

Calculation of foundation settlement

To determine the settlement of the foundation, it is allowed to use the formula, which is based on solutions of a linearly deformed half-space and does not require additional auxiliary tables and graphic constructions:

$$S = 1,44 \frac{\eta}{\eta + 1} \times \frac{(p - \sigma_{zg,0})b}{Ec}$$

b – width of the conditional foundation;

p – average pressure under the sole of the conditional foundation;

Es is the modulus of deformation.

η - calculation coefficient

$\eta = 1,4$

$$E_c = \frac{\sum_1^n E_i \cdot h_i \cdot z_i}{0.5 \cdot H_c^2}$$

$$H_c = k \cdot b$$

E_i – modulus of deformation of the i-th layer of the base;

Z_i is the distance from the middle of the i-th layer to the lower limit of the compressible layer of the base H_c ;

H_c is the depth of the compressible layer, which is calculated according to the formula

Table - Coefficient k

$\eta = l/b$	Round foundation	1,0	1,2	1,4	1,8	2,0	2,4	3,2	5,0	6.0 and above (strip)
k	1,8	2,0	2,2	2,4	2,8	3,0	3,4	3,8	4,3	6,0

Example

Geological structure and hydrogeological conditions of the construction site

№ layer	Soil	Well number and the depth of the sole of each soil layer from the surface of the earth, m				
		1	2	3	4	5
1.	plant layer	0,3	0,3	0,3	0,3	
2.	Subsidence soil	4,8	4,6	4,9	4,8	
3.	Sand medium-sized	3,4	3,6	3,5	3,3	
4.	sandy loam	3,5	3,6	3,7	3,6	
5.	Clay gray	8,7	8,9	8,8	8,7	
	The depth of underground water	8,2	8,0	8,3	8,1	
	Well mark, m					

Variant	Cross section of the column , mm	Combination			
		I		II	
		N,MN	M, MNm	N,MN	M,MNm
	600x400	2,1	0,26	1,2	0,41

Characteristics of soil properties

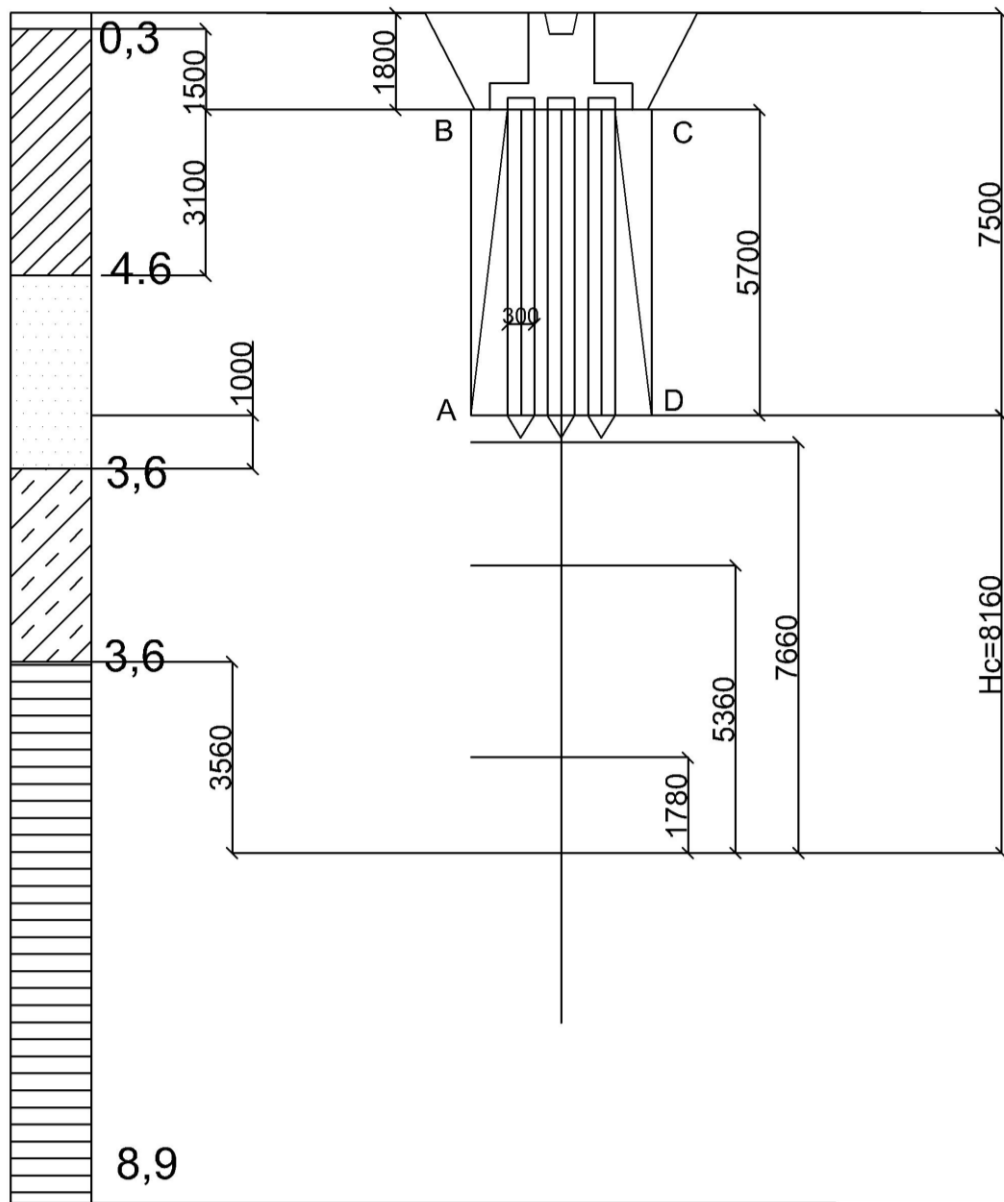
Name	Legend	Units of measurement	Layer number				
			1	2	3	4	5
Density	ρ_{II}	t/m ³	1,39	1,72	2,01	1,98	2,06
Solid Particle density	ρ_s	t/m ³		2,73	2,68	2,69	2,70
Water content	W			0,15	0,24	0,26	0,22
Liquid limit	W _L			0,35		0,28	0,40
Plastic limit	W _p			0,19		0,22	0,20
Angle of internal friction	φ_{II}	degree		21	33	20	15
Specific cohesion	C _{II}	kPa		25	1	12	80
Modulus of Deformation	E	MPa		20	30	15	50
Relative subsidence under pressure p, MПа	ϵ_{SL}	p=0,1		0,04			
		p=0,2		0,073			
		p=0,3		0,082			
Angle of internal friction water-saturated soil	$\varphi_{II,sat}$	degree		19			
Specific cohesion water-saturated soil	C _{II,sat}	kPa		5			
Modulus of Deformation water-saturated soil	E _{sat}	MPa		6			

