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## ERECTION OF HIGH - RISE COMPLEXES UNDER THE RESTRICTED CONDITIONS OF EXISTING BUILDING

*Special attention is given to „Geocomposite” method used by building sites for strengthening of a soil basis under adverse service conditions.*

*Key words: Bearing capacity, superstructure, grouting, injection, mechanical properties, reinforced materials, soil mechanics.*

**Statement of question.** The center of any modern city of Ukraine is a difficult conglomerate of historical buildings, low uncomfortable apartment houses, quarters of Khrushchev five – storey apartment blocks, residential communities build in the period of mass – construction in the 80th and the modern buildings interspersed in developed city environment.

In the center of cities mass post – war hinders and even makes impossible the development of an inhabited infrastructure of developing cities without the solid capital investments. At the same time, the centers of the developed building of cities are of interest to investors and builders. Land cost promotes creation of high-rise multipurpose complexes.

Nowadays the construction under the constrained conditions of city building raises acute problem. Problems of maintenance of reliable functioning of the bases, the bases the basements and underground parts of high – rise buildings special place at their designing and construction.

The soil basis of any construction, including high-altitude building, is a part not only the construction, but also the natural geological environment. Properties of the basis possess unsteadiness. It is more difficult to give the quantitative description of them others artificially created elements of a system „basis – foundation – superstructure”. Usually the basis especially natural is the most deformable element of the stayed system. In consequence of other factors (full load transmitting superstructure of the basic, technological difficulties of constructive decisions optimization etc.) foundations directly cooperating with the basis and superstructure are generally the most loaded elements of the constructive scheme. It is that is important that the efforts are defined with smaller trustworthiness, than in designs of superstructure [5].

**The work purpose.** The purpose of this paper is to investigate strengthening construction methods and to analyze high – rise buildings construction under various geological conditions. The most effective method of engineering preparation in difficult environment designing.

**Body of the paper.** The given researches are closely connected with a scientific and technical policy of the state in an estimation of a technical condition of buildings and constructions, in improvement of quality design responsibility of buildings and constructions in rational use and also territory protection according to Statement of the Cabinet of Ukraine № 409 from May, 5th, 1997 „About maintenance of reliability and safety of buildings, structures and systems”.

Designing of high-rise projects in existing building can lead to inadmissible deformations of the basis. It leads to inappropriate operation of side by side standing buildings in future. One of the reasons which leads to deformations of existing building is transmitting additional loads on the soil basis. The existing building can receive substandard settlement and list because of the weight erecting building. As a rule, five floors buildings are subject to such deformations while high –rise building are being constructed.

In the many countries different methods of soil basis strengthening are applied.

The bearing ability of the soil basis plays an important part in construction [1].

In Dubajah the most effective ways of its increasing are:

– a method of deep vibration which allows to increase insufficient bearing ability of the basis. As a result of vibration the soil is condensed. Addition of a special material raises bearing ability. The given technologies can be mainly applied in cohesionless gravels and sand;

– koplán stabilization method (CSV) allows to increase bearing ability of cohesive soil. By means of the drilling unit binding substances are injected into soil. These substances enable the reaction with water to take place in a ground. They harden columnform and can be used as means of perception of loadings;

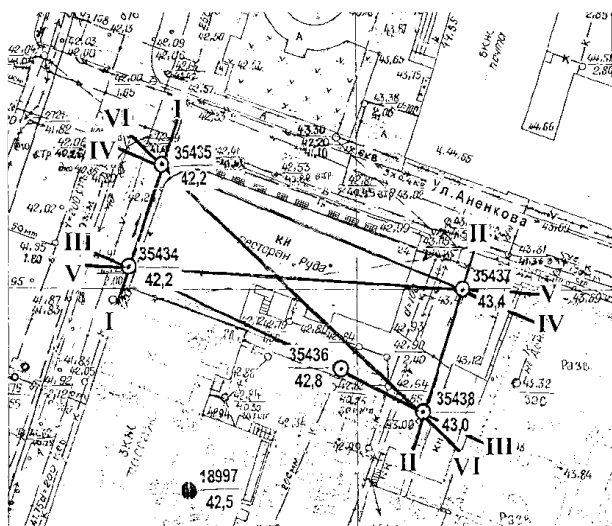
– jet injecting [2].

Jet injecting is also applied in Russia. Under this method the basis of a 22-storeyed archive depository building has been strengthened in Moscow. Combined soil consist with dense sands and average density sands with the layers thickness of 1,2 – 1,5 m with gravel and the rubble inclusion. There were prolayers of plastic sandy loams with the thickness of 0,7 – 2 m. Presence of sandy loam with low physical and mechanical characteristics and non-uniform capacity of layers has created threat of substandard settlement and its possible list. The basis has been strengthened by the „Geocomposite” method which deformation module has reached 39-50 MPa that exceeds design requirements in 1,5 – 3 times [3].

