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TYPES OF FOUNDATION FEATURES SELECTION IN CONSTRUCTION

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Annotation
The foundation - this is the main part of the building or a structure, basis, which is responsible for building or structure condition. From them belong the longevity of the building, aesthetic beauty, operation quality, heating waterproofing. Modern construction pace is quite high as emerging new technologies, which make it easy to develop invented new types of foundations. There are quite a lot: belt foundation, screw foundation, planar foundation, pile foundation and other types of foundations. They all have pluses and minuses. But have common characteristics: all the foundations withstands stable and unstable loads - roof, walls, ceilings. In this work is submitted the foundation types, their advantages and disadvantages, why one foundation worse than other, types of foundations popularity Lithuania, from what begins all foundations equipment, why it is important to examine the ground before starting to install the foundation. Nowadays prevails residential and civil construction. In the industry using large size and mass technological equipment. From them the load transmitted to the ground, that's why in the construction of civil buildings, residential houses are widely used pile foundation, about who in this work is submitted detailed analysis of the installation, in research discovered significant advantages: minor excavation; many new construction piles are small bearing capacity, low weight, their manufacture consumes less concrete, reinforcement and other materials; pile foundation reduces the amount of the working land; relatively inexpensive and quick installation and good quality; do not need drainage; their strength allows to ensure the foundation disintegration, not do deform buildings, unlike other types of foundations. One of their unique properties - installation in the winter; and the biggest advantage – the ability to approve them in the soft ground, that you can not do with other types of foundations.
KEY WORDS: construction sector; types of foundations, foundations advantages and disadvantages.

Introduction

Sometimes listening to the self-taught builders you can think that it is enough to pour the foundation of the house only to dig as much as half a meter deeper than the ditch, because allegedly deeply frozen ground rarely reaches, so the foundation do not be lifted. However, such advice is not worth listening to.

Foundations - one of the most important elements of the building, causing the whole house condition. Builders often pay too little attention for the foundation installation, because most of them are invisible and underground. However, from the foundation depends house the durability, heat waterproofing, home aesthetic beauty. Belt, drilled or pile foundation, the main question, which is better? Modern construction rates are very high, as the invention of new technologies. According to the International Soil Mechanics and Geotechnical Engineering Society ISSMGE (2010), recently popular is drilled foundations, which are often used in the construction of individual houses, especially frame. These foundations are stable and quickly installed. Young Lithuanian researchers pay a lot of attention on polar research foundation Jankauskas, Gadeikytė (2010); Stankus, Martinkus (2013); Sližytė (2001). Belt prefabricated foundations constructed of blocks. For foundation sturdiness ensure placed foundation slabs, and on them are mounting blocks. And at this point there is soft ground problem, because if the soil is unsteady, they need to combine the foundation – on drilled you have to put belt foundation. Where drilled foundations can not guarantee the strength as an alternative constructions of the weak soils instead of belt and drilled foundations are usually designed one of the most robust foundation - pile foundation. Pile foundation consists of piles connected through monolithic beams or plates, known as the foundation cross (grillages), in which is supported over the foundation in construction. Building load is transferred to the grate, from it - to the piles, from piles - to the ground. As the new building piles can be high bearing capacity, they are sometimes installed faster and cheaper (but frequent are quite expensive), compared with other foundation structures, so they are often installed and in fairly good soils.

The research problem: investigating the foundations of the types, arising questions are:

• what are some types of foundations advantages and disadvantages?

• why is it better to choose some types foundations (although they are sometimes more expensive) rather than other types of foundations?

• why the foundation of one type superior to the other?

During the work will be discussed answers to these emerging issues in choosing the bet type of foundation.

The aim of research: to show why in the construction is better choosing pile foundation, what are their advantages, why they are more useful then other types of foundations.

Objectives of the study:

• compare foundation types;

• evaluate different foundation types pros and cons;

• analyze how to choose the proper type of foundation by the ground;

• a comparison between the types of foundations, prove pile foundations advantage.

