International Journal of Geology, Earth & Environmental Sciences ISSN: 2277-2081
An Open Access, Online International Journal Available at http://www.cibtech.org/jgee.htm
2024 Vol. 14, pp. 255-260/Aimbetov and Iskenderov
Research Article

ENGINEERING AND GEOLOGICAL ZONING OF THE DESIGN OF STRIP FOUNDATIONS IN THE NUKUS DISTRICT

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ABSTRACT
The article presents the systematized results of calculations of the precipitation of the foundations of buildings in the Nukus district, performed by the method of layered summation. The calculations used the physical and mechanical parameters of soils obtained by local survey organizations. Analysis of the calculations showed that in most cases, the maximum precipitation occurs within the pressure range equal to the conditional design pressure of the base. Schematic maps of the foundation sediment with a width of 1.0 m, with a foundation depth of 1.0 m are constructed. The dependences of sediment on the pressure on the foundation are constructed. The rationale for the use of schematic maps of foundation sediments in the development of master plans of the city of Nukus and the Nukus district is given. It has been established that sandy loam is the most favorable foundation for the Nukus district, since at a pressure value of 300 MPa, precipitation of the base exceeding the permissible ones does not occur.

Keywords: *Layered Summation, Building Foundation*

INTRODUCTION

An important stage in the study and forecasting of the properties of the geological environment (including when conducting engineering and geological surveys) is the zoning of territories. A special assessment of engineering and geological conditions provides for an attitude to a specific type of use of the territory. A striking example of this are maps of special engineering and geological zoning. The method of engineering and geological zoning is close in its theoretical foundations to the method of engineering and geological mapping. The task of engineering and geological mapping is an objective image of the engineering and geological conditions of certain territories on the map. Each engineering and geological map (hydrogeological, etc.) is essentially always a zoning map, since it identifies territories similar in terms of a set of natural factors, which allows assessing the engineering and geological conditions for the construction of various types of structures on them. Consequently, there is no need for a general engineering and geological zoning of the territory, and for solving specific design and construction problems it must be special. This, in turn, determines the choice of criteria for zoning the territory [1].

In recent years, as part of the development of the general plan of the city of Nukus, which provides for the expansion of the city boundaries towards the Nukus district, on the territory of which it is planned to build new high-rise buildings.

Nukus district is an administrative unit in the central part of the Republic of Karakalpakstan, the territory of which covers the lands around the capital of the republic, the city of Nukus. Currently, it is planned to build a number of modern buildings and structures in the Nukus district.

The foundations of the constructed and designed buildings of the Nukus district mainly have a shallow strip structure. At the same time, alluvial quaternary deposits are mainly used as foundations. To plan the development of the territory of the district, information is needed on the bearing capacity of soils and foundations of buildings and structures. This information will allow more promptly and efficiently planning the development of the territory of the district as part of the development of the general plan.

MATERIALS AND METHODS

To assess the settlement of the foundations of buildings in the conditions of the Nukus district, special settlement calculations were carried out. The calculations were carried out using the layer-by-layer summation method. The calculations were grouped by types of soil under the foundation sole, where the conditional design resistances of the soil were determined. In deeper horizons, other types of soil are interlayered. The calculations were carried out for different values of increasing pressure. During the calculations, the pressure increased to the value of the conditional design pressure of the soil under the foundation sole.

In the calculations it was assumed that the depth of the foundation is 1.0 m, the width of the foundation sole is 1.0 m. The density of the soils above the foundation sole – 1.8 t/m^3.

The settlement of the foundation S using the calculation scheme in the form of a linearly deformable half-space is determined by the layer-by-layer summation method according to the formula:

$$S = \beta \sum_{i=1}^{n} \frac{\delta_{zp,i}, h_i}{E_i}$$

β - dimensionless coefficient equal to 0.8;

$\delta_{zp,i}$- the average value of the additional vertical normal stress in the i-th soil layer, equal to half the sum of the specified stresses at the upper Z_{i-1} and lower Z_i boundaries of the layer along the vertical passing through the center of the foundation sole.

h_i и E_i - respectively, the thickness and modulus of deformation of the i-th soil layer.

