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BASES AND FOUNDATIONS

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ANNOTATION
In order to design and build foundations not only economically, but, most importantly, reliably, it is necessary to clearly understand how the loads from structures are transmitted to soils, the peculiarities of the behavior of soils under the action of compressive, pulling and shearing loads on them, how the properties of different soils change when water acts on them, which foundations and in which soils should be used, by what methods to erect them. Answers to the listed and many other questions can be obtained from the study of the subject "Bases and Foundations."

Keywords: foundation, bases, structure, seismic resistance, construction, foundation wound.

АННОТАЦИЯ
Для того чтобы проектировать и строить фундаменты не только экономически, но, что самое главное, достоверно, необходимо четко понимать, как нагрузки от конструкций передаются на грунты, особенности поведения грунтов под действием сжатия, тянущие и сдвигающие нагрузки на них, как изменяются свойства различных грунтов при воздействии на них воды, какие фундаменты и в каких грунтах должны использоваться, какими методами их возводить. Ответы на перечисленные и многие другие вопросы можно получить из исследования предмета «Основания и основания».

Ключевые слова: фундамент, основания, конструкция, сейсмостойкость, строительство, рановидности фундамента.

INTRODUCTION

During the construction of bridges, up to 40% of time and labor and up to 30% of funds are spent on the construction of foundations, and in difficult engineering and geological conditions these indicators are even higher.

Increasing the economic efficiency of foundation construction should be carried out in an inextricable connection with improving the quality of work, which largely predetermines the reliability and durability of any structures as a whole. Special attention must be paid to the benign design and execution of underground works, since due to the lack of reliable methods for monitoring the condition of foundations and foundations during the operation of structures, it is not always possible to take the necessary measures to eliminate the consequences of accidental defects in a timely manner. Such defects arising as a result of design errors and not noticed during the construction of foundations, in the future, after some time, begin to appear in the form of various kinds of deformations of structures that impede or exclude their normal operation. Elimination of defects, as a

rule, requires costs significantly higher than the initial ones, and for bridges, in addition, long breaks or restrictions on the movement of rotating loads.

To study the subject "Bases and Foundations" it is necessary to know the basics of engineering geology, soil mechanics and hydrogeology. Engineering geology studies and evaluates the influence of geological factors on the operation of designed buildings and structures, as well as possible changes in these factors as a result of violation of natural conditions during the construction and operation of buildings and structures. Pound mechanics is engaged in the study of the stressed-deformed state and the physical and mechanical properties of foundation soils, the development of methods for calculating the strength and deformation of foundations, methods for determining the pressure of soils on enclosing structures. Hydrogeology studies the groundwater contained in the soil column.

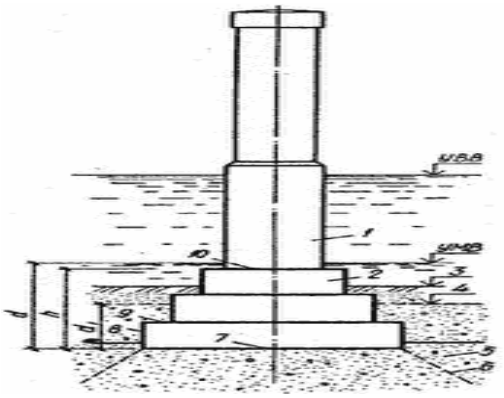

Fig. V. 1. The foundation of the bridge support from one bearing element 1 is the above-foundation part of the support; 2 - foundation; 3 - soil surface (bottom of watercourse); 4 - level of erosion; 5 - bearing layer of soil; 6 - conditional base contour; 7 - foundation base; 8 - side face of foundation; 9 - ledge; 10 - foundation cut; d - foundation laying depth; A - foundation height; d1 - design burial of foundation into soil

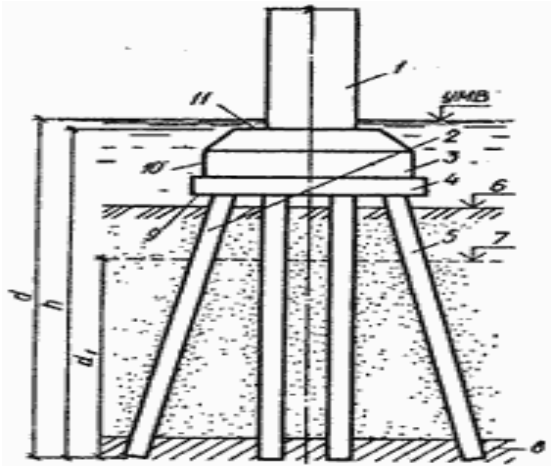

Fig. V. 2. Foundation made of load-bearing element cluster 1 - above-foundation part of support; 2 - foundation; 3 - pile cap; 4 - cement layer of concrete; 5 - bearing elements; 6 - soil surface (bottom of watercourse); 7 - level of erosion; 8 - bearing layer of soil; 9 - base of plugging layer; 10 - side surface of pile cap; 11 - foundation cut.