Foundation types, their advantages and disadvantages

The foundation is of each building, structure basis. They transmit the load of the building or the building to the ground and distribute them evenly. The foundation is one of the most important parts of the building, because the foundation needed the most work and from them belong the building, structure, durability, and its service quality (Nakas *et al.* 1992 41p.). There is a widespread belief that the foundations must be massive and deep, as this will ensure that the house is stable. But everything must start from the ground survey. The different composition of the soil is frozen differently, it is affected by the ground water level. If the ground water high in the event of a frost, wet soil cold. In the ice frozen water expands about 10 per cent, so expanding and primer. In winter it is trying to push out the foundations of the earth, and vice versa - is trying to involve them in the spring when the ice melts. Because this process in different places on the foundation going different it can lead to cracks or deformation of the foundation. The difference in intensity at different locations of plot, expanding soil can lift even the entire building. Therefore, it is necessary to choose the correct type of foundation and vent their quality, as the foundation have to maintain the building, so they have to be strong. The main mistakes of the foundation laying is unexplored ground during omission, sometimes you can see the cracked walls of the house, because of declined foundation, because soil has not been tested. That is why you should always carry out research and to calculate the strength of the soil and the weight of the house. The designer doing calculations and then determine the most appropriate place for resting the foundation and the necessary substructure depth. This is doing in a very responsible manner, because otherwise the wrong way of the calculation, the house will sit down, lose their shape, become hooked. When choosing a foundation should be considered not only the strength of the soil, but the house load and other factors. But the most important is the soil, from his research starts all foundation construction. To build without geological surveys is not recommended, although neighborhood and possible investigations showed that there's a strong primer, should be testing their place, that you do not need to regret it for a big loss. Soil properties are developed using two techniques: field and laboratory. Outdoor approach - this is some special equipment hammered metal bars, which at the end of a cone-lock ground resistance. It is clear what kind of load can withstand the primer. Laboratory method - which is studied the sample came in geotechnical laboratory. There shall be the following soil properties as grit, porosity, moisture content, density, plasticity and mechanical characteristics. Including the extent to decrease the volume of the soil, depending on loads. Construction means the foundation deposition (Ramoškevičiūtė 2013).

The most important things to consider when installing the foundations for this:

• Soil type and characteristics;

• Are there plans to have the basement;

• Foundation waterproofing of ground and rain water;

• Substructure depth should be below the frost line depth. Lithuania - 1,2m (Tinkamo pamatų tipo... 2014).

The most commonly chosen Lithuania construction of belt or drilled foundation (Fig. 1), occasionally polar or tooled foundation, a very popular planar foundation. However, whether this is a good choice? This requires an overview of each type of foundation pros and cons.

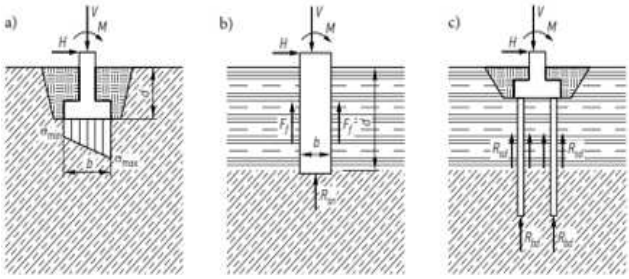


Fig. 1. Foundation types: a) shallow belt foundation b) deep foundation c) pile foundation (Ramoškevičiūtė 2013).

Belt foundation are made monolithic and prefabricated. More often choosing a prefabricated foundation of concrete blocks, because monolithic construction of foundations take up more time. Belt foundation is good that they are economical, quite strong and quick. Their sedentary is about 1,5 cm. However, they are equipped with the necessary lifting equipment (such as a crane) with which may not always be possible to reach some places. If in the plot is a high groundwater level, necessary drainage, which takes away even more time throughout the construction process because of the need to make a convenient access from all sides of the foundation, as the need to dig up the soil. That is why these foundations are recommended to choose the construction of buildings with a basement and a heavier construction. That as it may it is one of the better foundation.