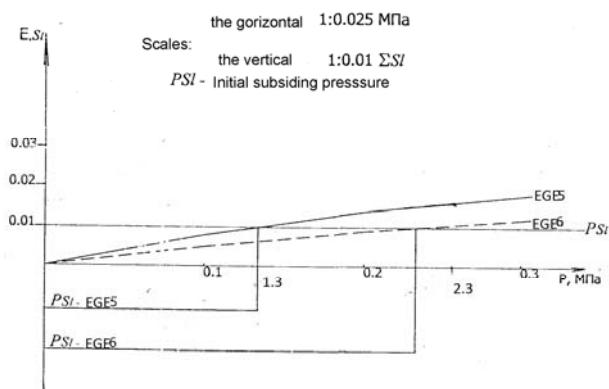
When reconstruction of the 1st Pirogov city hospital the method has been used

again for strengthening of the basis of strip and columnum foundations and also for strengthening bricks and rubbles foundations of building.

The considerable part of Krivoi Rog consist of the five-floor houses constructed in 1950-1970 the Majority of them have the strip foundations shallow station while a new high-rise buildings in the central areas are erected on the pile bases more often .



Pic. 1. Topographical shooting of district on Charles Marx's street



Pic. 2. Schedule relative subsiding bottom

Nowadays construction of four-star hotel „Grand Hotel” under difficult engineering-geological conditions is conducted (pic. 1). Building site is combined from such layers as erode proterozoic slates, quaternary sand, loess-like loams and a modern soil layer. From above the territory is planned and covered bulk bottom various capacity.

According to drilling site one water-bearing horizon in quaternary sand is opened on a studied.

Sand EGE7 and 8 are enhydrous. As a water emphasis serve soil of EGE9.

Conditions of soil thawing concern to the 1st type (pic. 2).

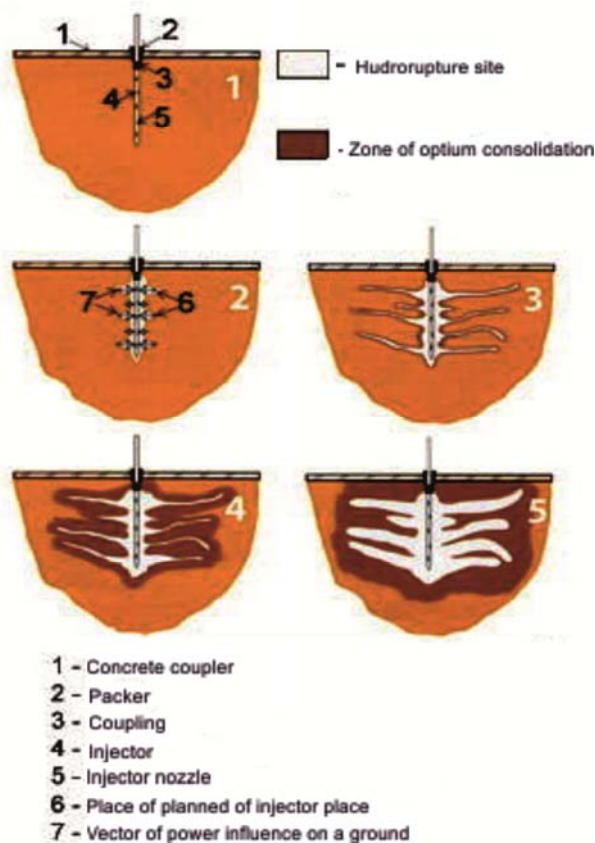
In the given territory the basic adverse factors are presence thawing loams and bulk soil of the various capacity, unequal soil structure and density.

Considering these conditions it is necessary to accept an effective method of territorial engineering preparation.

One of such methods is strengthening of a soil mass by „Geocomposite” method. Using means of this method following problems are solved:

- reinforcement of foundations of damaged buildings and structures;
- preparation of foundations for new structures;
- reinforcement of architectural monument foundations;
- soil mass reinforcement along open and above closed excavations in order to prevent neighbouring buildings and structures from damage;
- fill consolidation in order to construct houses, industrial enterprises, roads, etc.;
- soil mass reinforcement in order to increase slope stability;

- reinforcement of foundation composed of quarry stone;
- correction of building inclination;
- soil mass reinforcement in order to increase stability of excavation slopes;
- soil reinforcement in foundations of dwelling houses under construction in karst-prone zones;



Pic. 3. Technological scheme of a method „Geocomposite”

- anchoring during sheet piling of construction trenches and retaining walls;
- soil stabilization at tops of galleries and tunnels under construction;
- construction of impermeable shields in order to decrease the effect of seismic vibration generated by technogenic sources (railroad, underground, etc.);
- reinforcement of embankments and dykes [4].

