ISSN: 2582-4686 SJIF 2021-3.261,SJIF 2022-2.889, 2024-6.875 ResearchBib IF: 9.948 / 2024

THE MULTIDISCIPLINARY JOURNAL OF SCIENCE AND TECHNOLOGY

VOLUME-5, ISSUE-10

# ANALYSIS OF THE DESIGN RESISTANCE OF THE SOIL BASE UNDER THE FOUNDATION

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**Аннотация.** В статье в качестве основание принято грунтовое подущка, так как грунты под фундамент проектируемого здания являются просадочными. Проанализирована толщина этого грунтового подушка и расчетное сопротивление естественного грунта под ним.

**Ключевые слова:** *Грунтовая подушка, грунтовый слой, расчетное сопротивление, фундамент, деформация.*

**Annotation:** The article examines the use of a soil cushion as a foundation system in cases where the underlying natural soils are susceptible to shrinkage. The study focuses on determining the optimal thickness of the soil cushion and evaluating the design resistance of the natural soil beneath it.

**Keywords:** *soil cushion, soil layer, design resistance, foundation, deformation*

**Introduction.** The proper design of building foundations plays a decisive role in ensuring the durability and stability of structures. In the case of constructions located on subsiding or shrinkable soils, it is essential to apply anti-settlement measures to prevent excessive deformation. One of the most effective and widely adopted solutions is the installation of a soil cushion beneath the foundation. However, during the design process, situations may arise in which the thickness of the artificial soil layer is insufficient to meet the required engineering standards. This raises a critical question: Will the artificial soil cushion and the underlying natural soil layers possess adequate design resistance to withstand the imposed structural loads? If the calculated bearing capacity of the soil proves inadequate, the dimensions of the foundation must be modified accordingly. The optimal foundation parameters should be selected so that the calculated pressure beneath the foundation base does not exceed the design resistance of the underlying soil.

## Case Study

To illustrate the problem, let us consider the foundation design for a residential construction project. According to the results of the engineering and geological survey, the foundation soil—identified as the second geological layer—is classified as type I sedimentary soil, which necessitates preventive measures against potential settlement. The geological profile indicates the following stratification: Layer 1: A deposit of construction and household waste, with a variable thickness ranging from 0 to 2.6 m. Layer 2: Loess-like silt, extending from 2.6 m to 5.4 m in depth. Layer 3: Loess-like loam interbedded with sandy loam, with a total thickness from 5.4 m to 12.0 m. According to the engineering and geological report, the third layer is characterized as impermeable soil. Geological cross-sections obtained from sampling boreholes are presented in Figure 1, which provides a visual representation of the subsurface structure relevant to foundation design analysis.

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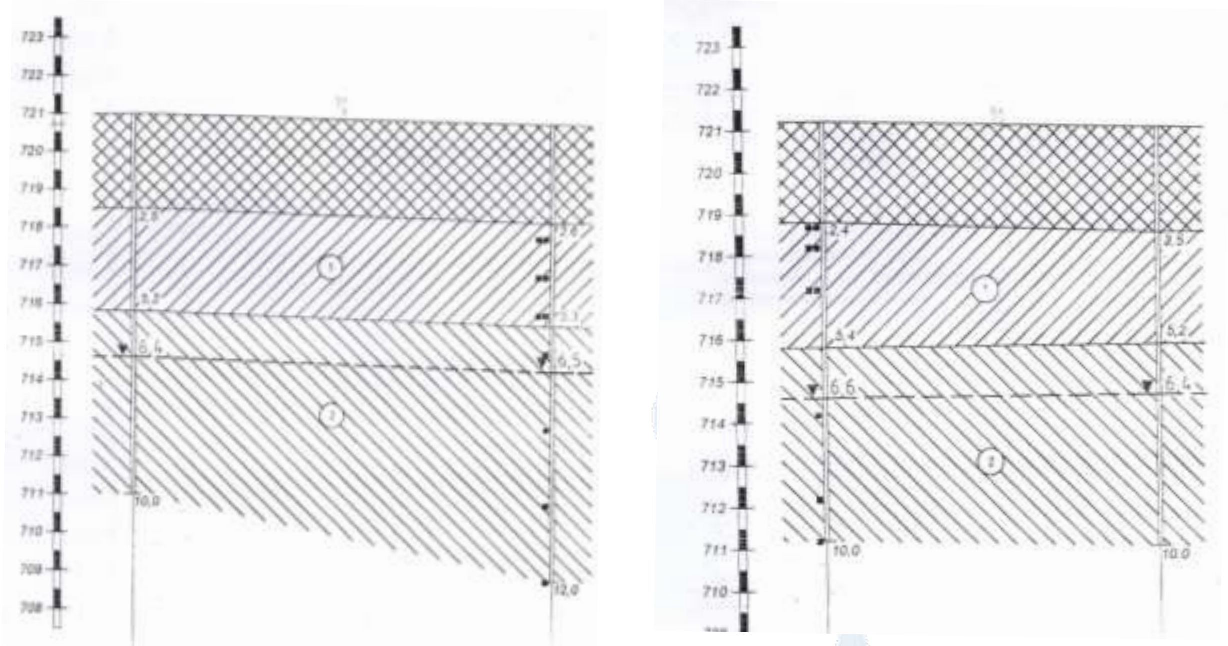