Another type of foundation: *drilled foundation*. They are also very popular in our country. Popularity influenced by low labor and material cost, as well as fast installation. It is also very convenient, if in a building construction place are a lot of engineering lines. Drilled foundation choosing the right technology are heated from sides and bottom, so there is no cold bridge. That's why they are good. But as everywhere there are pluses and minuses. Because the price is quite low, drilled foundations disadvantage is that they are among the weakest, more suitable for strong primers. Their sedentary 2 - 2.5cm. Very often mistaken from builders constructing this type of foundations.

Another type of foundation - *pole foundation*. They formed sharply hammering poles into the ground, but the foundations of the pole is best to use only for wooden houses. Such variant of foundation is the cheapest and easiest option, however foundation constructional scheme need to be made only after consideration of possible deformations soil. If they meet the requirements, then it is the only way to equip a house with such foundations. If the ground is expanding rapidly, walls can only be framed, if the soil is quite stable, can be other forms of wall construction. Such foundations are suitable more for the house size of not more than 80 square meters.

Planar foundation - the foundation of an integrated output structure, blended into the special foam forms, which completely isolates the reference card from direct contact with the soil. This helps to avoid the foundation deformation, cold bridges. This foundation plus is that the building built on the planar foundation remains sturdy and stable, because planar foundation hold the building the entire plane, rather than a number of individual parts. Also, the planar foundation is one of the warmest and strongest. They are designed especially for energy-efficient homes.

Table 1. Various foundations advantages and disadvantages

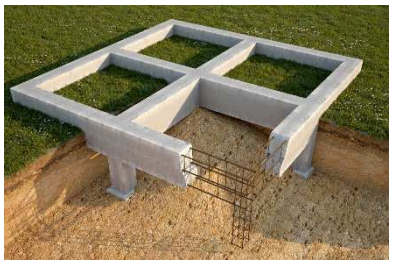
Type of foundation	Advantages	Disadvantages
Belt foundation 	• Installation time is not long; • Economical; • Has a good load-bearing capacity; • These foundations are advised to choose the design of the building with a basement or heavier structures.	• Needed Required lifting technique, which may not always be possible to reach; • If the high ground water level, necessary for drainage, which is time-consuming.
Drilled foundation 	• Low labor and material costs; • Fast installation; • Heated the bottom and sides, so there is no cold bridge; • Easy installation of the building instead of passing many engineering lines;	• One of the weakest types of foundations; • Compatible only stronger primers; • Common errors from builders installing these foundations;
Pile foundation 	• The only foundation of a defining characteristic that can be prepared in weak soil; • Low material costs: • Small earthworks volumes; • There is no need to prepare the base; • One of the strongest;	• Necessary technical equipment;
Pole foundation 	• The cheapest and easiest option of all foundation types;	• Applied mostly just for wooden foundations; • Supported only on a small ground; • Applicable only when home base size no larger than 80 square meters.
Planar foundation 	• Robust and stable foundation; • Warmest; • One of the strongest; • Quick installation, small earthworks.	• Required drainage.

Image source: Фундамент 2014.

The foundation of the thermal resistance *R* can reach 9.7 (R = 9,7m^{2}K/W) or more. They are quickly installed, because the construction period is removable only vegetable ground layer, made little ground work, but necessary drainage (Pamatų įrengimas 2013).

And one of the strongest - *pile foundation*. Pile foundations appropriate when the upper soil layer very weak or very deformable, such as peat, sludge and bulk non compacted soil or high water table, and his humiliation expensive (Sližytė 2012 98p.). In the land to

a depth of 10-12 meters are minted piles, providing not only support, Used some strong soil is deep. Piles are reinforced concrete, wood, concrete, steel, soil, synthetic, combined cross-section. Minted every 1.0 to 1.5 m. but also for compacting soil (Kokybiški namo pamatai 2015). Pile foundations advantage is that their use reduces material costs (concrete - 40%), reduces the earth works (80% compared with the belt foundation), do not need to prepare ground floor or degrade groundwater (Kaip išsirinkti tinkamus... 2013). Bearing capacity of the pile and the number in foundation calculated on the basis of the characteristics of the soil and building loads, in this respect, it is calculated and pole diameter. Pile is working by the vertical and horizontal forces, and in them must be taken in consideration by foundation counstructors to apply certain coefficients calculations. Also in the project must be calculated pile foundation subsidence. Pile foundations are one of the most progressive, zero-cycle construction types. This would suggest that each type of foundation has many different construction methods, the mechanical and technical characteristics. Of course they have common characteristics: all the foundations withstands permanent and volatile loads from above – the roof, walls, ceilings, volatile - machines, people and equipment, which are constantly changing position. The foundation works and physical natural factors - cold water, heat, that's why installing the foundation needed to remember their thermal insulation and the surrounding soil drainage. Thus, there is no universal method suitable for everyone. However, the strength andvariety, installation methods, characterized by the strength of pile foundation, which will attempt to review.

