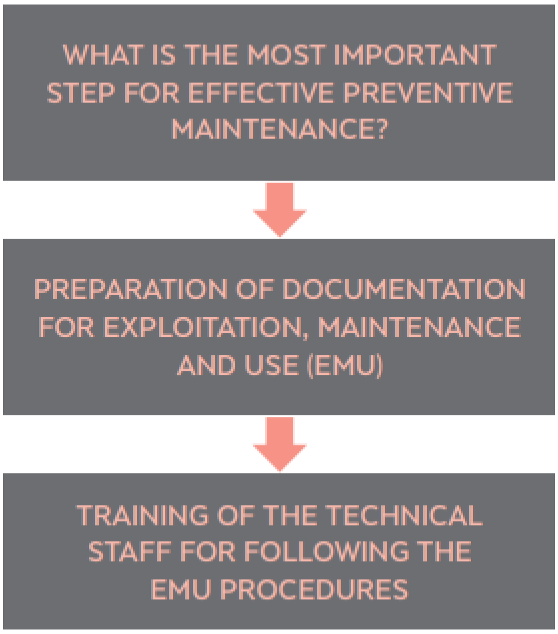
The maintenance of the construction positions includes planned and regular check of all construction positions of the building including: windows, doors, roof, walls, facades, floors, ceilings, and yard areas, pathways and access ramps for students with special needs (physical disabilities).

Components of the maintenance of construction positions In the Guidelines Manual, the most common problems that occur during the maintenance of the construction positions, the methods for their removal and the best practices for regular preventive maintenance are stated for each construction position.

In the Tables - Annual action plan for maintenance of the construction positions and Monthly action plan for maintenance of hygiene in school buildings the activities, the time period for their execution and the person responsible for maintenance of the construction positions.

The most important step in the preventive maintenance of the hot water heating systems is to prepare the documentation for exploitation, maintenance and use (EMU) of these systems. The next step is to train the technical staff for following the EMU procedures.

There is usually only one person in the schools, member of the technical personal, who is responsible for the operation and maintenance of the hot water heating system (Criteria for defining the required number of employees in the activity of the primary education, Ministry of Education and Science, 2003). Furthermore, the heating system is usually managed by the technical staff, based on the experience acquired during the performance of this job in the past years. In most of the larger central hot water heating systems, when the operator is absent from work, there is a risk that the heating system will operate with difficulties or it will not operate at all because there is no other trained personnel for that purpose.



The ideal solution would be to have a minimum of two employees as a technical staff, who will be responsible for operation and maintenance of the hot water heating systems. In accordance with the technical regulation in this sphere, every boiler room should obligatorily have a detailed working instruction for the entire heating installation and inventory list of the entire equipment, as well as as-built project on the entire heating installation.

In addition to the detailed working instruction, a short work instruction should be prepared that will contain the most basic functions and it will be put on a visible spot in the boiler room.

The benefits of having documentation for exploitation, maintenance and use of the hot water heating systems in combination with an adequate training are the following:

- Protection and safety at work;
- Prompt intervention in the event of defect and failure of the system;
- Possibility for the system to be operated by other persons in the absence of the technical staff responsible for the heating system;
- Knowledge of the type and features of the entire equipment for the purposes of making an adequate and timely replacement of the defected equipment;
- Planned abidance by the procedures for preventive maintenance of the equipment;
- Precise knowledge of all underground and hidden parts of the installation.

The documentation should contain instructions prepared in a certain form and with a certain order. The instructions should contain the project requirements for exploitation and use of the system.

These instructions can be provided as part of the instructions for the entire facility.

- The documentation for EMU should contain instructions on the manufacturers' equipment and components. If the system designer uses certain components that are not specified in the manufacturers' instructions, then that should be explained and indicated in the documentation;
- The documentation should be clear and prepared in unalterable form. It should be printed on indelible material that is adequate for everyday use;

- The format, style and number of copies of the documentation of EMU should be in accordance with the contract between the owner and the designer of the systems; There should be a list of locations to which the documentation has been delivered;

- One copy of the documentation for EMU should be adjusted for use by the persons responsible for the exploitation, maintenance and use of the systems;

- The International System of Units - SI should be obligatorily applied in the documentation for EMU.

A sound buildings maintenance plan serves as evidence that school buildings are, and will be, cared for appropriately. On the other hand, negligent buildings maintenance planning will cause real problems. Large capital investment can be squandered when buildings and equipment deteriorate or warranties become useless.

Failing to maintain school buildings adequately also discourages future public investment in the education system. School building maintenance is concerned about resource management and providing a clean and safe learning environment for children. It is also about creating a physical setting that is appropriate and adequate for learning.

A classroom with broken windows doesn’t foster effective student learning. However, neither does an apparently state-of-the-art classroom that is plagued with uncontrollable swings in indoor temperature, which can negatively affect student and instructor alertness, attendance, and even health. School building maintenance affects the physical, educational, and financial foundation of the Parish and School and should, therefore, be a focus of both its day-to-day operations and long-range management priorities.

These School Maintenance Guidelines attempt to provide best practice concepts along with the guidance of the PPBC that can be undertaken to develop a plan that meets the unique needs of the Parish School.

Purpose of School Maintenance Guidelines: To assist school administrators, staff, and Parish members, with help of the PPBC, to understand why and how to develop, implement, and evaluate the school maintenance plan.

The PPBC has the experience and knowledge to conduct a school buildings assessment, building by building, prioritize the repair and maintenance issues and assign an appropriate cost.

Effective school building maintenance planning:

- contributes to a Parish School's instructional effectiveness and financial well-being
- improves the cleanliness, orderliness, and safety of the Parish School's buildings
- reduces the operational costs and improves the life cycle cost of the Parish School buildings
- helps the School and Parish staff along with the PPBC to deal with limited resources by proactively identifying buildings priorities.
- extends the useful life of buildings
- increases energy efficiency and help the environment
- focuses specifically on the needs of the student
- stresses strategies and procedures for planning, implementing, and evaluating effective maintenance programs
- relies of the PPBC to develop appropriate solutions for each situation
- school Administrators and the PPBC; recognize that building maintenance contributes to the physical and financial well-being of the Parish and School
- understand that school building maintenance affects building appearance, equipment operation, student and staff health, and student learning
- understand that building maintenance requires funding
- acknowledge that strategic planning for buildings maintenance is a team effort that requires input and expertise from a wide range of stakeholders

7. LABOUR PRECAUTION
Labour precaution. General provision.

7.1. Dangerous and harmful effects that occur during strengthening of shallow foundation.

Shallow foundations are often situated on unsaturated zones above the groundwater table. In this study, the influence of rainfall infiltration on the settlement behavior of shallow foundations was investigated using numerical analyses.

The numerical solutions were compared with experimental data from in-situ load tests. The relative importance of rainfall intensities and groundwater table positions in inducing the additional settlement of shallow foundations was examined through a series of parametric studies.

Two different groundwater table positions contributing to settlements and three assorted rainfall intensities were used in the numerical analyses. Typical soil properties of two main residual soils in Korea were incorporated into the numerical analyses.

Special attention is given to the sequential analysis procedure comprised of a flow analysis and deformation analysis. Load-settlement relationships obtained from the numerical methodology in the present study were in good agreement with the field measurements.

Results from the parametric studies showed that the rainfall intensity plays a significant role in the settlement behavior of shallow foundations in unsaturated soils. The changes in the settlement during rainfall were also affected by the groundwater table position near the ground surface due to changes in matric suction.

In addition, higher bearing capacity in response to rainfall infiltration was observed in the soil with smaller permeability function as compared to larger permeability function.

Differential settlement is the term used in structural engineering for a condition in which a building's support foundation settles in an uneven fashion, often leading to structural damage. All buildings settle somewhat in the years following construction, and this natural phenomenon generally causes no problems if the settling is uniform across the building's foundation or all of its pier supports. But when one section of the foundation settles at a faster rate than the others, it can lead to major structural damage to the building itself.

Causes of differential settlements

- Soil of different lithological characteristics in the horizontal direction (different compressibility and soil compressibility beneath different parts of the foundation structure).
- Drying of soil surface layers.
- The proximity of trees with large roots.
- Piping leaks, sewer drainage etc.
- Excavations near the structure.
- Different dimensions and depth of structure foundation.
- Vibration.

Differential settlement is not usually a sign of carpentry construction flaws, although some people view it that way. Instead, the phenomenon results when the soil beneath the structure expands, contracts, or shifts in an uneven fashion, causing the foundation to settle at an uneven rate. Thus, the villain is not the carpentry construction practice, but rather the prior evaluation and preparation of the building site itself and the construction of the foundation.

7.2. Technical and organizational measures for decreasing influence level of dangerous and harmful production effects.

Uneven foundation settling—differential settlement—is best prevented by careful analysis of the soil before a building foundation is constructed. The best soils for building foundations are nonexpansive—meaning that they contain little clay or silt content. Ideally, the building site will be native soil rather than a site artificially filled with outside soil.

Make sure to consult an engineer to determine the load-bearing capacity of the soil. Any necessary changes or amendments to the soil—or to the foundation construction methods—can be determined early, before the foundation is built. In some cases, the solution may be as simple and extending the foundation below the poor soils to good load-bearing soils.

Construct embankment on it has two characteristics. One is easily form bulge on both sides of the foundation bottom or outside embankment slope toe and case collapse, it is proved the collapse surface is circular; the other is larger settlement. We should do treatments on it to avoid post-construction settlement and collapse.

The construction methods to reduce the post-construction settlement as follow. One is subgrade treatment method, such as controlling the type of the filler and the depth of each layer, etc.

Another is foundation treatment method. This method is commonly used on the treatment of foundation. There are so many methods for soil improvement and each method has its own principle and effects, it is important for us to clear the purpose of the foundation treatment and adjust measures to local condition.

7.3 Methods of prevention and remediation of the consequences of differential settlements

The consequences of differential settlements may be significant and jeopardize the stability of the entire structure. Therefore, it is necessary to carry out geotechnical exploration and investigation works in order to determine the possibilities for prevention and choose the optimal method of structure foundation remediation.