**Figure 1. Geological sections of wells for sampling. (a) geological sections between S-1 and S-2. (b) geological sections between S-2 and S-3.**

One of the currently common methods for preventing foundation subsidence is to remove the layer of soil on which the foundation is located, lay a new uniform layer of soil 20-30 cm thick, compact it to the required thickness and create an artificial soil cushion. The thickness of this soil layer is selected in such a way that, taking into account that the pressure created under the heel of the foundation is distributed as it passes through the underlying soil layers, it is necessary to ensure a sufficient reduction in pressure under the soil layer.

**The main part.** Before calculating the soil foundation, it is necessary to calculate the load on the foundation. The building is designed using a frame construction scheme and consists of 4 floors. The building has an Г-shaped plan and consists of two buildings. The first block along axes 1-4 and "A-L", with dimensions of 15.2 x 52 m. The second block along axes "З-Л" and 5-12, with dimensions of 15.2 x 42 m. The second part of the building foundation plan and part of the first part are shown in Figure 2. Floor height is 3.3 m. When calculating the forces acting on the foundation along the longitudinal and transverse design axes of the building, the greatest uniformly distributed force acting on the foundation along the axes of the middle row "K" and "I" is N=520 kN/m. Since the greatest forces acting on the foundation are located along the axes "K" and "I", we will carry out the calculations along this axis and accept these calculations for the remaining foundation bases. The depth of the foundation is shown in Figure 3.

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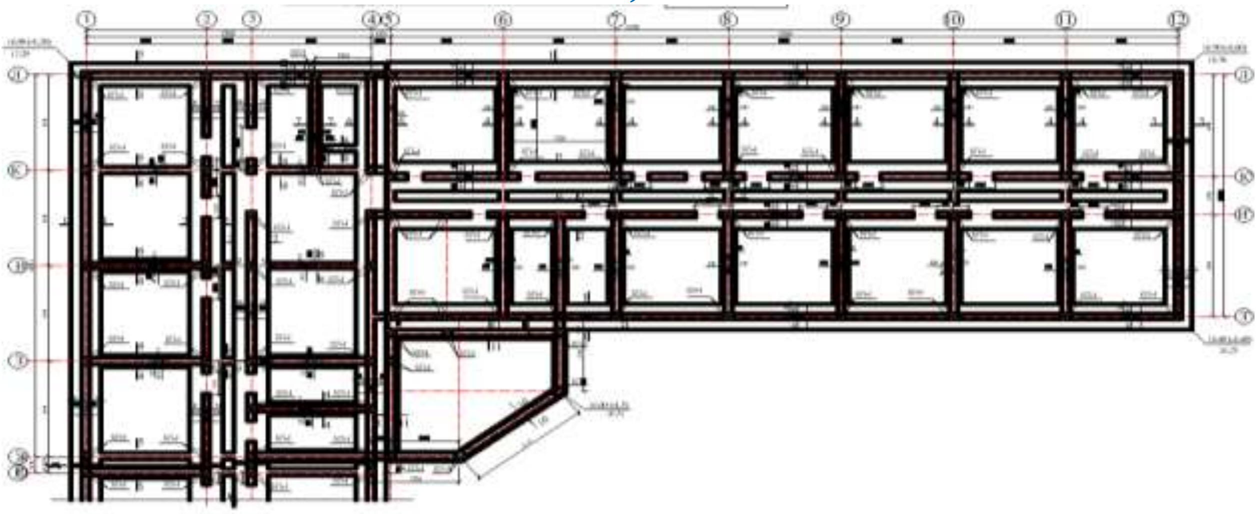