Brief mention should be made for *stone concrete foundation* but they are already obsolete. Yes, they are the cheapest of all types, but they are the weakest, most problems that cause the foundation of a long construction time, largest amount of builders mistakes - inadequate concrete-stone ratio, the wrong type and shape of the stones. Saw the advantages and disadvantages presented in Table 1.

Pile foundation types and their peculiarities installation

Piling work technology had a long way of development - from wooden piling methods to modern pile works based on effective methods of work and mechanization instrument (Kriukelis 1981, 119p.). The construction of pile foundation, compared with other foundation structures, more than twice decreases the volume of earthworks and concrete costs.

Because as has already been mentioned, pile foundation can be built with low labor and materials costs, quickly and cheaply, they are often installed even in strong soils, not only weak. In modern industrial and civil construction, many buildings are built on pile foundations. According to the material piles can be: wood, concrete, concrete, metal, combined cross-sectional, synthetic ground (Sližytė 2012 98p.). Piles load can pass in two ways: weak primers for external friction (friction piles) (see. Fig. 2 a) and when it is supported by the strong primers (see. Fig. 2 b). To install pile foundation used poles like: 1)

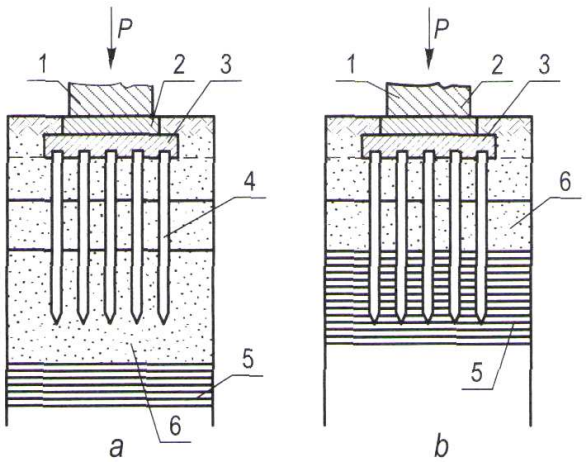


Fig. 2. Pile foundation scheme: a – friction piles, b – poles repel; 1 – Column, 2 – basis, 3 – grate 4 – pole, 5 – dense soil 6 – weak soil (Zavadskas et al. 2008).

Circular are made in factories and on construction sites, removing soil; 2) monolithic piles installed in soils bore-holes; 3) compound that possess characteristics of both groups pole; they can be installed using special techniques. In factories manufactured poles can be selected, depending on soil characteristics, computational load of the pile and the pile function, their price (Zavadskas *et al*. 2008, 112p.).

Before starting deepen pole, hace to do preparatory work: to level the pole outdoor area, mark pole field, installed temporary roads to bring piles and techniques, transported and mapped poles. Smooth out the field pole pitch, removing the vegetable layer is very important, because piling accuracy depends on the evenness of the area. This is done by bulldozers, graders. Pile Field Marking out - it is the foundation of polar axis transfer to the construction site. Future Polar foundation accuracy depends on the axis formatting accuracy, so marking is mainly done by surveyors. Rapper help set the height altitude and made outside pole marking scheme (see. Fig. 3). The scheme secured till the building's construction work is completed and forwarded to the customer.