The best way to prevent potential differential settlements is to carry out adequate exploration and investigation works at the location where the structure is planned. By analyzing the results of these investigations, optimal solutions in terms of the type of foundation of the planned structure as well as the possible type of soil improvement can be obtained.

Geotechnical exploration and investigation works are key in the foundation remediation in order to find the cause of differential settlements. The optimal method of foundation structure remediation is defined based on the specific cause. The foundation remediation can be realized by applying several technologies, the most commonly used being:

Foundation remediation by concrete underpinning.

Foundation remediation with jet grouting.

Foundation remediation with micro piles.

Foundation remediation by using expanding geopolymers.

Considering the possible causes of differential settlements and their impact on the overall stability of structures, it is necessary to keep them in mind when designing the foundation and landscaping, in order to reduce their effect to an acceptable level.

Increasing the Density by the Method of Drainage The disappearance of the excess pore water Press before ground consolidation occurs when clay foundation under loading, at the same time, the pore water is slowly discharge and the shear strength is improved. Experience has shown that, a prior greater load than a predetermined pressure to a pre-consolidation of the soil, when the load acting later, which will reduce the amount of compression, shear strength were much larger than the time of overpressure.

By using the method of drainage to increase the density of soil is the use of the properties of clay to improve the mechanical properties of the foundation. Including:

The method of reducing underground water level: It is reduce underground water level to decrease water pressure to deal with the problems caused by groundwater. It also can make effective stress increase, promote the foundation consolidation. Vertical drainage method: Good permeable material is placed vertically in a thick clay layer, then with the stagger drainage distance to accelerate consolidation.

Electro osmosis method: It is the method of using electro osmosis ruled out the moisture from the soil. The electro osmosis is settled direct current in the soil. The water in the soil generally moves from anode to cathode. To accelerate consolidate.

Atmospheric pressure method: Gas-impermeable film is covered on the ground, using the vacuum pump to drainage, reduce ground water pore pressure to increase the effective stress and apply the load for the consolidation. Hammer compaction method: with a considerable weight of the hammer falling from a considerable height, a large impact force generates by the foundation's approach.

The method of semi-permeable membrane: The fiber waste liquid is poured into a solution of a polyvinyl alcohol of the semi-permeable membrane interposed paper tube, then buried it in the earth.

The water discharged into the paper tube method for the semi-permeable membrane osmotic pressure generated by soil. Increasing the Density by the Compaction Method Vibration and shock force is applied in loose sandy soil. Sand particles arrangement will be dense, so that the soil was sandy compaction. Sandy soil after effects such as squeezed real load, it will reduce the amount of compression.

With the compression load increases, the pore becomes smaller. In addition, the soil dense, the sandy shear strength improved. It is not easy to produce liquefaction with relative density increases. Increasing the density by compaction method make use of these properties of sand to improve the foundation. Including:

Direct Impact Compaction method: using the motion produced by the H-rod with a pressure plate shaking force up and down to compact the foundation. Sand compaction pile method: With hammer impact or vibration generated by the vibration hammer casing pressure buries in the sand to make the sand compaction pile.

Vibration flush method: Insert horizontal vibration in the foundation shaking body and shoot water, filling the pores to form aggregates in the vicinity of the shock body, making foundations increased density. Above methods are the two basic methods to process the sand foundation.

Consolidation Method This method is to cure agent into soil pore, or to mix in the soil, or to cool or heat the soil. The soil consolidation improves the soil shear properties, compression property and water permeability. The consolidation is as follows: Mix method: a mixture of cement, lime and soil for the ground treatment. Sintering method: It needs to dig holes in the foundation, heat the hole wall soil to make consolidation and dehydration.

8. ENVIRONMENTAL PROTECTION

8.1 Ecological estimation of construction production influence on the environment

The plan is to use the same set of environmental indicators for the life cycle of renovation works as for the energy consumption for heating etc, so that the total environmental impact for alternative renovation scenarios can be presented.

The environmental effects used as indicators in the environmental module for reno should be effects that are generally accepted and often used, and effects for which reliable and complete environmental data are usually available.

Therefore the use of the following environmental effects as indicators is proposed:

- Global warming potential (GWP)
- Ozone depletion potential (ODP)
- Acidification potential
- Nutrient enrichment potential
- Photochemical ozone formation potential (POCP)
- Resources (optionally divided into fuels and metals)
- Bulk waste
- Slag and ashes It will be considered to include assessments of water consumption and household waste and maybe also impacts related to local and indoor environment. The tool will also include aggregation of the environmental effects into one single environmental indicator.

This aggregation will be based on the use of weighting factors chosen nationally or by the users. The environmental impact related to the life cycle of buildings are related both to temporary interventions like construction, renovation and demolition and to continuous efforts regarding operation and maintenance before and after interventions like refurbishment and retrofitting.

Therefore the environmental impact related to existing buildings first of all depends on: - Operation and maintenance before and after renovation

- Production and waste management related to renovation works - Service life for the building as a whole and for the individual building elements For LCA tools to be used in renovation projects clarification is needed regarding system boundaries and service life.

It will be argued that environmental assessment of renovation projects first of all have to focus on operation, the choice of new building elements (refurbishment and retrofit measures) and service life expectations. System boundaries

One of the main ideas of life cycle assessments is to analyse the whole life cycle of all components of a product. But for comparative assessments, processes can be omitted that are included in all the alternatives. For renovation projects, distinctions can be made between:

- Existing building elements that are not (or to a very limited degree) affected by any of the considered renovation alternatives; foundations and load-bearing walls for example can often be omitted, because they are included in all alternatives.

- Existing building elements that are removed from the building in one or more alternatives normally does not have to be included, see comments below. - New, supplementary or replacements of building elements like glazing of balconies, supplementary heat insulation and replacement of roof has to be included.

Existing building elements, which are removed from the building, will normally have had such a long service life that it can be argued that the impacts related to the removal and waste management can be allocated to the service life so far and therefore will not differ between different alternatives.

Looking at removed building elements, which can still be argued to be useful, and for which the service life so far has been short compared with the expected service life, it can be argued to allocate part of the impacts related as well to the production and construction as to removal and waste management to the removed element. This is not easy to do, because the existing building then has to be represented in BEAT.

Service life

The service life of buildings and building elements do have a strong influence on the environmental impact from the life cycle of the materials incorporated in the building. This is because this impact primarily is related to production and waste management, and because the impact will be calculated per year and added to the impact related to operation.

Moreover, further implications of the long service life for buildings and building elements need to be discussed.

A difficult aspect is related to the definition of the alternative scenarios to be comparatively assessed. If the expected "renovation service life"2 for the compared alternatives is very different, then a comparative life cycle assessment should include the same period of time for all the alternatives being compared. For alternative scenarios that include no action now, but which anticipate substantial renovation works within a short time horizon, these works, e.g. described in plan for maintenance and modernisation, has to be defined and included in the environmental assessment.

The service life and the end of life of a building or building element is not a matter of technical lifetime only, but it is also related to a number of other criteria such as functional, technical, economic, aesthetic, ecological and contextual criteria. But it is also important to state that for a number of building elements the technical criterion is crucial, and therefore also the degree to which these elements are maintained.

8.2 CONSIDERATIONS OF ALTERNATIVE CONSTRUCTION METHODS AND WORK SEQUENCE

Different construction methods for the foundation works, erection of the new flyover deck and retaining structures are examined based on the following criteria:

- Severity and duration of the construction impacts on the nearby environmental sensitive receivers;
- Traffic impacts on the existing carriageways;
- Site constraints, such as limited working spaces, unforeseen ground conditions and potential impacts on the existing structures;
- Satisfaction to the design requirements, such as loading requirements and retained heights; and
- Tight construction programme.

Options for Piling

Four piling options have been assessed during preliminary design, namely,

- ***Option A:*** Continuous Flight Auger Piles;
- ***Option B:*** Large Diameter Bored Piles***;***
- ***Option C:*** Pre-bored Concrete Piles; and
- ***Option D:*** Driven Steel H-piles.

The above options are considered common piling methods in Hong Kong and therefore the required machinery should be available in the Hong Kong market for foundation construction. Benefits and drawbacks of each option are discussed below and summarised in *Table 3.3a*:

Option A: Continuous Flight AugerPiles

In this construction method, continuous flight auger is used to form the pile holes, which will be infilled with concrete or grout after the placing of steel reinforcement which would either be steel H-piles or rebar cages. The sizes of CFA piles range from 300mm to 700mm in diameter and the most common pile size is 610mm in diameter.

<u>Benefits</u>

- Piles can be installed without appreciable noise and vibration;

- Generally ground loss/disturbance is minimal during pile hole excavation and therefore less disturbance on the adjacent structures and piles;
- Compared with Options B and C, it is a more economic pile construction method under suitable ground condition (i.e. for cohesive soils) and satisfying load requirements;
- Less working spaces are required compared with Option B;
- Construction time is relatively fast; and
- There is no restriction on the normal working hours.

Drawbacks

- Pre-excavation or pre-boring may be required to cope with any underground obstruction such as boulders within the soil matrix;
- Compared with Option B, this pile type has less structural capacities to resist lateral and vertical loads;
- Specialist contractor may be required to ensure workmanship; and
- Designed pile length is limited by the construction plants and it is generally less than 40m.

Option B: Large Diameter Bored Piles

Shafts of the large diameter bored piles are constructed by traditional boring machines with temporary steel casings or drilling fluid as a supporting system. Chisel and grab system with casings, and Reverse Circulation Drilling (RCD) are the common large bored pile construction plants. Typical sizes of large diameter bored piles range from 1m to 3m in diameter. Benefits

- Extensive experience of using this type of construction method has been developed in Hong Kong;
- Compared with Options C and D, less noise and vibration will be generated during pile installation;
- It is relatively easy to overcome underground obstructions;
- Compared with Option A, this construction method has higher flexibility in designing longer piles to suit design requirements;

- This pile type has larger structural capacities to cater for lateral and vertical loads; and
- With provision of temporary casings during pile excavation, shaft collapse and over-excavation can be minimized.

Drawbacks

- Comparatively larger working spaces are required due to larger piling plants required;
- It may be susceptible to bulging or necking during pile concreting in unstable ground due to the larger pile size;
- Compared with Options A and C, risk of loosening of surrounding soil is higher, causing ground movement and structural impacts on the adjacent structures; and
- Extension of working hours to the restricted hours may be required for concreting of very long piles.