**Figure 3. Building foundation plan**

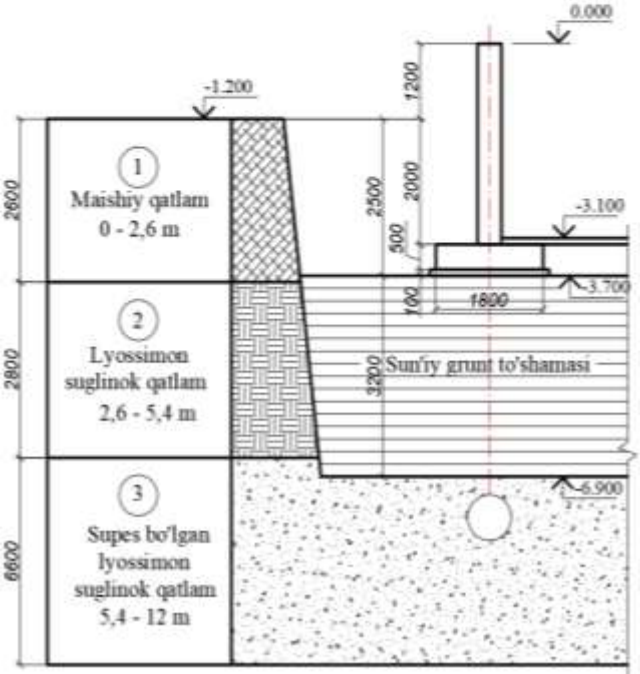


**Figure 3. Foundation depth.**

The standard and calculated values of the soil layer from the engineering and geological survey report, under which the foundation is located, are taken from Table 3 of the [1]. soil density, $\gamma = 1.83$ t/m$^3$, angle of internal friction $\varphi = 27^o$, adhesion strength of the soil S=16,5 Mpa. The calculated resistance of the third layer of soil is $R_0$=143 kPa according to the [2] (app B, table B.3). However, using the calculated values of the soil determined in the laboratory, we determine the calculated resistance of the soil in the real state using expression (1) given in [2, 3]

(1)

The calculated values here are taken from the appendices given in [2, 3] and are as follows:

$$R = \frac{\gamma_{C1}\cdot\gamma_{C2}}{k}\left[M_Y\cdot k_z\cdot b\cdot\gamma_{II} + M_q\cdot d_1\cdot\gamma'_{II} + (M_q - 1)\cdot d_b\cdot\gamma'_{II} + M_C\cdot c_{II}\right]$$

$\gamma_{c1}$=1,1; $k$=1,0; $\gamma_{c2}$=1,0; $k_z$=1,0 $M_\gamma$=0,91; $M_q$=4,64; $M_c$=7,14; average density of soil layers below the foundation heel $\gamma_{II}$=17,9 kN/m$^3$; Average density of soil layers above the foundation heel $\gamma'_{II}$=17,0 kN/m$^3$; foundation depth $d_1$=0,51 m; basement depth $d_b$=1,9 m; width of the foundation heel b=1,8 m; soil adhesion strength $c_{II}$=16,5 KPa. Let us determine the calculated resistance of the third soil layer using expression (1)

$$R = \frac{1{,}1\cdot 1}{1}\left[0{,}91\cdot 1\cdot 1{,}8\cdot 17{,}9 + 4{,}64\cdot 0{,}51\cdot 17 + (4{,}64 - 1)\cdot 1{,}9\cdot 17 + 7{,}14\cdot 16{,}5\right] = 335\,кПа$$

Let us determine the pressure created under the foundation using expression (2) [4];

$$P = \frac{N+G}{b\cdot l} \qquad (2)$$

The thickness of the artificial soil layer under the foundation is determined by expression (3). However, in our example, the thickness of this artificial layer is known in advance, that is, the distance from the level of the design foundation heel to the level of the third soil layer is hs=3m (here the second layer of soil is completely removed). Therefore, we need to determine the calculated resistance of the natural third soil layer located under the artificial layer. Because the calculated resistance of this soil layer must be higher than the pressure created by all the overlying layers, the foundation and the loads exerted on it by the building. The thickness of the artificial soil layer under the foundation is determined by expression (3) [4].