Poles come equipped with a temporary roads. Bringing piles are tested to meet the parameters, marking. Piles are marked, so you can watch as they plunge. The same circular process consists of auxiliary operations such as pile-riding field pole, building the pile piling famous, attracting poles and installation, beaten superposition and installing basic operations: piling into its design altitude or response. The other surgery sometimes takes more than 50 percent of the total cycle time pile. It is therefore necessary to reduce the installation and support poles for attracting scheme, selecting them proper piling scheme. This is the pole and the equipment concerned preparation process (Nakas *et al.* 1992, 128p.).

Piles in the strong ground should be recessed:

• to gravel, wholemeal, medium grit sand and clay in the soil in which the flow rate of IL <0.1 - not less than 0.5m;

• other dispersion primers - not less than 1 m (Ramoškevičiūtė 2013).

The biggest plus pile foundation is the construction in the weak soils. Here they do not lose shape, then building

non deformating compared to other types of foundations. Circular piles into the ground using various methods and technical machines, which allow a foothold in the weak soils. These are: the shock method and brakes; vibrators and vibration method; static indentation method and embossing machines; screw method and screw machines, hydraulic method; combined vibratory grinding method. Piles sunk necessary pile, pile embossing, screw machine. Perhaps the only drawback pile foundation and is that in order to install monolithic and compound poles must be ensured that the work will be done holistically, and to them the necessary technical equipment (drilling, the sinking, tamping and other). And another drawback that if not professionals develops, it is often a mistake - wrong pole arrangement. Sometimes it is redundant, because this type of foundation lose one of its main advantages - save concrete, and therefore money. So in order to have a really high quality and effective pile foundation worth the investment and ask a professional for help.

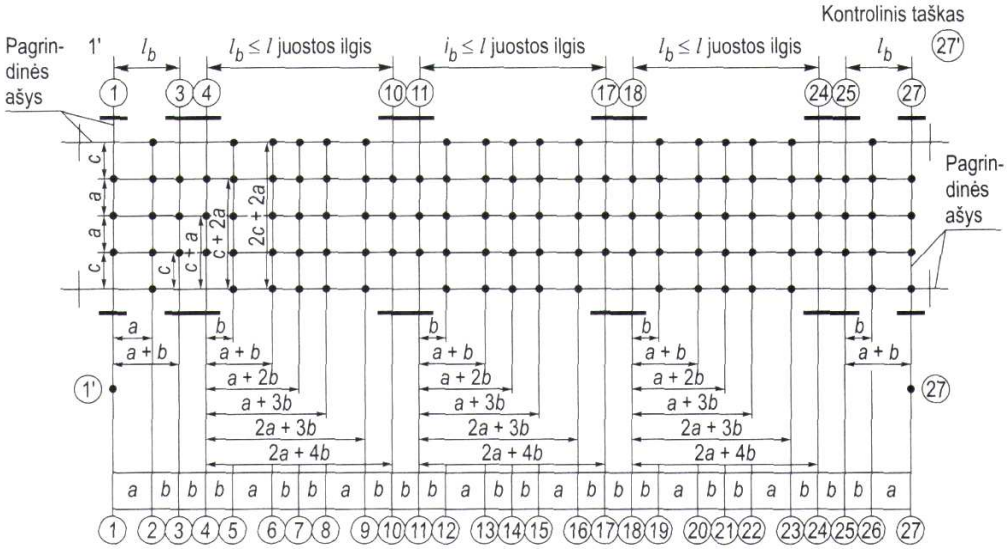


Fig. 3. Outdoor pole marking scheme (Zavadskas *et al*. 2008).

So pile foundation pluses are as follows:

• did not disturb adjacent or re-shaped by the soil;

• No vibrations do not cause disturbance of adjacent poles or structures (Bored pile advantages 2015);

• Small excavation. Their use reduces the amount of work the land;

• Many new structures are small piles bearing capacity, low weight, their manufacture consumes less concrete, reinforcement and other materials;

• The piles may extend deep below the frost penetration;

• No drainage;

• Perhaps the greatest advantage - the ability to approve the foundation in weak soil;

• Pile foundation strength allows not to deform buildings, unlike other types of foundations.