Option C: Pre-bored Concrete Pile

Pile shafts are formed by drilling rigs with the use of down-the-hole hammers. Pre-bored concrete piles are considered as small diameter bored piles. Therefore, similar to the large diameter bored pile construction, the pre-bored holes will be inserted with rebar cages and in-filled with concrete. Shaft-grouting can also be provided for enhancing shaft resistance for friction piles.

Benefits

- It is relatively easy to overcome underground obstructions by down-the-hole hammers;
- Compared with Option A, this construction method has higher flexibility in designing longer piles to suit design requirements;
- Compared with Option D, less ground borne vibration will be induced;
- With provision of temporary casings during pile excavation, shaft collapse and over-excavation can be minimized.

Drawbacks

- Pile excavation by down-the-hole (DTH) hammer will cause disturbance affecting the adjacent structures and foundations;
- Construction Noise Permit (CNP) under the Noise Control Ordinance (NCO) will be required for the use of DTN hammer. Longer construction period may be required due to the restricted working hours imposed by the Authority;
- It may be susceptible to bulging or necking during pile concreting in unstable ground; and
- Possible collapse of the annulus space (over-cut) between the side wall and temporary casing before pile concreting would reduce the skin friction.

9. Scientific research part

9.1 Main consideration

Rebuilding as a more general concept, which is any alteration of the structure or size of the foundations in order to adapt them for use in the changed operating conditions, can be divided into reinforcement and reconstruction.

Strengthening the foundation is associated with the restoration or replacement of morally or physically worn (destroyed) structural elements, with a decrease in the bearing capacity of the foundation, as well as with increasing loads on the foundation.

Under the reconstruction of foundations is understood the change of structure in connection with the replacement of above-ground structures or technological equipment, as well as with the change of functional purpose of a building or structure. Reconstruction of foundations is usually not related to their destruction (wear and tear).

Depending on the nature of the work performed, the table shows the main types, methods and goals of restructuring the foundations. Each type of restructuring is carried out in different ways, the choice of which is determined by specific conditions: the state of the foundation, the nature of damage to the foundation and its elements, the purpose of restructuring, available technical resources, etc.

Failures of foundations and foundations are frequent. They are mainly caused by mistakes made in geological exploration, design, construction and operation.

When designing, it is often not possible to take into account unforeseen external influences on soil soils. The increase in humidity during exploitation (watering at the expense of leakage and increase of groundwater level), especially in conditions of subsidence soils, is unfavorable. In some cases, there are insufficient number of geological workings at the construction site, there are errors in the laboratory determinations of the physical and mechanical soil parameters.

The lack of proper control over the zerocycle works leads to disruption of the natural structure of the upper layers of soil during the development of ditches, to improper conduct of dewatering (instead of deep water dewatering practice open drainage) and blasting, to soaking and freezing the foundation during prolonged idle time, neighboring houses from pile, tongue and other immersion.

In the course of construction, there are cases of accelerated installation and early self-healing of joints, which is an unfavorable factor in the conditions of weak soils, placement on the loose backfill mechanisms, the use of low-grade concrete, the impact of nearby existing foundations, the lack of completed plans and so on.

During the operation of buildings and structures, the substrate is often soaked with aggressive water, which leads not only to the development of adverse processes in the soil (chemical swelling, sedimentation), but also to the destruction of the foundations due to corrosion of the material; affects the dynamic impact of installed equipment, overburdening of foundations due to unilateral loading of stored products, violation of the stability of buildings and structures on sliding slopes, etc.

Reinforcement of foundations should be performed in the following cases:

- with increasing load on foundations, during reconstruction, overhaul and superstructure of buildings;

- at destruction of the structure of the foundation, at its location in an aggressive environment; - at increase of deformability and deterioration of conditions of stability of foundations as a result of additional moistening, or deterioration of soil properties at change of engineering-geological conditions;

- during the development of unacceptable sediments, which occur, as a rule, as a result of errors made in the design due to incorrect assessment of bearing capacity and deformability

Currently, the following methods are used to strengthen the foundations and foundations: - changing the conditions of transfer of pressure on the sole of the foundation to the soil of the foundations; - increasing the strength of the foundation structure;

- increase of bearing capacity of soils;
- transplanting foundations into piles;
- change of conditions of transfer of pressure on a sole of the basis on the ground by means of increase of a supporting area, deepening of the foundation, placement under the building of a base plate and introduction of additional supports.

If it is impossible to increase the bearing capacity of the base - increase the area of the foundations. The area is enlarged in two ways: without ground compression, and with pre-compression. In the first case, the area is enlarged with the help of additional parts (banquets), which can be one-sided (at off-center loading) or bilateral (at central).

The foundations for columns are often reinforced around the perimeter. Banquets and existing foundations must be rigidly connected using scrap metal or special metal and reinforced concrete beams. If necessary, a number of single foundations can be converted into tape, and several tape foundations into solid reinforced concrete slab.

In the case of expansion without compression, the expanded part of the foundation comes into operation only after a significant increase in external load, and the extension will accept only a fraction of the additional load, much of it will still be transmitted through the sole of the old foundation.

When expanding the foundation with the compression along the lateral faces, develop a trench and concreted, adjoining the faces of the basement banquets, separate sections along the length, jamming with masonry.

To strengthen the foundations, together with the compression of the soil, you can use flat hydraulic jacks, which are flat tanks of two thin (1 ... 3 mm) metal sheets having a perimeter roller circular section with a diameter of 20 ... 80 mm.

Jacks are recommended to inject curing fluids (epoxy resin, cement mortar) that capture the stress created. If it is necessary to significantly increase the area of the foundations, another method may be proposed, the essence of which is to lay on the crushed stone preparation of additional reinforced concrete slabs.

The plates are arranged in the form of two (or more) strips laid in the longitudinal direction perpendicular to the existing transverse walls. On each ribbon of the additional foundation, the formwork and reinforcement of the pressure frames, which consist of lower horizontal crossbars 40 × 60 cm, lying on the new foundations, and sloping posts-stops of the same section are installed.

Frames transfer effort to the belt-straps of the transverse walls, behind which is the laying of the above-ground brick walls of the building. For the formation of the closed contour of the pressure frames above them, in the plane of overlap above the technical underground, arrange monolithic sections of reinforced concrete in the form of strips 60 cm wide, height equal to the height of the precast slabs. Increasing the depth of laying the foundations are resorted to less often because of the considerable complexity.

However, this method is used when necessary to increase the depth of the basement, transfer the sole of the foundation to the denser lower layers of soil, etc. For tape foundations, this procedure is performed in the following order.

Initially, holes are opened in the load-bearing wall through which the discharge beams mounted on concrete pedestals or special supports pass. Given the possibility of settling the soil, it is advisable to rest the beams on the jacks, which allows you to adjust the position of the supports with increasing deformation of the bases.

Works on increasing the depth of laying lead to separate grips 2.5 ... 3 m in length. The introduction of additional supports is advisable for continuous replacement of overlappings and for large (more than 7.5 m) spans. It is necessary to observe the conditions of uniformity of deposition of existing and newly constructed supports, bearing in mind that the settling of already constructed supports stabilized and is practically equal to zero.

Increasing the strength of foundation structures is achieved through the arrangement of reinforced concrete, or metal (followed by concreting) cages. Increasing the bearing capacity of the soil base is carried out using methods of soil fixation. Usually fixing is carried out with the help of injectors that are immersed in the soil under the sole of the foundation.

The use of stuffed piles when reinforcing the foundations can be recommended with high soil deformation, the presence of groundwater, which complicate the expansion process, and with a significant increase in external loads. The bearing capacity and the number of piles are determined by the calculation.

The disadvantage of this method is its complexity because of the need for eyeliner. Piles are formed in soil usually from basements by casing pipes or in pre-drilled wells.

Effective for reinforcing the foundations is the use of drilling piles, which allows to carry out work without the development of ditches, exposing the foundations and disturbance of the soil structure at the base.

The essence of the method of strengthening the injection piles lies in the arrangement under the building of a kind of supports - rigid roots in the soil, which transfer most of the load to the denser layers of soil. In case of intensification of the drilling-injection piles, it may be envisaged to create a single structure in a boreless version. The injection piles may be vertical or inclined.

Drilling wells are drilled with rotary drilling rigs that allow drilling through the walls and foundations above.

Drill diameter 80 - 250 mm. When drilling, casing pipes, water, clay slurry, or compressed air are used to ensure the well walls. In comparison with other types, the injection piles have a higher friction resistance along the lateral surface, which is provided by partial cementation of the soil in contact with the pile.

Due to the passage through the existing structures, the injection piles are connected to the structure, so they do not need additional connection with the existing foundations. In the foreign practice of repairing and strengthening the foundations, drilling and injection piles are also used if necessary to arrange deep recesses in the immediate vicinity of existing buildings. A lattice retaining wall is constructed to keep the slopes from collapsing with the foundation. In some cases, the injection piles are organically linked to the existing building as a whole.

As a rule, the reconstruction of a building or structure is accompanied by a change in the loads on the building structures, and a change in their initial structural schemes. All this leads to the need to determine the technical condition of building structures, determine the residual life of their performance, decide on their fate, to strengthen, restore or replace.

The need for reinforcement or restoration of building structures arises not only during reconstruction or technical re-equipment, but also due to premature corrosion or mechanical wear, various damages and defects, etc. All this raises interest in the problem of reinforcement and reconstruction of existing building structures.

The urgency of the problem of reinforcement of building structures is to solve the following problems:

- ensuring the reliability of structural structures of buildings and structures related to the aging of structural materials, as well as the appearance of defects in concrete and reinforcement;

- ensuring the safe operation of the facility throughout its lifetime;

- adjustment of design decisions at the design stage and during construction;

-taking into account the negative impact of various aggressive environments, which were not considered in the design;

- increasing the load-bearing capacity of structural elements associated with changes in design rules or changes in the functional purpose of the building and increasing loads on the structure;

- increasing the durability of structural elements of buildings and structures;

- reinforcement or repair of building structures due to accidents, earthquakes or fires;

Structural reinforcement works, the main purpose of which is to adapt and use existing structures with increasing loads, can be divided into two main groups:

The first group includes works on the arrangement of structures that unload or replace existing structures, and also, partially or fully perceive the increased loads and exclude some of the elements of buildings and structures.

