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FEATURES OF DESIGNING HIGH-RISE BUILDINGS

Author − **V. Gornyts'kyy**, Stud.
Scientific supervisors − **O. Zinkevych,** Cand. Sc. (Tech.)., Assoc. Prof.,
K. Shlyakhov, Cand. Sc. (Tech.)., Assoc. Prof.
Prydneprovska State Academy of Civil Engineering and Architecture

Problem statement. In recent years, the load-bearing structures of high-rise buildings are frequently designed and erected of reinforced concrete, because this material has great fire resistance and is cheap, and its strength is close to the steel strength. High-rise buildings have specifics, which essentially distinguishes them from traditional high-rise buildings.

The main load-bearing elements of the structural system are columns, walls, slabs and floors, various foundations, including pile grids etc. In modern practice there are cases of modeling the aboveground part of the building ignoring the real geological conditions, or stages of the building construction. The creating the most accurate calculation model of the building leads to the adequacy of the calculation results.

Purpose of the study. To consider the main provisions and prerequisites for the design, modeling and calculation of the stress-strain state of the frame, bases and foundations of high-rise buildings using the finite element method, taking into account the structural solution of the frame and joint work with the base.

Main results. The structural system of a building is a set of vertical and horizontal load-bearing elements combined according to certain structural solutions, which provide its strength, spatial rigidity and stability.

The structural systems of buildings are classified depending on the type of vertical load-bearing structure : frame, wall, diaphragm.

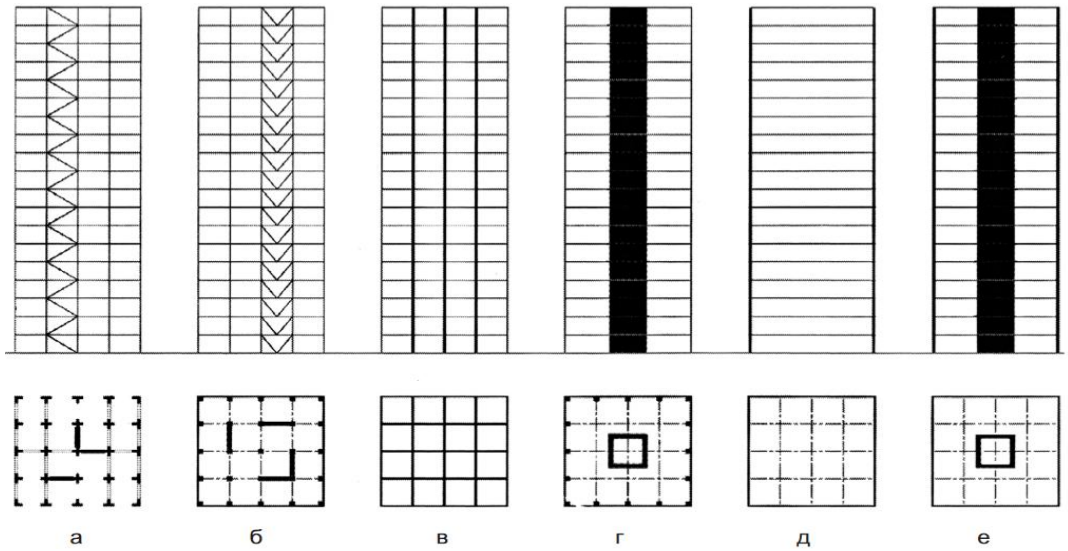

Fig. 1. Structural systems of high-rise buildings [1] : a - frame and link; b- frame with rigidity diaphragms; c- frameless with bearing walls; d- stem system; e - box; f- stem boxed

The main features of high-rise buildings include: 1) significant amounts of static and dynamic loads on load-bearing structures and bases; 2) high value of horizontal loads; 3) the problems of load value irregularity and character of its application; 4) increased importance of the impact of natural (air currents, seismicity, temperature, etc.) and man-made factors (vibrations, accidents, fires, local destruction) on the safety of construction and operation.

The calculation of the load-bearing structural system in the general should be carried out in a spatial setting taking into account the joint work of aboveground and underground structures, the base and the foundation under it. As a result of calculation of a bearing constructive system it is necessary to find out: in columns − the values of longitudinal and transverse forces, bending moments; in flat slabs of flooring, covering and foundations − the values of bending and torque moments, transverse and longitudinal forces; it is also necessary to calculate the values of vertical displacements (deflections) of floors and coverings, horizontal movements of the structural system, as well as for high-rise buildings − acceleration of oscillations of the upper floors. The values of the specified displacements and acceleration of oscillations should not exceed the ultimate values limited by the corresponding regulatory documents [1; 2]. The determination of efforts in the elements of a structural system should be performed from the action of longitudinal calculated constant, long-term, short-term and episodic loads, as well as their main and emergency combinations [2]. A spatial structural system is a statically indeterminate system. For the calculation of load-bearing structural systems, it is recommended to use discrete design models, calculated by the finite element method. Discretization of structural systems is carried out using shell, rod and volumetric finite elements. When creating a spatial model of a structural system, it is necessary to take into account the nature of the joint work of rod, shell and volumetric finite elements associated with a different number of degrees of freedom for each of these elements [3].

Conclusion. The consumption of materials for supporting structures and the cost of construction depend on the correct choice of the structural system of a high-rise building. The change in the stiffness of the floors as a result of the using of different design options affects the redistribution of efforts in the vertical elements of the frame. The efforts in the columns change not only due to an increase in the weight of structures with an increase in the stiffness of the floors, but also due to the redistribution of efforts in the elements of the frame. With an elastic foundation base, compared with a rigid foundation base, in the building frame between the columns and the stiffness stem, a redistribution of effotrs occurs when the type of foundation base changes. The stiffness core perceives less vertical forces and thereby partially loads the columns. When designing multi-storey frame buildings, it is necessary to develop different options for the rigidity of the structural solution of the floor, which affects the designation of the vertical elements section dimensions of the frame: with a decrease in the stiffness of the floor, it is necessary to reduce the dimensions of the column section and increase the section of the stiffness diaphragm.

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