Soil classification indicators

№ Layer	e	S_r	I_p	I_l	Soil properties
1					plant layer
2	0.825		0.16	-1.25	Subsidence soil loam solid
3	0.653	0.389			Sand medium-sized low moisture Medium density
4			0.06	0.667	sandy loam nplastic
5			0.2	0.1	Clay semi-solid

$$\rho_{sat} = \frac{\rho}{1+W} \cdot \left(1 + \frac{S_{r,sat} \cdot e \cdot \rho_w}{\rho_s} \right) = \frac{1,72}{1+0,15} \left(1 + \frac{0,9 \cdot 0,825 \cdot 1}{2,73} \right) = 1,93 \text{ t/m}^3$$

Psl=46 kPa



The depth of the compressible layer

$$H_c = k \cdot b = 2.4 \cdot 3.4 = 8.16 \text{ m}$$

$$p'' = \frac{2520 + 113,75 \cdot 1,1 + 1325 + 1543,6}{3,4 \cdot 4,3} = 377,1 \text{ kPa}$$

$$S = 1,44 \frac{\eta}{\eta + 1} \times \frac{(p - \sigma_{zg,0})b}{Ec}$$

$$E_c = \frac{\sum_1^n E_i \cdot h_i \cdot z_i}{0,5 \cdot H_c^2} = \frac{20000 \cdot 1,7,66 + 30000 \cdot 3,6 \cdot 5,36 + 15000 \cdot 3,56 \cdot 1,78}{0,5 \cdot 8,16^2} = 24844 \text{ kPa}$$

$$\sigma_{zg,0} = \sigma_{zg,2} + \gamma_3 \cdot h_d = 83.12 + 2,01 \cdot 10 \cdot 2.6 = 135.38 \text{ kN/m}^2$$

$$S = 1.44 \frac{1.4}{1.4 + 1} \cdot \frac{(377,1 - 135.38)3.4}{24844} = 0.028 \text{ m} = 2,8 \text{ sm} < S_{lim} = 10 \text{ sm}$$