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**ESTIMATION OF INFLUENCE OF THE BASES AND
FOUNDATIONS OF BUILDINGS AND STRUCTURES
DURING CONSTRUCTION IN RESTRAINED URBAN
CONDITIONS**

Abstract. This paper presents a work package, associated with the implementation of construction of the bases and foundations of new buildings in respect to surrounding existing buildings requiring qualitative empirical approach in making engineering decisions that should be based on a clear understanding of specificity of this issue. Examined a number of methods for protecting and strengthening of existing bases and foundations. The results showed that the design solutions for new construction and environmental development should be based on an analysis of their interaction.

Keywords: restrained urban conditions, strengthening, reinforced concrete (r/c), bases and foundations, surrounding structures, reducing the impact.

Introduction. Reconstruction of compact planning, especially in the historic center of the city, is a very complex geotechnical problem. Construction of a new building or a profound restructuring of the existing (leaving fragments, such as curtain walls) can cause significant settlement of structure surrounding buildings or saving designs. Therefore highly relevant is selection of a constructive solution foundation that

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does not have an adverse impact on existing buildings and structures.

Obviously, the choice of optimal constructive solution is possible only on by careful geotechnical calculations. The complexity of this calculation is that it is necessary to take into account a wide variety of factors, namely:

- actual bedding soils;
- sequence of loading base (history of construction in the area);
- the complex geometry of the construction site of already erected buildings and new buildings;
- the mutual influence of nearby buildings foundations;
- nonlinear properties of foundation soils (especially important for older buildings, grounds in the bases which often work outside the linear stage);
- stiffening effect on the development of the above-ground structures deformations base;
- assessment of efforts arising in aboveground structures with irregular settlement

Taking into consideration the current trends of modern urban construction, there are new requirements for the design of various objects in restrained urban conditions, aimed at providing the safety of existing buildings and structures, which are not rare invaluable historic monuments.

Characteristics of designed buildings. Engineering searches for the design of new buildings alongside the existing one need to provide not only the study of engineering-geological conditions of the construction site of the new building, but also to obtain the necessary data to verify the effect of a new building on the existing settlements.

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Conditions of location of building or structure are determined not only by its architectural and national economic significance, but also the technical characteristics and methods of the work.

Approximate area of application of various types of bases, depending on the transmission load on the soil foundation, as well as the particular areas allocated for construction, and the specific construction of the object shown in Table 1.

Table 1.
Several recommended types for foundations for buildings with different number of storeys

№ i/o	Number of storeys	Percentage ratio acc. to number of storeys	Approximate level of pressure under bases, kPa	Types of foundations						
				On the natural base			Pile foundations			
				r/c foundation			grout-injected piles	bored screw piles	Augercast piles	combined pile - plate
				Blo-cks	Rib-bon	Pla-tes				
1	2	3	4	5	6	7	8	9	10	11
1	Up to 5	17	100-200	+	+	-	+	+	+	-
2	7-9	14	200-300	+	+	+	-	-	+	-
3	10-17	49	250-350	-	+	+	-	-	+	+
4	18-25	10	300-450	-	-	+	-	-	+	+

Note: “+” recommended;

“-” not recommended

Drilling depth and surface sensing should be administered not just based on the type and depth of the foundations of the new building, but also by the type and depth of the foundations of the existing buildings. When choosing a method of sensing in a dense residential development preference should be given to the static surface sensing.

The design of buildings and structures of civil and industrial, above ground and underground complexes is performed for construction in restrained urban areas.

Selecting the type of foundation carried out depending on geological and hydrogeological conditions of the construction site, the location of the projected building, the depth of the undercroft, on the condition of structures and foundations of existing buildings, near which is planned to construct.

Characteristic of protected buildings and foundations.

To ensure the serviceability of existing buildings, near which the new construction is planned, it is advisable to use the following basic methods of protection and production work, including:

- foundations on a natural basis: strengthening the bases, increasing the bearing surface, the device cross ribbons or foundation slab, strengthening the foundation slab, strengthening piles of various kinds (grout-injected piles, bored, augercast piles, etc);

- pile foundations: gain (repair) of piles, piles with additional broadening of raft foundations, pile foundation design change due to transplant bearing structures for additional piles at a significantly greater load-carrying capacity of cross-device tapes or solid concrete slab on pile foundations, strengthening the body grillages;

- enclosing structures (tongue, diaphragm walls of different designs and methods for their manufacture);

- pre-grouting in various ways in the areas of interface reconstructed and new construction;

- use constructive solutions that do not create additional impacts on existing structures (cantilever type solutions with piles use the pinch and screw-pile structures, etc.).

Estimation methods of influence . When performing calculations based on existing buildings and structures are affected by the new construction should take into account changes in the physical and mechanical properties of soils and hydrogeological conditions in the neighboring building, including considering seasonal freezing and thawing of the soil mass.

