

Research on the dynamics of multi-storey buildings

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Abstract. The design of multi-storey buildings is a natural trend in the development of a modern metropolis. Obtaining exact solutions when studying their own and forced oscillations within the framework of a continuous homogeneous medium model (continuum mechanics) with an infinite number of degrees of freedom is often difficult to implement. Therefore, in the article (as part of the modernization of the finite element method), the model of a multi-storey building is discretized and endowed with a finite number of degrees of freedom placed in the middle of the finite elements at the nodes (the mass of finite elements is also placed there), which elastically interact with the finite elements of the model that do not have mass. It is believed that the elements of a multi-storey building work only for bending, which is fully justified by comparing the frequencies of its bending and longitudinal oscillations. The resolving system of differential equations of oscillations of a multi-storey building, in which expressions for energies (potential, kinetic and Rayleigh) are written in quadratures, is obtained using Lagrange equations of the second kind. In the article, the problems of free oscillations of 3- and 100-storey buildings are solved using Green's functions, stiffness, mass, compliance matrices, etc. The approximate results obtained in the article, when compared with the little-known approximate results obtained by other methods, as well as exact results (direct and indirect methods of boundary elements), showed a good correspondence.

Keywords:

oscillation of multi-storey buildings, oscillation frequencies, Green's function, stiffness matrix, mass matrix, compliance matrix

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