This reinforcement structure is a system of girder structures, usually metal, that accepts new high loads and transmits it through its supports to existing load-bearing elements that have sufficient bearing capacity. This method of reinforcement is simple enough, but not always rational, since existing structures are partially or completely discontinued. This gain reduces the usable space and dimensions of the room.

The second group is related to works aimed at increasing the load-bearing capacity of existing structures.

Each reinforced concrete monolithic or prefabricated structure, overlap or space frame, acting as a supporting structure, works as a spatial system. However, when designing reinforcements, the designs are divided into separate planar systems to simplify complex design problems. The reinforcement of planar systems depends on the stress-strain state of the core static circuits, which are combined and further defined as structural circuits.

Increasing the primary load-bearing capacity of structures is performed in two main directions - reinforcement with the change and without change of the structural scheme of the element of the structure.

The method of reinforcing the structural element while maintaining the same structural design is to increase the cross-section of the element and is achieved by arranging the clamps, linings and unilateral extensions.

The increase in the primary bearing capacity of the element depends on the rational change of the corresponding design scheme, which may relate to the static scheme itself or its stress-strain state. This effect is ensured by the insertion of additional supports, bindings and fasteners or the arrangement of intermediate hinges, including plastic ones in statically immutable systems.

A way to strengthen the elements of buildings at structures by changing their design scheme is to arrange additional rigid and flexible supports, various adjusting, unloading, tension and spacer structures.

To date, there are many traditional methods of reinforcing reinforced concrete structures, namely:

- increase in cross-section of structural elements, which is characterized by an increase in the own weight of the structure;
- arrangement of auxiliary structures (external heights, belts, retaining racks, suspensions), which leads to changes in the architectural appearance of the building and significant costs of material resources and time;
- reinforcement of structures by gluing to the stretched or compressed zone of the structure such effective materials as: polymer concrete, fibrebeton or carbon fiber;

For many years, the main method of reinforcing building structures has been the method of increasing the cross section of structures by attaching additional elements to it.

Additional elements used as reinforcement may be of a material similar to a reinforced structure or other structure.

The following requirements must be observed when constructing reinforcement by increasing the cross-section:

-ensuring that the design and reinforcement work together to meet the power, temperature, and other requirements according to the approved connection scheme;

- determination of the places of separation of the reinforcement elements on the sites of elastic work of the material, prevention of areas of sharp stress concentrations;

- it must be borne in mind that the reinforcement element not only increases the cross-sectional area of the structure, but also increases the moment of inertia and redistributes the force.

Depending on the stress-strain state of the original element (structure), the reinforcement element must be positioned:

- in the bending elements, if there is no danger of loss of stability, with the maximum distance from the neutral axis of the section to increase the moment of resistance in the plane of bending;

- in centrally-compressed elements, without breaking the position of the center of gravity, seeking to increase the radius of inertia in both planes;

On-site examinations of foundations and foundations should be carried out after obtaining permission from the relevant organizations (design, supervisory) to carry out these works.

The purpose of the examination of foundations and foundations is to identify their actual condition.

. Surveys include the following:

- getting acquainted with the condition of soils and structures of the building and drawing up a program of surveys of foundations;

- visual (general) survey of building structures;

- a detailed (technical) examination of the foundations and study of the soils of the basics;

- determination of strength and fracture strength of foundation structures;

- technical assessment

The inspection program is made on the basis of the technical specification of the customer and familiarization with the design documentation of the reconstructed building.

The Terms of Reference contain the following information: the justification for the work, the goals and objectives of the work, the composition of the work, a summary of the reporting materials and the obligation of the customer.

Familiarity with the design documentation is carried out in order to take into account engineering and geological conditions of the site, structural features of the work of structures, as well as to identify the causes and nature of possible defects.

At this stage, it is also necessary to install the actual load on the foundations, taking into account the own weight of structures, technological equipment and temporary loads

If necessary, it is necessary to establish: design mark and class of concrete, diameter, class and number of working fittings, brand of brick and mortar, geometric dimensions of structures and other data.

In the absence of the above data, they are specified during the survey and, if available, selectively checked.

Visual inspection of building structures should be performed to determine the condition of the structures, the presence of cracks in the walls and floors and their fixation (establishing their direction, length, magnitude of the opening), as well as to identify the subsidence of the foundations.

The results of visual examination of the structures of the building are recorded in the form of a map of defects, plotted on the schematic facades, plans and sections of the building, photographs, or in the form of tables with the symbols of major defects.

According to the results of the analysis of available material and visual inspection, depending on the type of building and its condition, the complexity of engineering-geological conditions, as well as depending on the purpose of reconstruction (increasing loads on the foundations, etc.), determine the composition, volume and methods of examination of soils and foundations.

In case of visual inspection of unacceptable deformation or structural damage, the customer and the design organization should be informed immediately.

Examination of the structures of the foundations is carried out by the method of their disclosure by the passage of holes or other workings.

A detailed survey of the foundations includes:

- inspection of structures and registration of detected defects;

- measurement, measurement of width of crack opening, values of sediments and deflections (instrumental examination);

- determination of the actual characteristics of reinforced concrete and stone structures by testing their selected samples or by non-destructive methods (instrumental examination). The composition and scope of work, as well as the degree of detail in the survey of foundations is determined by the work program.

When inspecting the foundations fix:

- cracks in structures (transverse, longitudinal, inclined, etc.);

- exposure of reinforcement;

- Piles of concrete and stone masonry, caverns, sinks, damage to the protective layer, areas of concrete with discoloration of its color are revealed;

- damages of fittings, mortgages, welds (including due to corrosion);

- schemes of support of structures, mismatch of planes of support of prefabricated structures to design requirements and deviation of actual geometric dimensions from design;

- the most damaged and emergency sections of the foundation structures;

- the results of determining the moisture content of the foundation material and the presence of waterproofing.

The determination of the condition of structures by the humidity of the foundations is carried out by the following methods:

- sampling of the material of the foundations and subsequent research in the laboratory;
- electrometric evaluation of the specific resistance of the masonry material, etc.

When determining the moisture content of structures of foundations, it is necessary to establish the reasons for their moistening.

All structures of the foundations, in which visual inspection revealed serious defects are subject to a detailed examination. If according to the results of the preliminary examination, a sufficient assessment of the state of the structure is made in accordance with the set tasks, then a detailed examination may not be performed.

Detailed surveys are conducted to clarify the initial data needed to perform a complete set of calculations of the structures of the objects to be reconstructed.

Depending on the condition of the structures and the required tasks, the survey can be continuous and selective. At continuous survey all designs of the bases under each wall and all columns are checked. In a sample survey, separate structures are examined that make up a sample, the volume of which is assigned depending on the state of the structures and tasks of the survey, but not less than three.

In the instrumental examination of the state of foundations in the necessary cases should determine:

- strength and permeability of concrete;
- number of fittings, their area and profile;
- thickness of the protective layer of concrete;
- degree and depth of corrosion of concrete (carbonization, sulfatization, chloride penetration, etc.);
- strength of masonry materials;

- slopes, slopes and displacements of structural elements;
- degree of corrosion of steel elements and welds;
- deformation of the base;
- subsidence, rolls, deflections of foundations.

In the non-destructive method of control in reinforced concrete structures the position and diameter of the reinforcement is determined by the magnetic and radiation method according to 1765-13.

The thickness of the protective layer of concrete and reinforcement is also determined by the method of opening.

Reinforcement control areas (diameter, placement of reinforcement, thickness of the protective layer) are recommended to be positioned:

- in places of increased crack opening;
- for non-centrally compacted foundations with low eccentricity in an arbitrary, easy to access section along the length of the structure;
- for extra-centrally compacted foundations with higher eccentricity, as well as for flexible structures - at the estimated design cross sections.

An important indicator of the condition of the reinforced concrete structure of the foundation is the actual value of the concrete strength, its compliance with the design strength.

In a detailed examination, the strength of concrete should be determined by the following methods:

- testing of specimens (cores) sawn or drilled from the foundation structure;
- mechanical methods of non-destructive testing;
- by ultrasound or radiation defect method.

Other methods provided by national and industry standards may be used.

When examining the masonry of the foundations, the strength of the stone, mortar and type of stress should be taken into account.

The strength of the stone can be determined in a non-destructive manner by means of ultrasonic devices.

When reconstructing buildings near dynamic sources that cause oscillations of adjacent sections of the base, it is necessary to perform vibration tests.

A vibration test is performed to obtain actual data on the vibrations of soil and structures of foundations of reconstructed buildings and structures in the presence of dynamic influences:

- from the equipment being installed or planned to be used in the building;
- from the passage of land or underground wheel or rail transport near the building;
- from construction works during reconstruction;
- from other sources of vibration near the building to be reconstructed.

If the dynamic properties of the building and its foundations are substantially altered as a result of the reconstruction, the oscillation parameters should be measured in order to predict the levels of its oscillations after reconstruction.

For vibration surveys of buildings, foundations, their foundations and underground structures, it is recommended to use complexes of equipment to record vibrations in the frequency range from 1 to 100 Hz.

The following materials are required to analyze the results of the vibration survey, in addition to the actual data on the oscillations of the foundation structures (soil sections):

- data of engineering-geological and geodetic surveys;
- results of observations and measurements of deformations of structures of the building, subsidence of foundations;
- data on the presence of cracks, damage to structures;
- data on the condition and actual bearing capacity of the structures and foundations under the foundations of the building.

The results of the vibration survey should be presented in the form of tables of the rms values of the vibrations (vibration velocities, vibration accelerations) at the survey points.

Based on the results of a vibration survey of foundations or structures of underground structures, they conclude that the vibrations are acceptable for normal operation of the structure, or make recommendations for reducing the dynamic impact on the bearing structures of the examined structure or its reconstruction in order to reduce the level of oscillation to the acceptable level.