All buildings and structures are based on the surface layers of the earth (clays, sands, rocks, etc.), referred to in construction practice as soils.

The base is called the part of the soil mass that directly perceives the load and, as a result, is subject to deformation under its influence. The base of soils of natural composition is called natural. The base of soils pre-compacted or reinforced in one way or another is called artificial.

If the base consists of one layer of soil, it is called homogeneous, if of several layers it is heterogeneous. The soil layer (layer) on which the foundation rests is called the bearing layer, and the underlying layers are called the underlying.

A foundation is a part of a building or structure located below the surface of the soil (on land) or below the lowest (low) water level in a watercourse (reservoir) and designed to transfer loads to the base. There are massive foundations consisting of one bearing element (Fig. B.1), and non-massive foundations consisting of a group (bush) of bearing elements - piles of different types, shell piles (shells), pile pillars (pillars), combined into a single structure by a plate called a pile cap (Fig. B. 2).

Regardless of the type of foundations and the peculiarities of their design, it is customary to call the surface of its contact with the supra-basement part of a building or structure as a cut of the foundation; foundation base lower surface of its contact with base soil; foundation height distance from its base or lower end (bottom) of bearing elements to the cut; foundation laying depth distance from soil surface or water level in water body to foundation bottom or bottom of bearing elements. Under the influence of vertical loads on the foundation, which uniformly compress the foundation soils, there are movements of buildings and structures called settlement. When the foundations are affected by uneven compressive loads, slopes called tilts are observed. Exposure to large horizontal loads sometimes results in displacements called shifts.

To prevent the possibility of unacceptable settlements, tilts or shifts of buildings and structures (based on the condition of ensuring their normal operation), foundations are laid at some depth from the day surface in order to transfer the design loads to stronger soils.

Depending on the peculiarities of the load transfer to the foundation soils, foundations are divided into two types: shallow and deep laying. A characteristic feature of shallow foundations (see Figure B. 1), sometimes incorrectly called "foundations on a natural base," is the transfer to the base of vertical, horizontal and bending (from moments) loads from the upper basement of the structure only through their bottom. Their side surface is not involved in the work due to the inability, as a rule, to provide filling of sinuses between the side surfaces of foundations and pits with soil with a density equal to or higher than natural. Unlike shallow foundations, loads perceived by deep foundations (see Figure B. 2) are transferred to the ground not only through their bottom or the end of bearing elements in the form of piles, shells, pillars or lowering wells, but also through their side surface due to the manifestation of friction forces that resist pressing (vertical displacement) of foundations into soil, and forces of lateral resistance of soil resisting displacement (shift or rotation) of foundations.

Due to the fact that in the operation of deep foundations, in addition to the sole, their side surface is involved, the degree of use of the strength properties of materials increases, and therefore their consumption is reduced. For the arrangement of deep foundations in equal conditions with shallow foundations, depending on the design of the foundations and the complexity of local construction features, 2-4 times less concrete is required. At the same time, the volume of earthworks is reduced by 5-10 times, labor costs and the construction time of foundations are reduced by 1.5-3 times. In addition to significant economic efficiency, deep foundations have higher reliability.

Culverts are constructed, as a rule, with shallow foundations and rarely with foundations made of piles of different types. Supports of bridges of traditional design, having a supra-basement part, are erected with foundations of both shallow and deep laying.

Foundations of shallow and deep laying used for bridges, culverts, buildings and other structures are divided by structural features. Shallow foundations can be divided into massive, solid in the form of a slab, belt, rack, combined. Deep foundations are divided by the type of bearing elements: from piles, shells, pillars or lowering wells.

In turn, the foundations of the listed types can be monolithic, fully erected at the construction site, and prefabricated, mounted from pre-manufactured elements. Intermediate position is occupied by prefabricated-cast-in-situ foundations consisting of prefabricated elements reinforced with concrete, for example piles with a cast-in-situ slab, foundations made of prefabricated reinforced concrete shells filled with concrete, etc.

In addition to the listed main types of foundations, in the practice of building bridges and pipes, varieties of foundations are known, which are modified main structures, for example, cap-free foundations of bridge supports, the so-called cap-free supports. A characteristic feature of such supports (Figure B. 3) is the use of the lower part of the racks buried in the soil as a foundation that does not have a pile cap combining them, and the upper part of the racks rising above the soil or above water and combined sub-truss slab (nozzle) as a sub fundament structure of the supports. Piles, shells or poles are used as supports.

Cap-free supports are widely used for bridges with a span length of up to 33 m, in some cases up to 100 m. Supports are designed mainly from one, less often from two rows of posts along the facade of the bridge. Each row has two or more posts.

The rejection of the pile cap in the structure of the supports simultaneously with the reduction in the need for concrete provides a significant reduction in the cost of manual work and the timing of the construction of the supports mainly due to the exclusion of excavation work on the construction of the pile cap.

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