This method is based on operated injecting under the volumes pressure and hardening solutions calculated on special is volume-planning scheme (pic. 3). Fragments of a soil mass are condensed with pressure of injecting solution. They get essential-improved mechanical characteristics. The solution fills cracks and emptiness. A friable ground is condensed with pressure. Operating as an intra-massive jack solution forms rigid reinforcing skeleton.

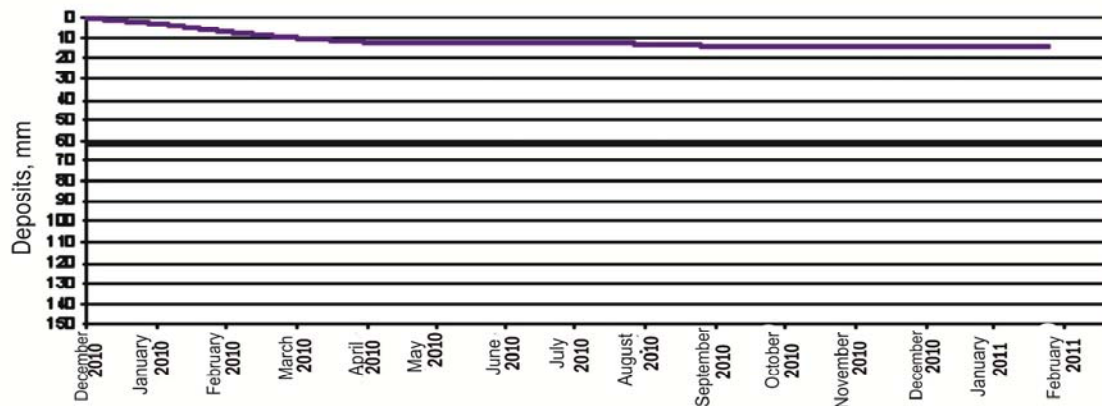
It also forms cement stone inclusions with a radius of 1,5 – 2,0 m. from injector. In this addition the rigid skeleton obtained from the hardened solution, strengthens the condensed soil mass. Thus strengthened soil mass is essentially new technogenic formation which possesses high rigidity and chaotic structure.

In 2010-2011 using the stated technological scheme (pic. 1) the works on basis strengthening were carried out on a building site. Strengthening results are indicated on pic. 4.

**Conclusions.** For geotechnical problem solving on the considered building site application of „Geocomposite” method allows to get economic advantages, such as:

- the low cost price of technological works provided with high mobility and efficiency.
- use of the inert materials providing ecological cleanliness of a method.
- unnecessary to use the heavy shock equipment causing dynamic loadings.

– using of light – weight equipment in dangerous and reconstructing buildings and constructions. It allows to strengthen the bases practically in any premises without infringement of a condition and its integrity.



№ layer	The ground description	The deformation module, MPa	
		Natural addition	Ground strengthening
5	Sandy loams plastic	14	21
6	Loams samelplastic	14	31
7	Sand of average coarseness, the average density	29	35
8	Sand of average coarseness, the friable	24	35

Fig. 4. Schedule averaged a deposit of the basis of a building on Anenkova street

It has been shown that also technological advantages take place:

- soil strengthening in a zone of demultiplexing that connected with a lining of an underground collector;
- basis settlement stabilizing under the tape foundations of standing side by side building;
- bearing ability restoring of pile foundation of „Passage” shopping center;
- excluding the additional settlement development in a zone of building influence.

In comparison with other traditional methods this reliable method will allow to receive economy of 30-50 % on labor costs, terms and project value.

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### **Annotation.**

Special attention is given to „Geocomposite” method used by building sites for strengthening of a soil basis under adverse service conditions.

**Key words:** Bearing capacity, superstructure, grouting, injection, mechanical properties, reinforced materials, soil mechanics.

### **Аннотация**

Особое внимание уделяется методу „Геокомпозит”, который применяется на строительных площадках для укрепления грунтового основания в неблагоприятных условиях эксплуатации. Это новая технология основана на принципах создания композиционного материала.

Метод „Геокомпозит” представляет естественный и искусственный композиционный материал, обеспечивая высокую жесткость и хаотическая структура.

В результате исследований было доказано, что несущая способность грунта после укрепления увеличивается в 1,5-3 раза.

**Ключевые слова:** несущая способность, надстройка, цементация, инъекция, механические свойства, армированный грунт, механика грунтов.

### **Анотація**

Особлива увага приділяється методу „Геокомпозит”, який застосовується на будівельних майданчиках для зміцнення ґрунтової основи в несприятливих умовах експлуатації. Це нова технологія ,яка базується на принципах створення композиційного матеріалу

Метод „Геокомпозит” представляє природний і штучний композиційний матеріал, забезпечуючи високу жорсткість і хаотичну структуру.

В результаті досліджень було виявлено, що несуча здатність ґрунту після укріплення підвищується в 1,5-3 рази.

**Ключові слова:** несуча здатність, надбудова, цементация, ін'єкція, механічні властивості, армований ґрунт, механіка ґрунтів.