According to the survey results are:

- technical report containing: results of the survey, which are presented in the form of defective information on the condition of the structures of the foundations, the presence of their deformation, sediments, defects of materials, etc. damages, including plans and sections of buildings with engineering-geological profiles; structural features of the building, foundations, their geometry; schemes of arrangement of rappers, marks; description of the measurement system used; photographs, graphs and diagrams of horizontal and vertical movements, rolls, development of cracks; a list of factors contributing to the occurrence of deformations; assessment of the strength and deformation characteristics of the material of the structures of the foundations;

- technical conclusion about the possibility of using the structures of foundations during reconstruction.

Technical conclusion about the possibility of reconstruction of the building with increasing loads on its base, arrangement of the underground structure near it or within its construction, as well as the deepening of the basements contains:

- technical characteristics of the intended design;

- description of the existing condition of the building;

- plans of load-bearing structures, including foundations indicating the depth of their laying;

- data on loads that were applied to the foundations of the building before reconstruction;

- data on additional loads on a building or structure and their distribution on separate foundations after reconstruction; - information about the deformation of the building and the leveling of the plinth or windows of the first floor; - information about the material of the foundations;

- data of engineering-geological and hydrogeological surveys (generalization of archival materials, description of wells and wells, geological sections in the basic directions of the location of bearing structures, physical and mechanical characteristics of the soils of the bases, necessary for the calculation of deformations of the building after its reconstruction, change in the level of their occurrence in the autumn-spring period, composition and nature of their aggression);

- check calculations of existing and expected after the reconstruction of pressures on soil soils;

- forecast of average subsidence of the building and their irregularities after reconstruction;

- conclusions and recommendations for the reconstruction of foundations and foundations, which include the type of foundations being reconstructed and the technology of their arrangement.

Examination of shallow foundation foundations, enclosing underground structures, the type and condition of the foundation soils is carried out by drilling holes at depths up to 1.5 m below the sole. Surveys of pile foundations or foundations with increased depth of laying, as well as their foundations, are made by the passage of dowels.

Soil exploration for foundation remodeling should be done in the same way as for new design. Investigations for the reconstruction of buildings should ensure the use of field and laboratory methods of soil characteristics such as density and humidity for all soils, granulometric composition of sandy soils, number of plasticity and fluidity index of clay soils, degree of peatland and tanners modulus of deformation, angle of internal friction and specific coupling.

The total number of control holes, explorations and probing points is determined depending on the complexity of the geological structure and the degree of study of the territory, the size of buildings and structures. Engineering and geological survey of the bases and foundations is preceded by a detailed study of the available design and archival materials of the primary survey, the condition of existing buildings and structures, the conditions of laying the foundations and other underground communications.

Observation of sediment and deformation is a special type of geodetic work, which is performed according to the program agreed with the design or research organization. Since most of the deformations are usually completed during the observation period, maximum accuracy of observations is required to estimate the rate of their course.

Surveillance of sedimentation is carried out by the method of geodetic leveling. The most optimal under conditions of reconstruction and reinforcement of the foundations may be the so-called "non-reference" leveling technique, in which only the values of relative vertical displacements of sedimentary signs are determined. In this case, vertical movements are determined by comparing the corresponding exceedances measured at different points in time.

Observation of the building or foundation rolls is carried out by the method of geodetic leveling (by the difference of settling opposite sides, related to the transverse size) or by the method of projection with the use of theodolite (by the difference of the counts of projections above and below, related to the height).

9.2 Methods of foundation strengthening.

In most cases, they are caused by errors made in the geological survey, design, construction and operation.

Reconstruction and reinforcement of the foundations should be preceded by full-scale examinations of the deformed buildings and structures. Before conducting full-scale surveys of the foundations and foundations of buildings (structures) that are deformed or reconstructed, they must obtain permission from the relevant organizations (design, supervisory) to carry out these works, and safety measures must be taken.

The purpose of the examination of foundations and foundations is to identify their actual condition.

The works include: review of existing foundations with fixation of their condition and strength; study of soil of the base with establishment of the changed hydrogeological regime; organization and observation of deformations, subsidence and banks of foundations.

The nature and scope of field surveys is determined by the specific tasks of redeveloping the foundations. Inspection of shallow foundations, enclosing underground structures, determining the type and condition of the foundation soil is carried out by drilling a hole to a depth of up to 1.5 m below the base sole.

Surveys of pile foundations or foundations with increased depth of laying, as well as their foundations, are made by drilling wells (pipes).

Observation of sediments and deformations is a special type of geodetic work, which is carried out according to the program agreed with the design or research organization. Since most of the deformations are generally completed during the observation period, maximum accuracy of observations is required to estimate the rate of their course. Observation of sediments is carried out by geometric leveling. The most optimal under conditions of reconstruction and reinforcement of the foundations may be the so-called "continuous leveling" technique, in which only the values of relative vertical displacements of sedimentary signs are determined.

In this case, vertical displacements are determined by comparing the corresponding exceedances measured at different times. Observation of the building or foundation rolls is carried out by geometric leveling (by the difference of the opposite sides of the transverse dimension) or by a theodolite (by the difference of the elevation projections of the top and bottom).

Surveying of cracks is also part of surveying. These observations have two goals: to detect the propagation of deformation zones (by beacons Fig. 9.1) and to establish the nature of the development of damage over time (for example, using the simplest microscope).

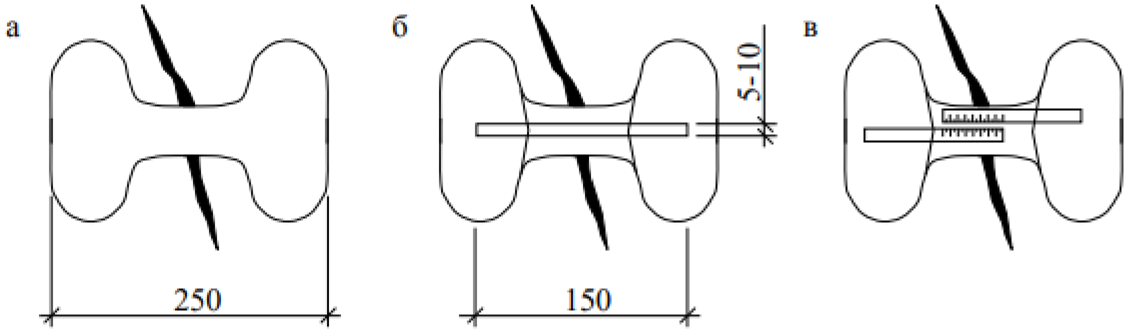


Рис. 8.1. Види алебастрових маяків, що використовуються в будівництві: а – у вигляді вісімки; б – зі скляною пластинкою; в – з пластинами внапуск

Strengthening and strengthening of the bases can be ensured by drainage and drainage, consolidation and strengthening of soils. Drainage and drainage of foundations is used alone or in combination with active methods of protection against deformation (reinforcement of foundations, replacement or reinforcement of aboveground structures).

In protecting the bases from groundwater, the following measures are taken:

1. To completely stop access of water to the built-up area.

In this case, arrange upland ditches and ditches, water interceptors and drainage trays, drainage trenches or backfill with drainage pipes, anti-filtration curtains, etc.

These include surface water abstraction measures, which are carried out by vertical planning and storm sewer arrangement.

2. Water protection measures intended for diversion of water arriving to the building (structure) from closely located sources of soaking. In this case, arrange

ring drainage in the form of trenches with enclosed drains, filled with drainage material, drainage curtains, drainage galleries, etc.

3. Measures to reduce groundwater directly below the foundations of the building. Different types of drainage are used. When performing water depletion in soils having a filtration coefficient of less than 0.1 m / day, use special methods of water depletion - vacuum and electric drying.

Increasing the strength of foundations, including during the period of reinforcement of foundations and above-ground structures, can be ensured by fixing methods (chemical, thermal, physico-chemical). Due to the nature of the injectors, the chemical fastening can be vertical, inclined, horizontal and combined (Fig. 9.2, a, b, c and d respectively). Fixing zones arrange with tape, continuous, intermittent and annular. The choice of fixing method and schemes depends on the type and characteristics of the soil base, shape and size of the foundation, the current loads.

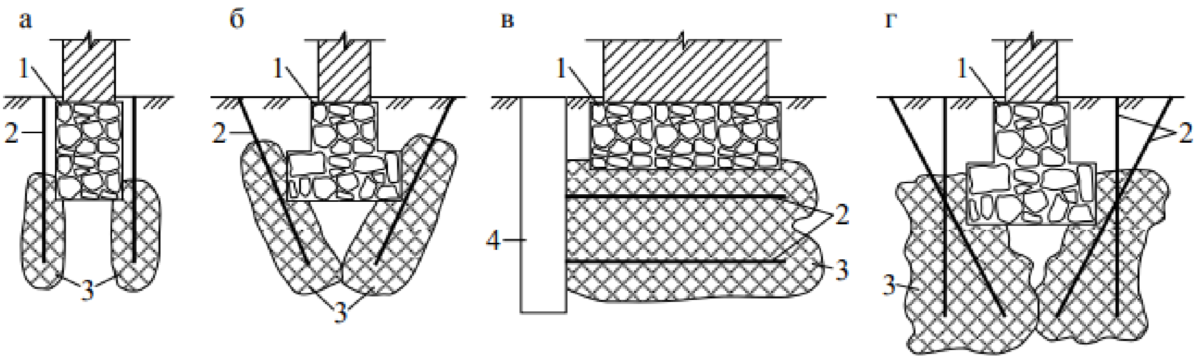


Рис.8.2. Схеми можливого розміщення ін'єкторів при закріпленні основ
1 – фундамент; 2 – ін'єктор; 3 – зона закріплення; 4 – шахта

The traditional methods of chemical fixing include cementation, silicatization (one- and two-soluble, gas, electrosilicatization), electrochemical fixing, smolization. Thermal fixing (firing) is used mainly for the consolidation of non-irrigated forest soils. The bases can also be reinforced by erecting the perimeter of the base of the enclosure wall, arranged below the sole vertically or obliquely of monolithic or precast concrete, sheet piles, piles (crushed, bored, drilled).

The soil of the base, located between the enclosing walls, is compacted and, due to friction, part of the load is perceived by the walls. In addition, enclosing walls, usually arranged to a depth of 1-2 width of the foundation, prevent the weak soil from protruding from under the sole.