To carry out the calculations, the results of engineering and geological surveys conducted in the Nukus region were collected and systematized. Table No. 1 presents the minimum and maximum values of the physical properties of the soils.

Table No. 1 Minimum and maximum values of physical properties

Soils	Natural humidity, %	Density, g/cm3	Particle density, g/cm3	Porosity coefficient	Plasticity number
Sand	14.2-29.8	1.81-1.97	2.64-2.66	0.607-0.889	-
Sandy loam	16.8-29.52	1.8-1.95	2.67-2.68	0.608-0.928	4.8-6.6
Loam	16.6-28.2	1.92-1.99	2.69-2.71	0.628-0.790	7.9-12.6

The soil deformation modulus E_i varies within 3-12, 86 MPa. To establish the patterns of settlement changes in strip foundations in the Nukus district, settlement calculations were performed using the layer-by-layer summation method for foundation pressure values of 50; 100; 150; 200; 250 and 300 kPa. In total, foundation settlements were calculated for 48 points in the district.

Fig. 1 shows the dependences of foundation settlement on pressure obtained for two points that reflect the absolute minimum and maximum settlement values. Analysis of the graphs shown in Fig. 1 shows that, in general, the dependences of settlement on pressure have forms close to linear.

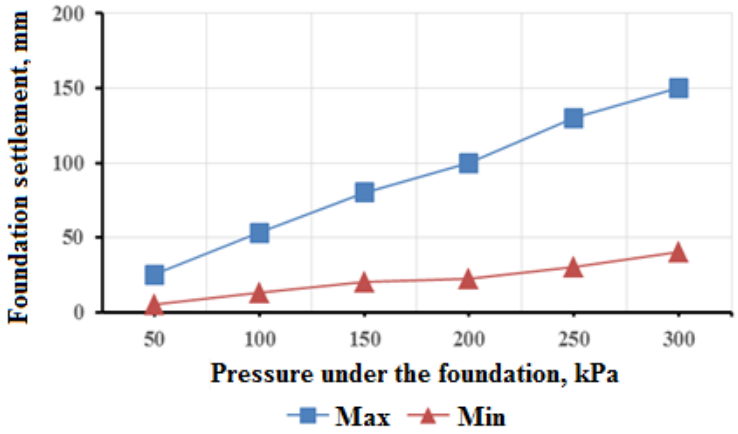

Figure 1: Dependence of foundation settlement on pressure

Currently, in the Nukus region, construction of brick buildings with reinforcement and the installation of reinforced concrete belts is practiced.

Analysis of the calculation results showed that in this case, the maximum settlements occur in three cases (before the pressure reaches the value of the conditional design pressure).

