TECHNICAL SCIENCES

INFLUENCE OF SUBGRADE REACTION

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Abstract
This work discusses model of building and ground (base) interaction on the static influence and their joint operation determines the stressed deformed condition of the construction. Calculation is conducted by using the computer program complex (LIRA SAPR 2014", which is based on finite element method. Calculation is conducted by changing the building rigidity (thickness of fundament tile is changed), one also uses different methods of calculating on flexible base. One has done analysis of obtained results.

Keywords: subgrade reaction, rigidity, stressed-deformed condition of the building

Introduction

Ground variety has an important influence over the stressed deformed condition of the building. Correctly determined ground properties and then correctly described data in the projecting would give us the opportunity to make the building more rentable along with reliability. Developing the modern program complexes gives opportunity to make the joint operation of provided ground and buildings (construction) as close as possible. By means of computer calculating program, selected by us, it's possible to study the joint operation of building and ground. This work discuses calculation results of really constructible 11 storied building on the clay ground.

Modeling

Calculation by linearly deformed semi-space method

In computing program LIRASAPR 2014, used as the research tool, base modeling happens by using he subgrade reaction, which are calculated by three methods [2], [4].

The first method: according to the first method subgrade coefficient is calculated according to the Poisson's ratio and flexibility module of average importance.

Subgrade reaction is calculated with the following formula: $C_1 = \dfrac{E_{zp}}{H_C(1-2m_{zp}^2)}$ (1).

The second method: subgrade reaction is calculated by this method by using the Winkler foundation: $C_1 = \dfrac{q}{S}$ (2), where $q = \dfrac{P}{\eta b^2}$ is the average pressure on the foundation bottom. *b* – Minimal size of the foundation; η - ratio of the maximal side of the foundation with the minimal one; *S* – foundation closure;

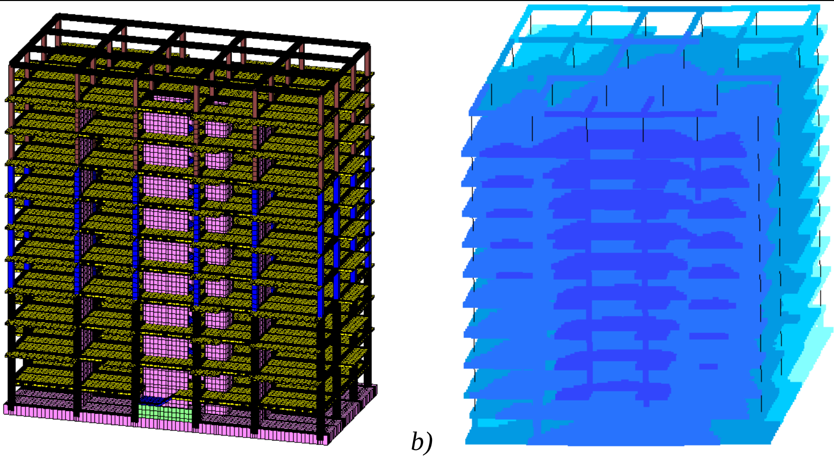
The third method: for determining the subgrade reaction in the third method one uses formula of the first method (1). Difference among these methods is that for determining the module of the average deformation of ground one uses the coefficient correcting the module of the average deformation of ground. This coefficient is changed $u_1 = 1$ from the benchmark of the foundation bottom $u_1 = 12$ up to H_C limit of the active zone (before finishing the compressed zone).

$u = \dfrac{11z^2}{H_C{}^2} + 1$ (3). C_2 - Subgrade reaction for all three methods is calculated by one common formula: $C_2 = \dfrac{C_1 H_c{}^2 (1-2m_{zp})}{6(1-m_{zp})}$ (4).

Determining the subgrade reaction in the used computer program is possible by two versions, averaged and ground modeling. In both versions one can determine the subgrade reaction by above-mentioned three methods. We would use ground model version, as it exactly describes joint operation of construction and base and the subgrade reaction is not averaged on the whole space. Calculation was conducted according to the norms of **СНиП2.02.01-83*, SP50-101-2004, SP22.13330.2011.** Difference among the results obtained according to these three norms is insignificant. Regarding the above-mentioned methods, results obtained from them are different from each other (see the schedule 1). Building rigidity has the influence on the account results. Influence of the building construction on the account is foreseen and modeled by changing the thickness of base tile (see the schedule 1). [1], [3].

Calculation

Calculating subgrade reaction obtained by the ground model



a) b)

Picture 1. a) Calculation model of the building; b) Type of deformed building

Schedule 1. Results of theoretical calculation

Regulatory document СНиП2.02.01-83*	Tile thickness (mm)	Maximal closure of building (mm)	მაქსიმალური ძაბვები							
			საძირკვლის ფილა					სვეტი		
			M_x tm/m	M_y tm/m	Q_x t/m	Q_y t/m	R_z t/m²	My t/m	Qy t	N t
Method 1	60	-58.7	87.4	75.3	-502	-530	-21.8	26.9	-39.4	-235
	80	-63	87.2	74	433	-465	-21.9	23	-31	-226
	100	65	86.2	73.3	382	-404	-22.7	19	-25	-219
Method 2	60	-38.7	93	65.2	439	-541	-44.8	34	-30.5	-216
	80	-40.8	106	71.1	-416	-499	-44.6	32.5	-23	-214
	100	-41.8	116	75.2	-366	-458	-46.3	-29.6	19	213
Method 3	60	-25	59	47.3	-199	221	-21.8	-19.5	-35	-232
	80	-26	62.6	47.9	-193	209	-21.9	-17.4	-28.8	-225
	100	-27.2	62.9	51.4	-183	197	-22.5	-15.4	-23.8	-220

Conclusion

In case of three methods increasing the building rigidity (thickness of building tile) may increase the closures, and flexible moments and transverse forces are different in the base tile and columns. In case of the first method increasing the thickness of vase tile may reduce the flexible moments and cutting forces, in the base as well in columns. In case of the second and third methods flexible moments in the base tile are increasing, and transverse forces are reduced. And in case of columns cutting forces, as well flexible moments are reduced, and meanings of longitudinal forces in the columns in three methods are reduced when increasing the thickness of base tile.

As calculation shows, meanings of subgrade reaction, calculated by different methods, are different from each other within approximately 30-50%.

With the purpose of increasing the reliability of calculated results in future one considers comparing the theoretical importance of deformed building with the importance of really constructible building.

References:

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