The choice of the method of reinforcement and reconstruction of the shallow foundation foundations (both tape and columnar) depends on the reasons that necessitate such reinforcement, the structural features of the existing foundations and the soil conditions of the site.

The methods used in such cases are divided into the following groups:

1. In the conditions of destruction of the base material, insufficient bearing capacity of the base and the need to partially increase the load, reinforcement of the masonry is applied by injection of cement mortar into the cavities, replacement of a weak section of the foundation, arrangement of concrete or reinforced concrete clips without expansion or expansion 3(b, c).

2. At a large thickness of weak soils d basis, corrosion or other destruction of the foundation, the need to increase the depth of laying or change the underground part of the building carry out the structural elements (slabs, columns) under existing foundations (Fig. 9.4, a, b). Erection of columns and plates is carried out in a staggered way or by a solid wall.

An increase in the support platform is possible.

If it is impossible to expand the sole of the foundation and the presence of value 8.5. Schemes of reinforcement of foundations by piles and deep walls: a - crushed; b - stuffed; c - injection; d - wall in soil; 1 - existing foundation; 2 - metal tubular piles; 3 - announcements; 4 - monolithic reinforced concrete beam; 5 - wall of the building; 6 - stuffed piles; 7 - reinforced concrete clip; 8 is a column; 9 - dense soil; 10 - piles; 11 - wall in soil; 12 - basement Fig. 12. 9.4.

Design solutions for laying the foundation: a - pillars with chess placement in the plan; b - reinforced concrete slabs; 1 - the foundation; 2 - a pillar; 3 - screw; 4 - plate; Fig. 5 - reinforcing frame Fig. 5. 8.3. Strengthening the foundations: a - cementation; b - replacement of a weak area; in - concrete or reinforced concrete clip; 1 - existing foundation; 2 - injector; 3 - metal reinforcing beams; 4 - newly arranged part of the foundation; 5 - clip; 6 - anchor rods of the thickness of the weak soil reinforcement is carried out by:

- arrangement of intermediate supports, which with the help of both clamps monolithic with the body of the foundation;

- increase by laying the foundations on piles.

Reinforcements are made by pressed piles (metal, reinforced concrete), including compound ones (Fig. 9.5, a), stuffed (Fig. 9.5, b), and injection (Fig. 9.5, c). Under heavy loads, reinforcement can be made by laying the foundation on the portable structures, which are erected around the perimeter by the wall-to-ground method.

This method of reinforcement is also used in the arrangement of deep recesses and basements in the immediate vicinity of the foundation (Fig. 8.5, d).

Strengthening of pile foundations is performed in cases of damages of grilles, destruction of pile headings, as well as insufficient bearing capacity of pile bushes or increase of load during reconstruction. The method of amplification of grating is chosen depending on the nature of the damage and the reasons that caused it. So repair of small superficial and shallow cracks which do not develop, elimination of gaps and sinks is carried out by means of a coating or torkretki (under pressure of a cement mortar on a metal grid).

At through cracks, insufficient strength of concrete, insufficient reinforcement, and also to prevent further development of dangerous vertical cracks in a grid, along with cementation arrange reinforced concrete clips in the form of a shirt or a belt.

Reinforcement of the upper ends of reinforced concrete piles and their places of connection with the grill (various cases of damages and disturbances in the course of works, destruction of concrete and reinforcement during operation) can be accomplished by arrangement of a reinforced concrete shirt-clip (Fig. 9.6, a).

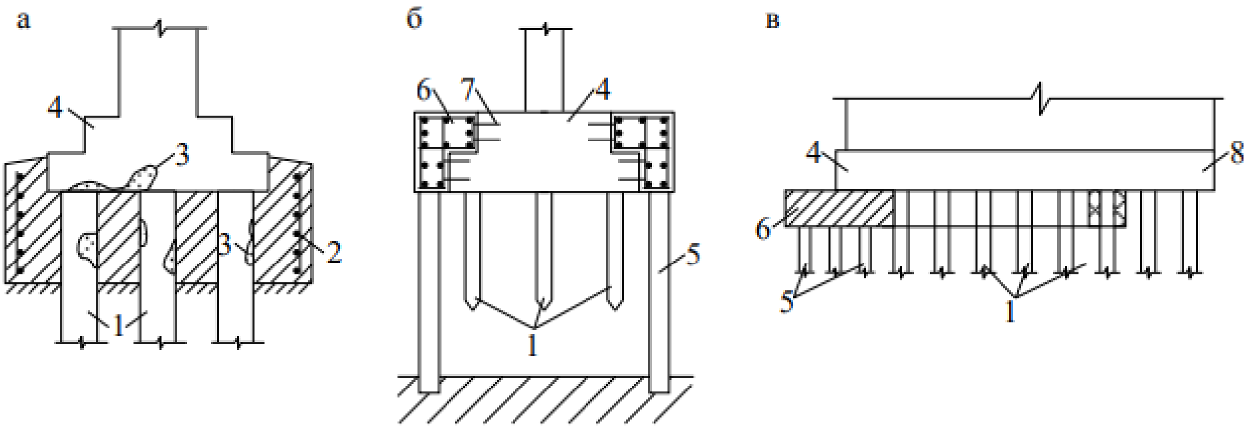


Рис 8.6 Підсилення пальових фундаментів: а – омонолічуванням оголовків паль; б – влаштуванням виносних паль; в – підведенням додаткових паль; 1 – існуючі палі; 2 – залізобетонна обойма; 3 – пошкодження у палі та ростверку; 4 – ростверк; 5 – додаткова виносна паля; 6 – новий ростверк; 7 – зв'язки додаткового ростверку з тим, що підсилюється; 8 – сторона будівлі, по якій вирубувались палі

Shirt sizes and reinforcements are taken constructively; the work is done by grabs.

Most often, reinforcement is performed by immersing additional piles outside the circuit (remote piles). The load on the external piles can be transmitted by means of special support horizontal beams that pass through the grid or wall of the building, as well as by means of a new grid (Fig. 8.6, b).

Reinforcement can also be accomplished with the help of injection piles.

The type of additional piles - drilling, crushing compound, drilling - are chosen according to specific conditions. Strengthening of pile foundations with remote fields also make for the suspension of the roll. In this case, the top of the barrel was cut down in the existing piles in order to put the remote piles into operation (Fig. 9.6, c).

The most effective measures for securing an unstable (landslide) slope with the buildings and structures located on it are the arrangement of counter-banquets, buttresses and retaining slip structures. However, it should be borne in mind that buildings or structures constructed on slopes can be deformed regardless of the degree of stability of the slope. If the slope or slope on which (or near) the building or structure is erected is stable and deformations of the foundations occur, then the causes of these deformations should be sought in the insufficient bearing capacity of the foundation or the strength of the foundation. In these cases, the reinforcement of foundations and foundations is made previously considered in the PP. 8.2-8.5 ways.

The counterbank (Fig. 8.7) is a soil dump and intended

to increase the holding forces in the slope under the influence of its own weight. The greatest effect of a counterbank is achieved when it is located above the upward branch of the sliding surface. In some cases, the lower slope of the counterbank may be reinforced by a retaining wall or pile structure.

The basis of a counter-bank is often made of drainage material (gravel, gravel, coarse sand).

To strengthen the slopes, instead of a solid contrabank arrange

a buttress, which is a transverse vertical projection, an edge or a wall that reinforces a slope (or retaining structure, such as a retaining wall) and which assumes soil pressure (Fig. 8.7, b). Counterforms can be either stone or concrete; stone buttresses also serve to divert groundwater from the slope and are called buttress drainages.

Deformation of buildings and structures on sliding slopes is not always possible prevent a counter-lock or counter-bank. In such cases, sliding retaining structures of deep laying are used. Such structures are most often made of drilling piles located across the shear motion and combined with reinforced concrete grilles (Fig. 8.7, c).

Recently, sliding retaining pile structures have been used with the use of an anchor, which secures the grating on the bedrock. As anchoring devices use inclined drilling piles with a diameter of 200-300 mm. Such structures are more economical, since anchoring the head of the structure greatly facilitates its operation and allows to reduce the number of rows of piles, their diameter and length.

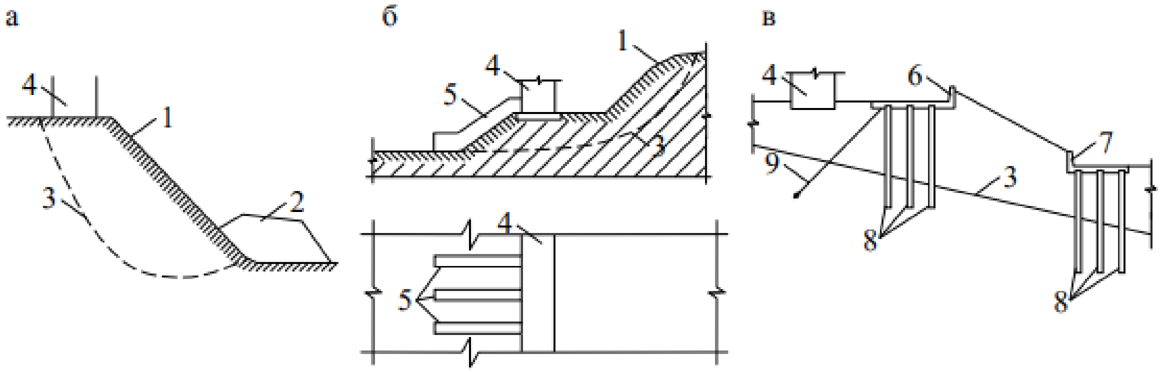


Рис. 8.7. Підсилення схилів: а – контрбанкетом; б – контрфорсом; в – утримуючими конструкціями; 1 – поверхня схилу; 2 – контрбанкет; 3 – поверхня ковзання зсуву; 4 – будівля; 5 – контрфорс; 6, 7 – верхня та нижня утримуюча конструкції; 8 – буронабивні палі; 9 – анкер

The construction of a new building in the context of close construction influences the deformation of the foundation under previously erected buildings. Extra subsidence (sometimes cracks, slopes, and warps) are more pronounced in the part of the existing home that is near the new one.

As is known, the stressed (or deformed) zone basically goes beyond

foundation, resulting in an abyss of sediment. The mutual influence of the closely spaced foundations is that a common sedimentation funnel is formed.