Another defining characteristic has a pile foundation, so that they can prepare in the winter. Piling area should be covered with insulation material, covered with snow. From the pile must be cleaned ice, frozen soil. When the ground is frozen only up to 30 cm depth, the pole can be guilty of prior preparation of soil. Deeper frozen soil piling areas or thawed or frozen layer is drilled by drilling machine. Over the frozen ground is difficult to drill more than 60 centimeters in diameter foundation wells. Therefore, the soil must be thawed. Future borehole is drilled through the center of frost 30-50 cm diameter drill, bore is filled to 120 to 170 degrees Celsius heated sand and warmly wrapped. Within 8-12 hours primer thaw around 1 - 1,2m. It can be thawed with electrodes. In winter, into the well shaken concrete mixture temperature should not fall below +5 degrees Celsius. Concreted the top of the pile is covered with insulation material (Krušinskas 1992 41p.). Already in 1981 the book "Construction technology", V Krušinskas mentioned that the then industry and civil construction about 20-25 per cent of the buildings were built on pile foundations. (Krušinskas, 1981, 120p.).

So for all these reasons: the pile foundation fastening weak soil, due to low material and labor costs for the foundation of other defects, the best construction of buildings, choose pile foundations. This is the cheapest and probably the best choice to ensure the quality.

Conclusion

The design of the building, the most appropriate foundation type is selected according to the results of geological engineering.

A comparison of various types of foundations, found that various types of foundations are suitable for the construction of certain terms. Many types of foundations, which can not be prepared in soft ground is an alternative - pile foundation, which is the biggest pile foundation plus.

They may be placed in strong soils. It has recently become rapidly popular type of planar foundation for its strength and heat. This is one of the strongest and warmest foundation. This is the reason why rapidly in popularity this type of foundation.

The evaluation of the various advantages and disadvantages of the foundation, noted that among the most important advantages of all types of foundations have pile foundations: the rapid construction of relatively inexpensive (for what many are choosing these

foundations not only soft ground), small excavation, drainage unnecessary.

The advantage pile foundation against other foundations that they may be held in the winter. If the foundation designed and installed in high-quality, full building ber equally and no cracking or fissures supporting constructions do not occur.

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TYPES OF FOUNDATIONS FEATURES SELECTION IN CONSTRUCTION

S u m m a r y

Often builders too little pay attention for foundation mounting, because the majority of them is invisible and is underground. But for real, foundation is the most important home base, most important part of building, because of most labor costs and they affect the longevity of the house, building, heat waterproofing, building aesthetic beauty. Everything in the foundation building area starts not from building but from ground investigation. In the winter, soil trying to push foundation from ground surface and in the spring, soil trying to draw in foundation, then the ice is melting. Also we need choose right foundation and to pour them quality, because foundation have to keep building. Foundation have to be very strong. Here is different types of foundations as belt foundation, screw foundation, planar foundation, pile foundation and other types of foundations. Everyone type of foundations have their advantages and disadvantages. Of course all types of foundation have common properties: each type withstands constant and volatile loads from above – roof, wall, overlays and etc.. Foundation is working natural factors like water, cold, heat. So there is no universal type of foundation. But from pluses and minuses we can choose the best option for our buildings. Belt foundation pluses are that they are most economical from all types of foundation, strong enough and quickly mounted. But they need special lifting equipment, with which they can not reach every places there they need to drive. Screw foundation is popular because of low cost materials and fast mounting. But they are one of weakness types of foundation. Planar foundation is one of strongest and warmest from all types of foundation. They have fast mounting, because during construction performing small amount of ground working, but for planar foundation is necessary drainage. But pile foundation is better than other types of foundations. Pile foundation is very popular, because of low material cost and price, because of quickly building, because piles can be extended to depths below frost penetration, and seasonal moisture variation, because of disadvantages of other types of foundations and because of building them on winter. Of course, the most important thing, why pile foundation is very popular is because of their ability to be fastened in weak soil. Other types of foundations just can't be built on weak soil, because then, the building can lose shape, appear some cracks in the building or just start to take. So that's why people have to choose right foundation. And as research shows, the best type of foundation is pile foundation, because they are better then others, don't have as many disadvantages as other types of foundations have, they have more pluses.

KEYWORDS: construction sector; types of foundations, foundations advantages and disadvantages.

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