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Calculation and Design of Reinforced Concrete Frame Residential Buildings with a Flexible Ground Floor

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Abstract: This article is devoted to the assessment of the strength of multi-storey residential buildings, the design of reinforced concrete frames.

Keywords: Multi-storey building, transverse and longitudinal walls, structural schemes of buildings, frame-panel, and reinforced concrete frame, mechanical engineering, instrumentation, chemistry, electrical engineering.

INTRODUCTION

Structural schemes of buildings can be frame and panel (frameless), multi-story and single-story. The frame of a multi—story building is formed from the main vertical and horizontal elements - columns and crossbars. In a frame building, horizontal impacts (wind, seismic, etc.) can be perceived jointly by the frame and vertical coupling diaphragms connected by overlaps into a single spatial system, or only by the frame, as a frame structure, in the absence of vertical diaphragms. In a multi-story panel building, horizontal impacts are perceived jointly by transverse and longitudinal walls, also connected by overlapping's into a spatial system.

To reduce the effort from temperature and shrinkage, reinforced concrete structures are divided by length and width by temperature-shrinkage seams into separate parts — deformation blocks. If the distance between the temperature-shrinkage joints at temperatures above minus 40 ° C does not exceed the limits specified in Table.1.1, then structures without prestressing, as well as prestressed ones, the crack resistance of which is subject to the requirements of the 3rd category, temperature and shrinkage cannot be counted on.

Table 1. The largest permissible distances between. temperature-shrinkage joints in reinforced concrete structures

Type of construction	**Distance between seams, m**
inside heated buildings and in the ground	in open structures and in unheated buildings
Prefabricated frame " solid Monolithic and prefabricated monolithic frame is the same, solid	

Temperature-shrinkage seams are performed in the aboveground part of the building — from the roof to the top of the foundation, while separating the floors and walls. The width of the temperature-shrinkage joints is usually 2-3 cm, it is specified by calculation depending on the length of the temperature block and the temperature difference. The clearest temperature-shrinkage seam of the building structure is created by the device of paired columns and paired beams along them.

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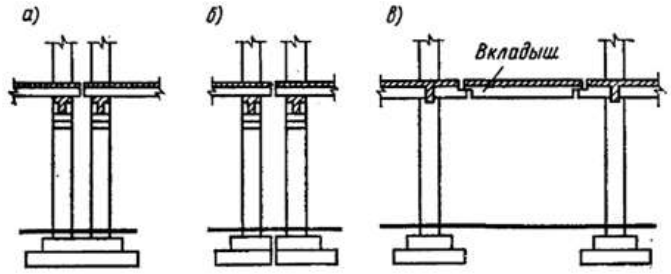

Fig. 1. Deformation seams
a – temperature seam on paired columns;
b – sedimentary seam on paired columns;
c – sedimentary seam with an inset span

Multi—storey industrial buildings serve to accommodate various industries - mechanical engineering, instrumentation, chemical, electrical, radio engineering, light industry, etc., as well as basic warehouses, refrigerators, garages, etc. They are designed, as a rule, frame with hinged wall panels. The height of industrial buildings is usually taken according to the conditions of the technological process in the range from 3 to 7 floors (with a total height of up to 40 m), and for some types of industries with non-heavy equipment installed on floors, up to 12-14 floors. The width of industrial buildings can be equal to 18-36 m or more. The height of the floors and the grid of the frame columns are assigned in accordance with the requirements of the typification of structural elements and the unification of overall parameters. The height of the floors is taken to be a multiple of the modulus of 1.2 m, i.e. 3.6; 4.8; 6 m, and for the first floor sometimes 7.2 m. The most common grid of the column frame is 6x6. 9x6. 12x6 m. Such limited dimensions of the grid of the frame columns are due to large temporary loads on the floors, which can reach 15 kN/m2, and in some industries 25 kN/m2 or more.

For industrial construction, multi-storey frame buildings without special vertical diaphragms are most convenient, since they limit the free placement of technological equipment and industrial communications. The main load—bearing structures of a multi-storey frame building are reinforced concrete frames and interlocking floors connecting them. The spatial rigidity of the building is ensured in the transverse direction by the work of multi—storey frames with rigid nodes — according to the frame system, and in the longitudinal direction by the work of vertical steel ties or vertical reinforced concrete diaphragms located along the rows of columns and in the plane of the outer walls — according to the coupling system.If connections or diaphragms cannot be supplied in the longitudinal direction due to technological conditions, they are replaced with longitudinal crossbars. In this case, spatial rigidity in the longitudinal direction is also provided by the frame system.

Multi—storey civil frame and panel (frameless) buildings are designed for mass construction with a height of 12-16 floors, and in some cases - a height of 20 floors or more. The grid of columns, the pitch of load-bearing walls and the height of floors are chosen in accordance with the requirements of the typification of structural elements and the unification of overall parameters. Structural schemes of buildings constructed from prefabricated elements are characterized by constancy of geometric dimensions in height, regularity of typical structural elements, a clear solution of the plan.

Frame structures are used for various administrative and public buildings with large rooms, rarely located partitions, and in some cases for residential buildings with a height of more than 25 floors. The main load-bearing structures of a multi-storey frame building in civil engineering are reinforced concrete frames, vertical coupling diaphragms and interlocking floors connecting them.

The most important condition for achieving high operational qualities of a multi-storey building is to ensure its reliable resistance to horizontal loads and impacts. The necessary spatial rigidity of such a building is achieved by various variants of the layout of the structural scheme, mainly by different ways of perceiving horizontal loads.

Panel constructions are used for residential buildings, hotels, boarding houses and other similar buildings with often located partitions and walls. In panel buildings, the main load-bearing structures are vertical diaphragms formed by panels of internal load-bearing walls located in the transverse, sometimes in the longitudinal direction, and interlocking floors connecting them. The panels of the outer walls are hung on the ends of the panels of the load-bearing pop-river walls. A multi-storey panel building both transversely and longitudinally perceives a horizontal load through a communication system. Other structural schemes of multi-storey buildings are possible. These include, for example, a frame building with a central core of rigidity, in which the internal walls of interlocked elevator and ventilation shafts, stairwells are used as vertical coupling diaphragms; a building with two cores of rigidity of an open profile - in the form of I—beams; a building with two cores of rigidity and a complex configuration in terms that allows you to individualize the architectural the solution. In the described structural schemes of buildings, horizontal impacts are perceived by a frame-link or link system.

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