The nature of deformations (sediments and rolls) in the mutual influence of foundations depends on the loading conditions of these foundations, that is, on the time of application of the load. So, if the bases of the two foundations are loaded simultaneously, then the building or structure tilts toward each other. When the foundations are erected and loaded consecutively, the building, which is being erected in the second place (all things being equal), will receive less settling than at the same time; the roll of buildings of the first and second turn is directed in one direction.

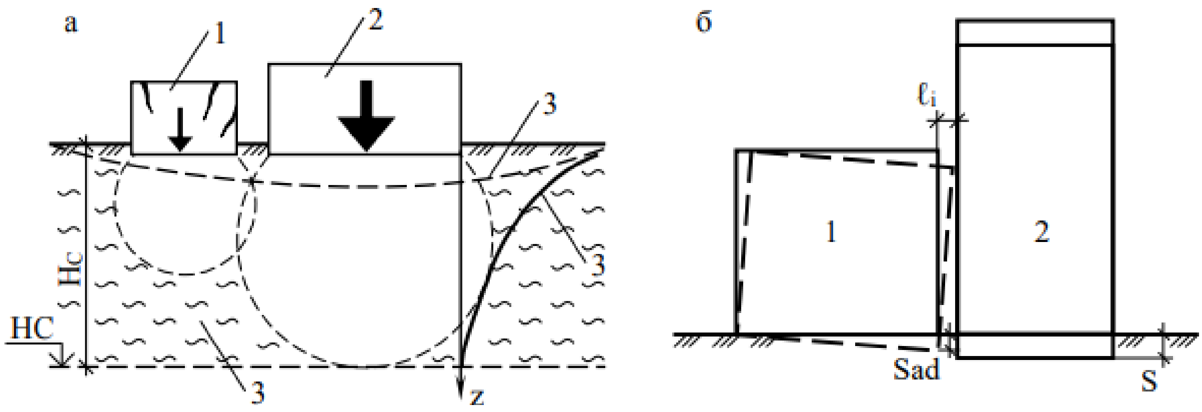


Рис. 8.9. Осідання поверхні ґрунту (а) та характер деформації різнонавантажених будівель (б), що розміщені поблизу одна від одної: 1 – існуюча будівля; 2 – будівля, що зводиться; 3 – вирва осідання; 4 – епюра осідання поверхні ґрунту; 5 – стискувана товща

The surface of the soil directly at the edge of the sole of the rigid foundation gives a sedimentation close to the subsidence of the foundation itself (Fig. 8.9, a), and it decreases with distance from the edge of the sole.

Formation of an abyss of subsidence of the soil surface near relatively "heavy" the erected buildings lead to additional sedimentation of the Sad and the deformation of adjacent existing buildings (Fig. 9.9b) and engineering communications within the aforementioned abyss. At a distance equal to 0.5b from the edge of the foundation, the depth of the sediment ejection can be 25-40% of the value of the subsidence of the foundation itself.

The formation of a sediment funnel in an existing building may also be caused by unilateral loading of the assembled material or the soil filling of the planned works.

In cases where it is not possible to provide a gap between adjacent ones

foundations not less than width b for columnar and 1,5b for ribbon, special measures must be taken: arrangement of the fence on the partition wall and the use of bases with consoles.

Enclosure of the weak foundation of the existing building (Fig. 9.10, a) along the onethe sides that begin the construction of a new building are made of sheet metal,drilling and drilling piles and the wall-to-soil method. In order to avoid the impact of a new building, the enclosure shall extend beyond the contours of the existing building not less than the thickness of a layer of weak soil. In a vertical section, the enclosure must cut through the compressible thickness in the weak soil and enter the dense layers so that the displacement of the enclosure is much less sedimentary

The essence of using foundations with consoles (Fig. 8.10, b, c) lies in next. The foundation of the new building does not come to an end. The front part of the building is supported by a console, the departure of which is determined by the calculation.

The console is most often made in the form of a plate.

The choice of protective measure depends on the specific conditions of construction of a new building near the existing one.

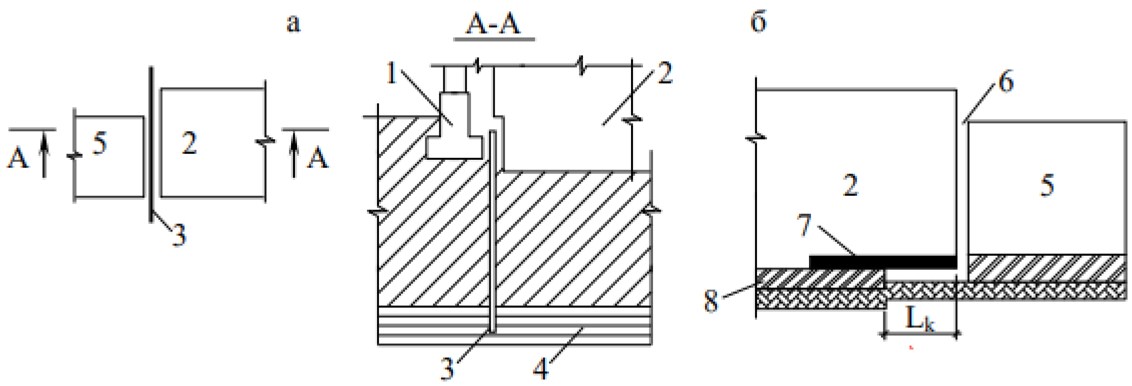


Рис. 8.10. Конструктивні заходи для виключення взаємного впливу близько розміщених будівель на їх деформації: а – захисне огородження; б – фундаменти з консоллю при поздовжніх несучих стінах або плиті; в – при поперечних несучих стінах; 1 – існуючий фундамент; 2 – будівля, що проектується; 3 – захисне огородження; 4 – щільний ґрунт; 5 – існуюча будівля; 6 – осадочний шов; 7 – консоль; 8 – фундамент, що проектується; 9 – несуча стіна; 10 – монолітна частина стіни фундаменту з консоллю; 11 – зазор

9.3 Design of shallow foundation strengthening

The calculation and design of the reinforcement of shallow foundations must be carried out in accordance with the standards

When increasing the area of the sole of the foundations, it is necessary to take into account the increase of the depth of the active zone of the foundations of the foundations and the different deformation and strength characteristics of the soils under the sole of the existing foundations and under extensions.

The calculated soil resistance Rt kPa, under the sole of the existing foundation, taking into account the compaction pressure of the foundation, shall be determined by the actual indexes of the III bearing layer to a depth of 0.5 m below the base of the foundation in accordance with Annex E.

For preliminary calculations it is allowed to determine Rt by the formulaRt =

Ro m Ks ,

where ro is the design resistance of natural (non-compacted) soil, which is accepted by the DBN for new construction, kPa;

t is the coefficient that takes into account the change in the physical and mechanical properties of the soil during the period of the house (structure) operation, adopted depending on the degree of compression of the pint P0 / R0. At P0 / R0> 0.6 m = 1.5; at P0 / R0 = 0.7 - 0.8 m = 1.1; at P0 / R<0.7, m = 1.2;

P0 - pressure under the sole of the existing foundation, kPa;

Ks is the coefficient that characterizes the change in soil compressibility and is taken from Table 1, depending on the degree of realization of the boundary subsidence of the foundation (the ratio of the calculated subsidence Sk at the pressure equal to the calculated one, to the maximum allowable subsidence Su.).

For dusty-clay soils with a consistency index of Il with 0.5 and a useful life of less than 15 years, and for houses on soils of different types, if the calculated sedimentation at a pressure equal to permissible exceeds 70% of the marginal sedimentation, loading is allowed increase only within the values of R0.

If there are cracks and signs of uneven deformation in the existing building, the load on the base under the existing foundations shall not be allowed to accept more than R0.

When performing calculations of soil pressures under the sole of a reinforced centrifugally loaded columnar foundation of buildings with overhead cranes with a lifting capacity of 75 tons and above, pipes, blast furnaces and other structures of tower type, as well as foundations of open crane trestles The soil of the base is not higher than 0.15 MPa. The pressure plot on the soil under the sole of the foundation must have a trapezoidal shape with the boundary pressure ratio Pmin: Pmax = 0.25.

The calculation of additional foundations (unloading the main ones) is done taking into account the depth of their foundation and interaction with the existing foundations. If it is necessary to plunge the new foundation below the depth of laying the existing one, the conditions should be observed.

When designing the reinforcement of foundations and foundations, it is necessary to determine the calculation of the magnitude of the projected settlements, taking into account the change in the size of the foundations in plan and depth, changes in loads on them, depth of the core and the like. It is necessary to determine the possible unevenness of the sediments.

Calculation and design of piles and their foundations when reinforcing the foundations must be performed as required. In this case, reinforcement piles should transfer to the base an additional part of the external load, as well as prevent and ensure stabilization of further subsidence of foundations and deformations of ground structures.

Exemption from the soil work of existing foundation structures is allowed only when their complete technical unfitness is established.

Vertical ties should be used to strengthen the foundations. Inclined piles may only be used if vertical piles cannot be arranged or horizontal loads are placed on the foundation.

The bearing capacity of the inclined pile on the material of the trunk and soil is determined by the calculation of the application of the DBN for the simultaneous action of the longitudinal and horizontal forces resulting from the decomposition of the vertical load on the pile along and across its axis, as well as the bending moment when rigidly laying the pile in the foundation.

In addition, the trunk of the sloping pile is checked by calculating the bending from the influence of soil pressure transmitted from the sole of the existing foundation.

The results of the calculation in the software complex Plaxis 3D

PLAXIS 3D is a simple elemental program designed for three-dimensional calculations of stresses, deformations and strength (stability) of complex geotechnical objects.

The program has ample opportunity to solve various problems that arise in the design of geotechnical structures for various purposes.

The program allows to model the work of the system of structural elements and their interaction with the soil environment taking into account nonlinear, rheological and anisotropic behavior of soils.