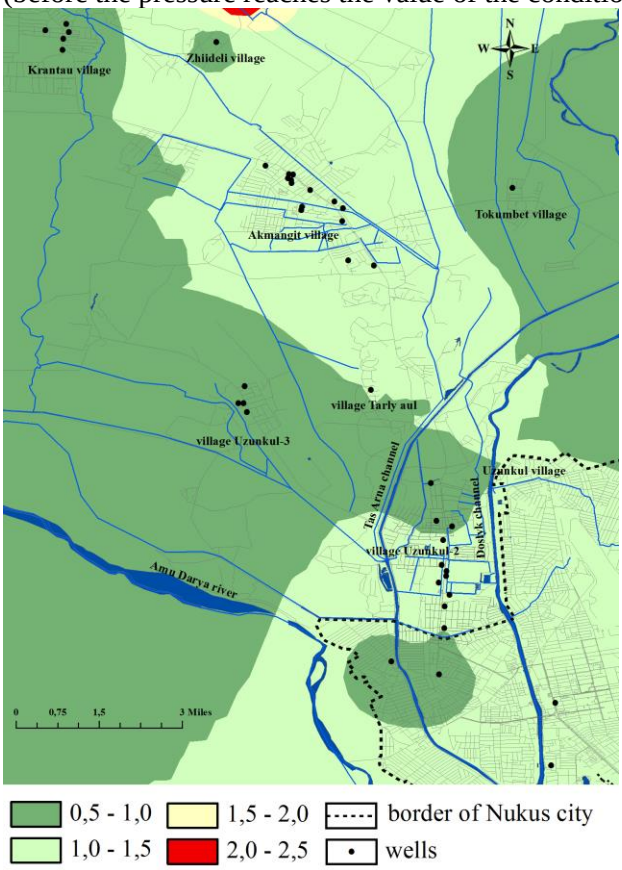

Fig. 2. Map-scheme of strip foundation settlement (cm).
Pressure under the foundation is 50 kPa.

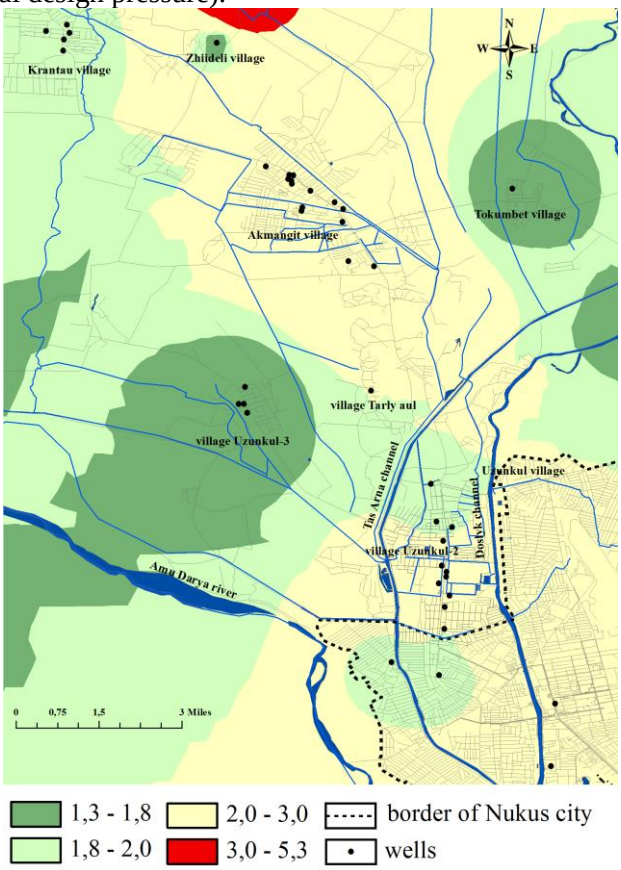

Fig. 3. Map-scheme of strip foundation settlement (cm).
The pressure under the foundation is 100 kPa.