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During the construction vicinity existing buildings and structures of their settlement and foundations to the strains should be performed based on two conditions:

$$S + S_{ad} \leq S_{ad}^{complete} \quad (1)$$

$$S_{ad} \leq S_{ad,u} \quad (2)$$

Where: S – Deformation of the base before the new construction, defines by requirements of СНиП 2.02.01-83 «Основания зданий и сооружений»;

S_{ad} - Additional deformation of a base caused by new construction;

$S_{ad}^{complete}$ - Limit value of the total deformation of the base;

$S_{ad,u}$ - Limit additional deformation of base caused by new construction

Limit value of the total deformation of the base $S_{ad}^{complete}$ should be determined by the next formula:

$$S_{ad}^{complete} = \gamma_c * S_u \quad (3)$$

Where: S_u - Limit deformation of base caused by new construction, defines by requirements of СНиП 2.02.01-83 «Основания зданий и сооружений»;

γ_c - coefficient of working conditions assigned depending on the category of state of building structures in accordance with the table 2.

Table 2.
Coefficient of working conditions

Category of state of building structures	γ_c
I-II	1,0
III	0,8

Note: Values of coefficient of working conditions are given for buildings aged for at least 10 years.

Installation methods foundation. With the construction of a new building, directly adjacent to the existing minimum distance between the edges of the new and existing foundation established in the design depending on the way of development of soil and depth of excavation, foundations and construction of the separation wall.

If necessary, the emplacement foundations of a new building in the pit below the uncorroborated foundations of the existing (Figure 1) allowable difference in elevation of emplacement is determined from the condition:

$$D_h \leq a (tgj_1 + c_1/p) \quad (4)$$

Where: a - the inner distance between foundations;

j_1 and c_1 - respectively the calculated values of the angle of internal friction and specific adhesion of soil taken for the calculation of the first group of limit states

p - average pressure under the foundation of the existing building design loads determined for the calculation of the base bearing capacity.

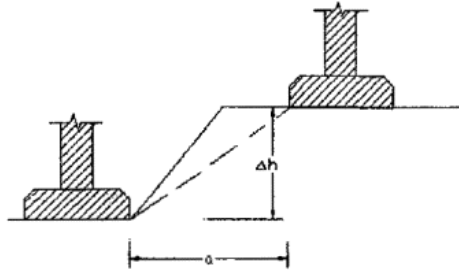


Figure 1. Location adjacent foundations at different depths

If condition (Fig. 1) cannot be satisfied or the amount of deformation of the existing building from the effects of the new building will exceed the limit values, it is necessary to take measures to reduce the impact of settling a new building on an existing one. These measures include:

- Use mounts pit;
- Pressure transmission from the new building on the dense layers of subsoils by using deep pillars or piles of various designs;
- Strengthening the foundation soil of buildings of various technological means (chemical fixation, reinforcement, etc.);
- Installation of separating wall.

Separating wall may be used:

- Piling row;
- A series of a screwed steel tubes with wire-wound (grout-injected piles);
- Wall of piles, including bored, grout-injected piles and pressed;
- “Wall in the ground”.

Embedment depth calculation separating wall in stronger soil layers or soil layers below the base of the projected thickness of compressible foundation (fig.2) is made on the basis of conditions:

$$m u S f_{1i} l_{1i} \leq 2 u S f_{2j} l_{2j} \quad (5)$$

Where: m - coefficient of working conditions taken to separating wall, immersed in the soil to a depth of less than 4 m, $t = 0.6$; the same to a depth more than 4m, $t = 0.8$;

u - length of the separating wall, assumed to be 1 m;

f_{1i} and f_{2i} - calculated resistance of the i -th and j -th soil layer, respectively;

l_{1i} and l_{2i} - width of the i -th and j -th soil layer, respectively.

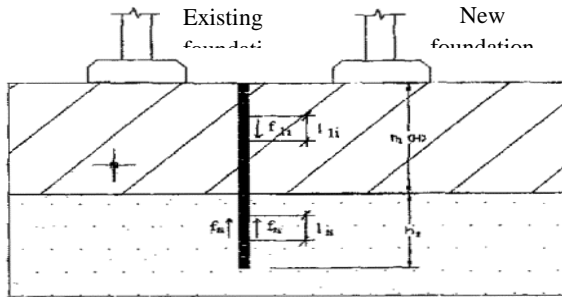


Figure 2. Scheme for calculation separating wall

Thus, during construction of a new building alongside the existing as well as in cases of disassembly at the same time old buildings should be avoided:

- violation of the structure bearing layers of the base and the loss of the stability of slopes in the passage of pits, trenches, etc.;
- fracture in filtration;
- freezing soil foundation of the existing building from the Open-pit.

The main problem in the design and construction of new engineering objects in restrained urban conditions is to ensure the safety and normal operation of the surrounding buildings.

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Аннотация. В данной статье представлено комплекс работ, связанный с осуществлением строительства оснований и фундаментов новостроек, расположенных в непосредственной близости от существующих зданий, проектирование которых требует нового качественного эмпирического подхода в принятии инженерных решений, которые должны быть основаны на четком понимании специфики этого вопроса. Также рассмотрены методы защиты и укрепления существующих оснований и фундаментов. Приведенные результаты подтверждают, что проектные решения для нового строительства и экологического развития должны быть основаны на анализе их взаимодействия.

Ключевые слова: условия плотной застройки, укрепления, железобетон, основания и фундаменты, окружающие структуры, снижение воздействия.

Анотація. У даній статті представлено комплекс робіт, пов'язаний із здійсненням будівництва основ та фундаментів новобудов, розташованих у безпосередній близькості від існуючих будівель, проектування яких вимагає нового якісного емпіричного підходу в прийнятті інженерних рішень, які повинні бути засновані на чіткому