In the software complex can be carried out static calculations of the stability of structures, filtration calculations, can be determined excessive pore pressure of soil, calculations of soil consolidation (requires the task of coefficients of filtration for soils), determined coefficients of reliability (by the method of reducing the parameters of soil)

The above calculations can be performed for step-by-step loading and for gradual construction and excavation of soil. For significant deformations, the

Lagrangian correction calculation, which is a calculation on a variable finite element grid, can be additionally used.

Calculation complex Plaxis is a targeted package of geotechnicalprograms for finite element analysis of the stress state of the system "buildingbasis" in a flat and spatial formulation. All material models used are based on the relationship between the rate of change of effective deformation and the rate of deformation.

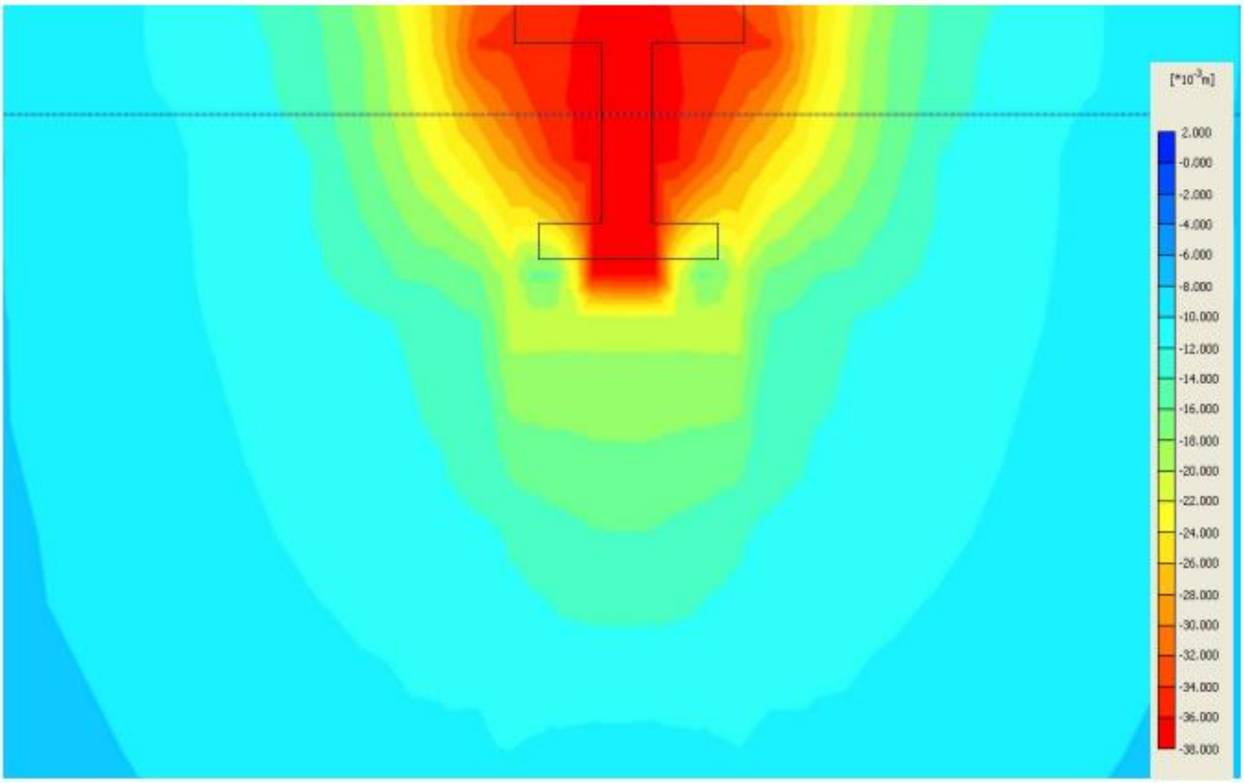


Figure 9.1 The nature of the distribution of principal vertical stresses in the soil mass when modeling the work of a columnar base with banquets at the level of the base

sole.

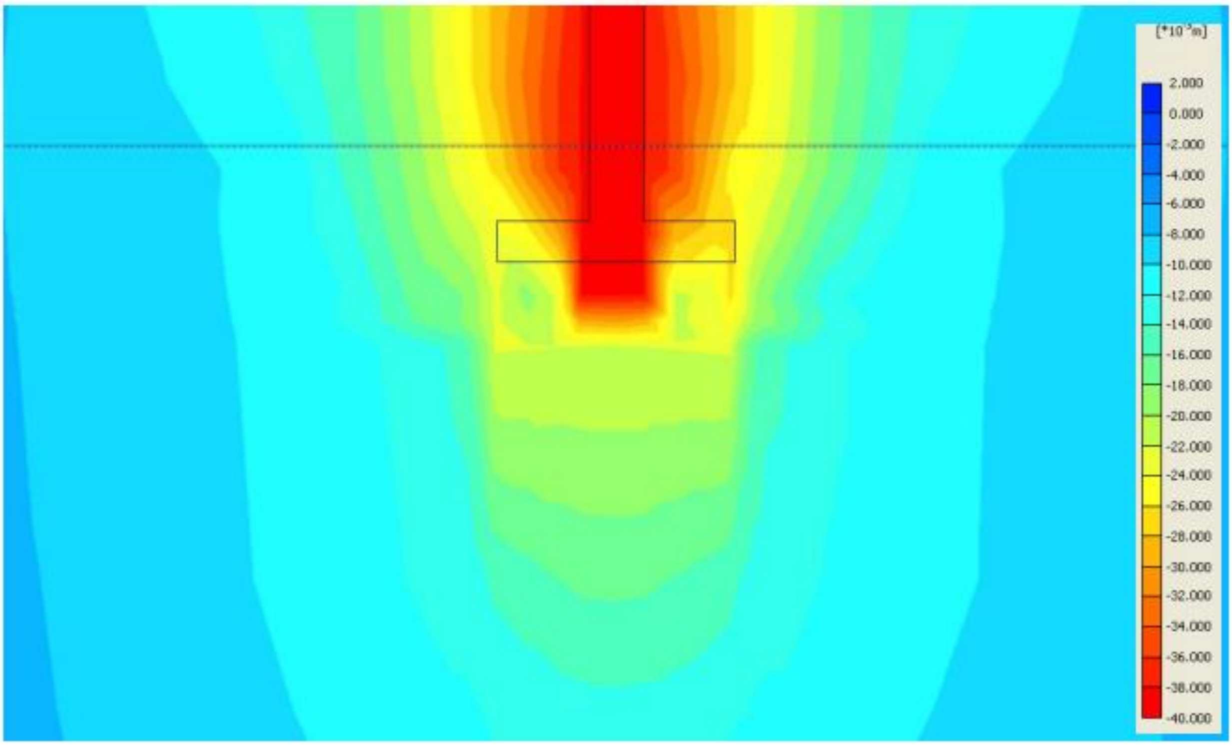


Figure 9.2 The nature of the distribution of principal vertical stresses in the soil mass when modeling the work of a columnar foundation without banquets at the level of the base sole.

The bearing capacity of the tape foundation with different position of the banquets at loading on the base 100kN 1 at the base level of 120kN 2 are missing 200kN

Conclusions.

1. When arranging banquets at the level of the surface of the soil, the soil under the banquet is drawn into the work when the load is increased, which provides the effect of reinforcement.
2. Compared to the option of arranging banquets at the sole level, the effect of reinforcement is 80% percent.

List of literature

1. Law of Ukraine from February 17, 2011 No. 3038 - \ / AND "On Regulation of Urban Planning Activity".
2. Law of Ukraine of May 20, 99 No. 687-X \ / I "On Architectural Activity". OF THE LAW OF UKRAINE of 09.04.2015 «On Amendments to Certain Legislative Acts of Ukraine on decentralization of authority in the field of architectural and construction control and improvement town planning legislation »
3. DSTU B. V. 2.6-189: 2013 Methods of choosing thermal insulation material for insulation buildings.
4. Energy Saving Law of Ukraine
5. Law of Ukraine “On metrology and metrological activity”
   DBN A.2.2-3-2014 Composition and content of project documentation for construction
6. DBS A.3.2-2-2009 "Occupational Safety and Industrial Safety in Construction".
7. DBN A.3.1-5-2009 Organization of construction production
8. DSTU-N B. V. 1.1-27: 2010 "Building climatology"
9. DBN V. 1.1.7-2016 Fire safety of construction sites.
10. DBN V. 2.6-33: 2008 Exterior wall structures with front thermal insulation. Requirements fordesign, arrangement and operation
11. DSTU B D. 1.1-1: 2013 “Rules for determining the cost of construction”.
12. On approval of Amendments to the Procedure for development of project documentation for construction of objects. Ministry of Regional Development of Ukraine; Order No. 492 of 11.10.2013
13. DBN B.1.1-31: 2013 Noise protection of territories, buildings and structures
14. DSTU BA 2.2-8: 2010 Section "Energy Efficiency" in the Design Documentation objects

15. Grounds, foundations and underground structures. Designer's Guide / Ed. EA Sorochana, Yu. G. Trofimenkova. - M .: D985. - 479s.
16. Soil mechanics, foundations and foundations. Tutorial / SB Ukhov et al. Ear. - M .: Izd. ACS, 1998. - 527 p.
17. Dalmatov BI Mechanics of Soils, Foundations and Foundations, Part 2. Fundamentals of geotechnics. –S.-P .: St. Petersburg State Architecture and Civil Engineering University, 2002. - 392 p.
18. Shvets VB, Feklin VI, Ginzburg LK Strengthening and reconstruction of foundations. - M.: Stroizizd, 1985. - 203 p.
19. Garagash BA Reliability of sptial adjustable systems “costruction-base” with uneven deformations of the base. - Ed. Kubankino, 2004. –908 p.
20. Reinforcement of foundations for the reconstruction of existing enterprises LK Ginzurg, B. E. Koval, etc. Grounds, foundations and soil mechanics, 1986, № 4
21. Designing the bases and foundations [Vaganov II, Mayevskaya IV, Popovich MM, Titko OV]. Vinnitsa: VNTU, 2003. - 132 p.
22. ARCHITECTOR'S BRIEF GUIDE (Civic Buildings and Structures), edited by Yu.N. Kovalenko;
23. L.E. Linovich. “Calculation and construction of parts of civil buildings”
24. N.S. Primak “Calculation of frame structures of single-storey industrial buildings”;