WAYS OF DEVELOPING CONSTRUCTION ON SETTLEMENT-PRONE SOILS

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The tremendous amount of construction in our country in the years of Soviet rule has led to a situation where regions with soil conditions suitable for construction are steadily diminishing. In addition, in utilizing new uninhabited regions, one must frequently work with soils that are not favorable for construction. Therefore, in recent years an ever-increasing amount of construction has been carried out under conditions of complex soils, particularly on settlement-prone soils (soils in which the primary structure tends to collapse when wetting and other constructional activities occur).

Settlement-prone soils are widespread in the Soviet Union, occupying about 15% of its entire territory. Extensive construction of industrial enterprises and living complexes has been undertaken on these soils, e.g., such important objects of the Ninth and Tenth Five-Year Plans as the Volga Automobile Factory and the new region of the city of Tolyatti (Fig. 1), the Kama Automobile Plant at Naberezhnye Chelny (Fig. 2), the Cheboksary Commercial-Tractor Factory (Fig. 3), the Volga-Don Plant of Heavy Machine Construction, and others.

Extensive investigation of the constructional properties of settlement-prone soils began in the 1930s in the Soviet Union, and this led to development of methods for building on such soils.

However, the complex and specific mechanism for revealing settlement deformation requires the constant development of theory and practice in installing foundation beds and foundations on settlement-prone soils, a re-examination of early complicated views, and the introduction of recent achievements in science as rapidly as possible into construction practice.

As we approach the 60th anniversary of the Great October, the results of efforts in this field should be noted, since considerable success has been achieved by the work of scientific-research, design, and construction organizations in this field, especially in the last 10-15 years, during which construction on settlement-prone soils has been carried out on the largest scale. The possibilities of progress are far from exhausted, however, and construction practice introduces ever new and newer problems. Therefore, these investigations must be continued and intensified.

Further development of methods of installing foundation beds and foundations on settlement-prone soils may be accomplished by multiple efforts along the following principal trends: study of the mechanism and patterns of development of settlement (collapse) deformation, development of methods of investigation and determination of the principal characteristics of soils, calculation of settlement deformation and designing of foundation beds and foundations, methods of installing foundation beds and foundations, and designing buildings and other structures with consideration of the effects of settlement deformation on them.

In the field of mechanism and patterns of development of settlement deformation, in recent years we have established and studied the indices, criteria of settlement tendency, and principal characteristics of settlement-prone soils; the sources of wetting and some patterns of water movement in loessal soils; design states of foundation beds relative to moisture content; forms and patterns of development of settlement deformation in plan and with depth, including horizontal displacements; types of soil conditions relative to settlement tendency; peculiarities in development of settlement with rise of the water table; installation of planned fill and earthen constructions; and so forth. New data obtained relative to these problems have led to extensive re-examination and development of basic viewpoints for designing and installing foundation beds and foundations on settlement-prone soils, and these views have been reflected in Construction Specifications and Regulations (SNIP) II-15-74 and III-9-74 as well as in the Manuals of such regulations. Design and construction practice shows that for further improvement in the installation of foundation beds and foundations on settlement-prone soils, the following scientific studies must be developed:

1) On the nature of strength and settlement tendency of soils, taking into account existing hypotheses concerning the formation and manifestation of factors determining the strength of soils with low moisture

content, the reduction of strength with high moisture content, the structural strength in the water-saturated state, and more.

2) On aspects of settlement tendency in sandy and, also, clayey soils containing gravelly and rubbly material, with study of standard indices and criteria of settlement tendency of these soils; the dependence of settlement tendency of these soils on moisture content, density, composition, effective pressure, and other factors.

3) On the influence of dynamic and seismic effects on the settlement tendency of soils in different stress states, with different moisture contents, for different effective times, etc.

4) On the developmental patterns of settlement with complex bedded soils (dipping layers, change in thickness, and wedging of individual layers having different degrees of development of the settlement tendency), hilly or sloping relief of the region, formation of excavations and fills, and more.

5) On the distribution patterns of water and the formation of moist zones in homogeneous and layered sequences of loessal soils with constant and periodic wetting, the presence of shields of consolidated and indurated soils with consideration of elevated density of the soil because of settlement, silting of the soil during wetting by contaminated industrial wastes, and so forth.

6) On the stress state of soils during and after development of settlement (soil-structure collapse) in the moistened zone, outside this zone, during settlement of soil from the load of foundations and, chiefly, from the weight of the soil itself.

7) On the interaction of piles, footings, reinforced and consolidated masses with surrounding soil of natural structure during settlement under its own weight with determination of the forces of negative friction on these piles, footings, and reinforced and consolidated masses, and dependence of the forces of negative friction on various factors.