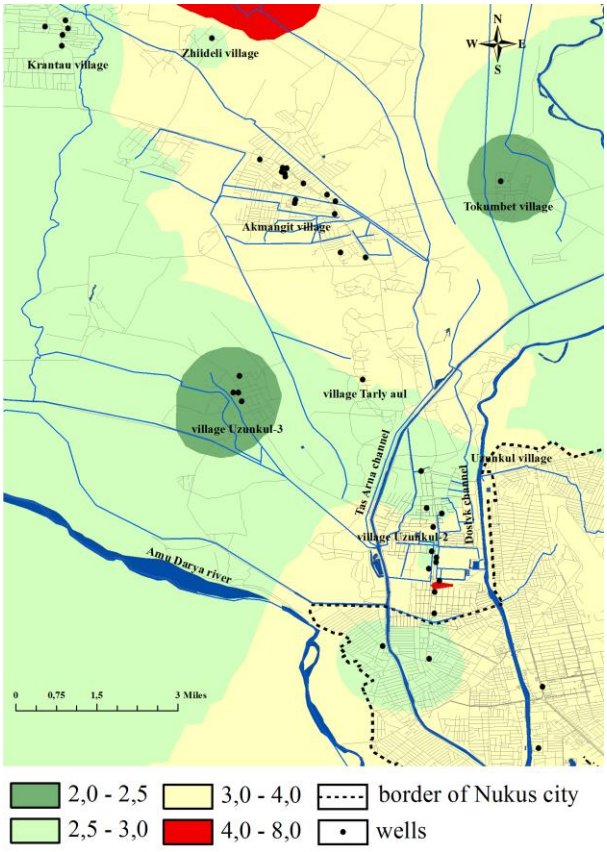

Fig.4. Map-diagram of strip foundation settlement (cm).
The pressure under the foundation is 150 kPa.

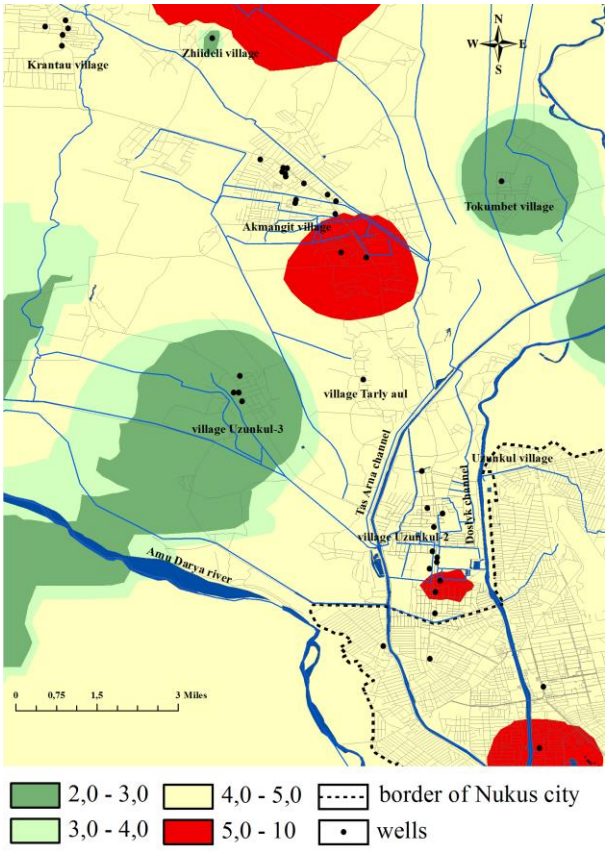

Fig.5. Map-diagram of strip foundation settlement (cm).
The pressure under the foundation is 200 kPa.

Fig. 2-7 shows schematic maps of foundation settlement isolines for different values of pressure under the foundation.

As can be seen from the figures presented in Fig. 2-7, in the territory of Nukus district, depending on the location of construction sites, different values of foundation settlement are observed. For example, the smallest foundation settlement is observed in the western part of the district. The greatest settlement is observed in the territory of Akmangit settlement and on the border of Nukus city. This is due to the low deformation properties of the soil layers of these territories.

Calculations have shown that the maximum settlement at a maximum pressure under the foundation of 300 kPa is 150 mm. As was said above, in the Nukus region, the construction of brick multi-story buildings with reinforcement and the installation of reinforced concrete belts is mainly practiced. According to the standards, the maximum settlement for such buildings is 150 mm [2]. In this regard, with this pressure on the ground up to 300 kPa, the stability of the building will be ensured.
Schematic maps of foundation settlements can be used in the reconstruction of existing buildings and in the design of new buildings and structures in the development of master plans for the Nukus region and the city of Nukus.