$$h_s = \frac{(P - P_{sl})b}{P_{sl}} \quad (3)$$

From expressions (2) and (3) we can derive expression (4). This expression can be used to determine the pressure created beneath a soil layer.

$$P_{sl} = \frac{N+G}{l(h_s+b)} \quad (4)$$

Here $N$ is the calculated load on the foundation 520 kN, $G$ is the average weight of the foundation structure and soil 23.7 kN, $l$ is the length of the strip foundation for calculation work - 1 m, $b$ is the width of the strip foundation - 1.8 m, $h_s$ is the thickness of the soil layer under the foundation - 3 m. In this case, the pressure $p_{sl}$ created under the soil layer should not exceed the calculated resistance $R$ of the third soil layer.

$$P_{sl} = \frac{N+G}{l(h_s+b)} = \frac{520+23,7}{1*(3+1,8)} = 113,3\ kPa < R = 335\ kPa$$

It is obvious that the calculated resistance of the third soil layer exceeds the pressure created under the soil foundation. Therefore, the third layer of soil does not subside. If we place the foundation on top of the natural third layer of soil without creating an artificial soil cushion, it will look like this:

$$P_{sl} = 302,1\ kPa < R = 335\ kPa$$

Even without a soil cushion, the calculated resistance of the third soil layer is sufficient. However, since there is a second layer of soil before the third layer, and since this layer is cut away, it is necessary to construct an artificial soil cushion.

**Conclusion.** The following conclusions can be drawn from these calculations:

1. Taking into account the calculated resistance of the natural soil beneath the artificial soil layer under the foundation when calculating it will help avoid unnecessary costs for excavation work during construction.

2. Calculations show that even with sufficient soil resistance, the overall foundation settlement should not exceed the standard settlement specified in [2]. Foundation settlement calculations are performed for this purpose.

**Used literature.**

1. Texnik xisobot “Samarqand viloyati, Samarqand shahri, SamDAQU hududida davlat sherikchilik asosida 850 o‘rinli talabalar turar joyi binosi qurish”
2. ShNK 2.02.01-19 “Osnovaniya zdaniy i soorujeniy”
3. Borozenes L.M., Shpoltakov V.I. “Raschyot i proektirovanie fundamentov”. Uchebnoe metodicheskoe posobiya. FGBOU VPO «Tolyattinskiy gosudarstvennыy universitet», 2015 g.
4. NIIOSP im. Gersevanova. Posobie po proektirovaniyu osnovaniy zdaniy i soorujeniy (k SNiP 2.02.01-83)

ISSN: 2582-4686 SJIF 2021-3.261,SJIF 2022-2.889, 2024-6.875 ResearchBib IF: 9.948 / 2024

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VOLUME-5, ISSUE-10

5. Pasternak P.L. Osnovы novogo metoda rascheta fundamentov na uprugom osnovanii pri pomoщi dvux koeffitsientov posteli.-M.:Gosstroyizdat, 1954.-56s.

6. Filonenko-Borodich M.M. Prosteyshaya model uprugogo osnovaniya, sposobnaya raspredelyat nagruzku: Trudы MEMIIT, 1945.-Vыp.53.s,16-25.

7. Vlasov V.Z., LeontevN.N. Balka i plitы obolochki na uprugom osnovanii.-M.:Fizmatgiz.1960.-492 s.

8. Gorbunov-Pasadov M.I., Malikova T.A. Raschet konstruksiy na uprugom osnovanii.M., Stroyizdat, 1973.

9. Gilman L.S.K vrprosu ob opredelenii napryajeniy na poverxnosti uprugoy sredы. Trudы LIIPS,vыp.1,1934g.

10. Tursunov Sh.A., Determination of an Effective Method as a Result of Calculation Methods of Reinforcement of Reinforced Concrete Plate, Journal of Innovative Studies of Engineering Science ( JISES ) 4 (2), 151-156

11. Tursunov Sh.A., Method of reinforcing reinforced concrete plate with carbon fiber fabric, international bulletin of engineering and technology 5 (3), 115-119

12. Tursunov Sh.A., Experimental and theoretical investigations on shear rigidity of soil, Proceedings of the v central asian conference on soil mechanics and geotechnical engineering (V Cacsmge), 2022