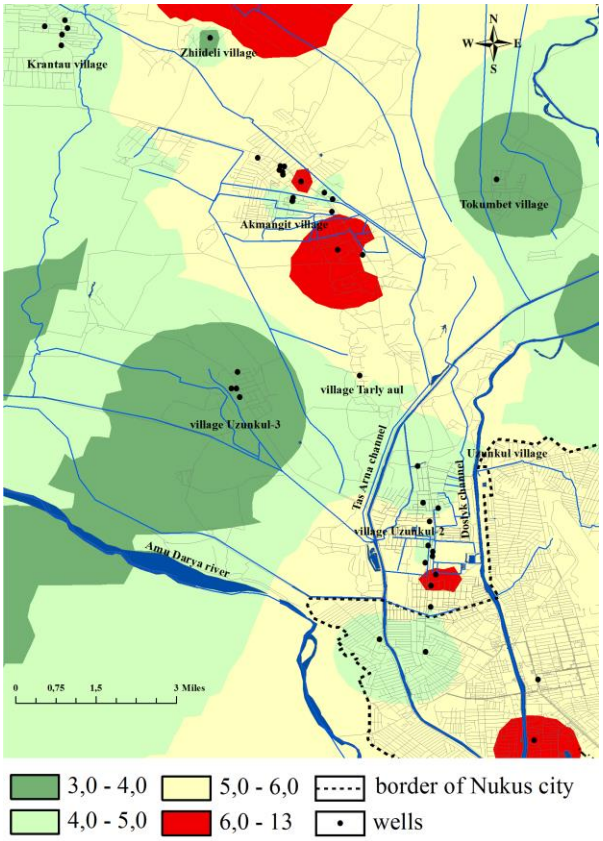

Fig.6. Map-diagram of strip foundation settlement (cm).
The pressure under the foundation is 250 kPa.

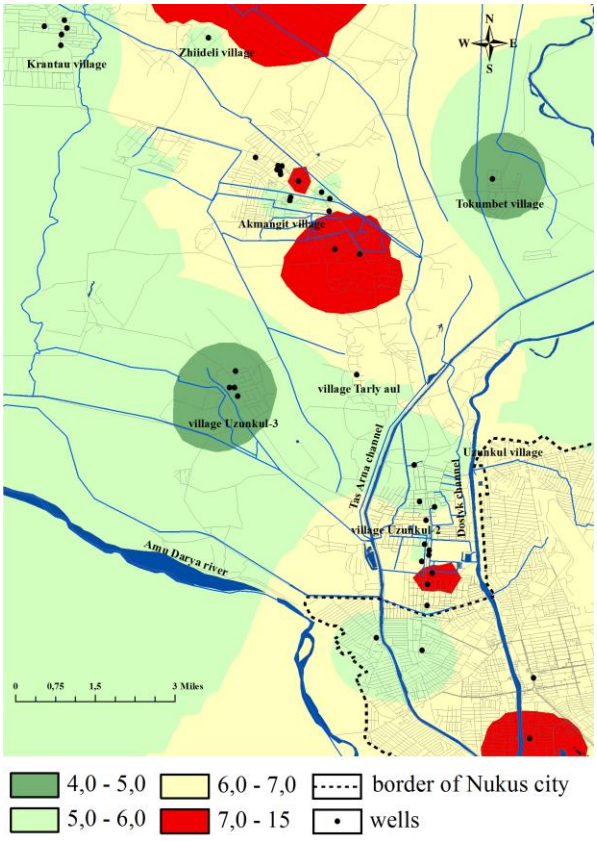

Fig.7. Map-diagram of strip foundation settlement (cm).
The pressure under the foundation is 300 kPa.

RESULTS AND DISCUSSION

The results of calculations of strip foundation settlements in the Nukus district showed:

1. In the case where the underlying soil is sand, with a soil pressure value of up to 300 MPa, settlements above the permissible values may occur under the foundation up to a pressure below the conditionally calculated pressure.

2. The most favorable base is sandy loam, since at a pressure value of 300 MPa, foundation settlements do not exceed the maximum permissible values.

3. The greatest foundation settlements occur in the Akmangit settlement and on the border of the city of Nukus.

4. Schematic maps of foundation settlements can be used in the reconstruction of existing buildings and in the design of new buildings and structures in the feasibility study of the development of general plans for the Nukus district and the city of Nukus.

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