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Results of the Survey of the Technical Condition of A Nine-Storey Reinforced Concrete Frame Public Building

YUSUPOV R.R., ALIMOV X.T., AZIMOV A.A., SAYDULLAYEVA D.Q.
Tashkent University of Architecture and Civil Engineering
E-mail: xikmat.phd88@gmail.com

Annotation.
This article presents the results of a comprehensive survey of a nine-story reinforced concrete frame public building. In this case, non-destructive testing methods were used to assess the stress-strain state of the bearing elements. To calculate the bearing capacity and resistance to seismic loads of such buildings, the real strength of concrete and the consumption of reinforcement in structures are required. Based on the data obtained, the building was calculated for the first and second limit states in accordance with the current regulatory documents and, based on their results, practical recommendations were issued to ensure the seismic resistance of this building .

Key words: reinforced concrete, frame, building, reinforcement, concrete, diaphragm, analysis, soil, result.

Introduction. We can point out frame, frame-diaphragm, single-core systems as the most used structural system in the construction of multi-story reinforced concrete buildings and structures in seismic areas. Frames consist of horizontal and vertical load-bearing elements, that is, columns and beams, frame-diaphragm systems consist of columns, beams, and monolithic diaphragms, and in single-core systems, the monolithic single-core core is the main load-bearing element. The load-carrying elements of these systems form mutual spatial unity [1].

The effect of horizontal force is taken into account when calculating the stability and displacement of multi-story buildings. Therefore, in order to reduce such forces, diaphragms are used in multi-story frame buildings. The placement of the diaphragm on the kaer determines the effect on its horizontal deformation.

It will be possible to choose the most suitable option based on the comparison of structural solutions of a multi-storey reinforced concrete frame building made from different options. Therefore, in the design process, a specific solution is selected based on the comparison of various structural solutions for one building.

In buildings with a height of nine floors and above, horizontal loads are received by single-node frames and partial single-joint elements. Reinforced concrete walls, that is, diaphragms, are used as such elements.

Main Part. Constructive solution and dimensional plan of a nine-story building. The dimensions of the nine-story building made of prefabricated reinforced concrete structures are 15x24 m (column grid is 3x6 m and 6x6 m), the height of the floors: the height of the basement part is 3.4 m, the height of the 1st floor is 4.5 m, the height of the floors from the 2nd to the 9th floor is from 3.3 m. designed and built.

The technical condition of the analyzed building meets the requirements of the current QMQ 2.01.03-19 [2] for a 9-point earthquake zone in terms of structural structures (height, spacing, spacing of transverse walls, block length and other parameters).

The building frame consists of prefabricated reinforced concrete elements of the 2nd set of the IIS-04 series, connected by single diaphragms with frame-connectors; Diaphragm

Single diaphragms are located between axes 3 and 4 along the B-axis of the building, axes 1 and 2 along the G-axis, B and V-axes along the 2nd axis, V and G-axes along the 3rd axis (Fig. 1). The basement part and the 1st floor are made of solid reinforced concrete, from the 1st floor to the 9th floor, the IIS-04 series is made of prefabricated reinforced concrete panels with a thickness of 240 cm.

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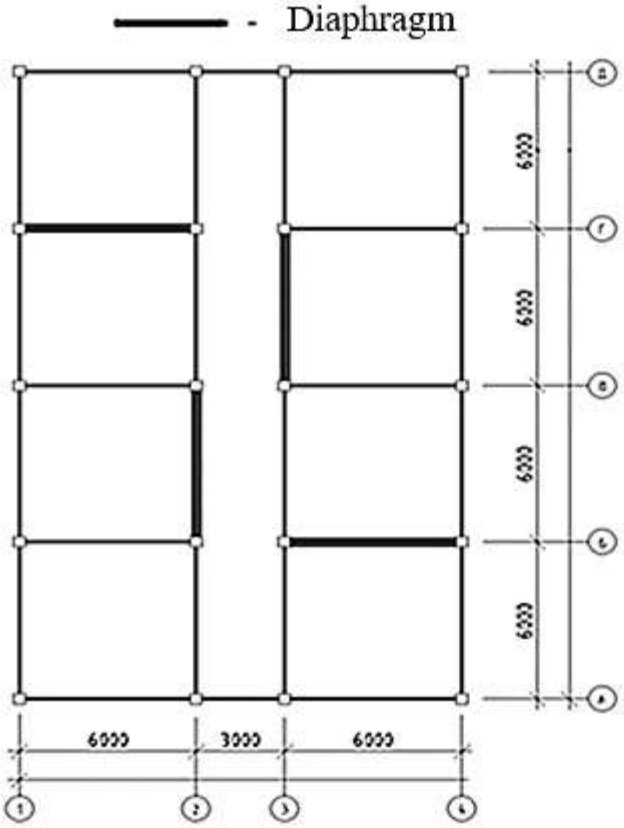

Figure 1. Layout diagram of the roof and diaphragms of the 9-story building.

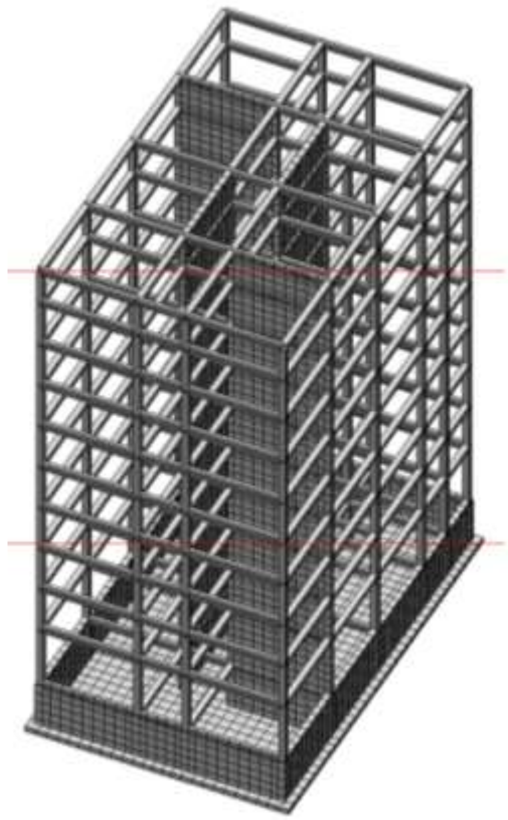

Figure 2. Spatial model of the building.

In the process of modeling this nine-story building as a spatial frame in the Lira PK 9.6 program (Fig. 2), the following designations and simplifications were made:
Structural load-bearing elements of the building are made of prefabricated reinforced concrete elements. Concrete class B25, reinforcement class A-400. Oroyopma slabs are prefabricated multi-cavity slabs. The size of the columns in the basement part is bxh=50x50 cm, in the 1-9 floors, bxh=40x40 cm. The size of the beams in the length and transverse direction of the building is as follows: the thickness of the diaphragms is 320 mm in the basement, 240 mm in the 1-9 floors.
In modeling the foundation and its interaction with soil in the program, the foundation is in the form of a flat slab, its thickness is hp=0.4 m.
The normative and calculated value of the loads affecting the building was calculated in accordance with QMQ 2.01.07-96 - "Loads and effects" [3].

Results. Displacements resulting from seismic forces in the frame systems under consideration were analyzed using the graphic printing function of the Lira PK 9.6 program and the result of the seismic calculation (Fig. 3 and table).
A)

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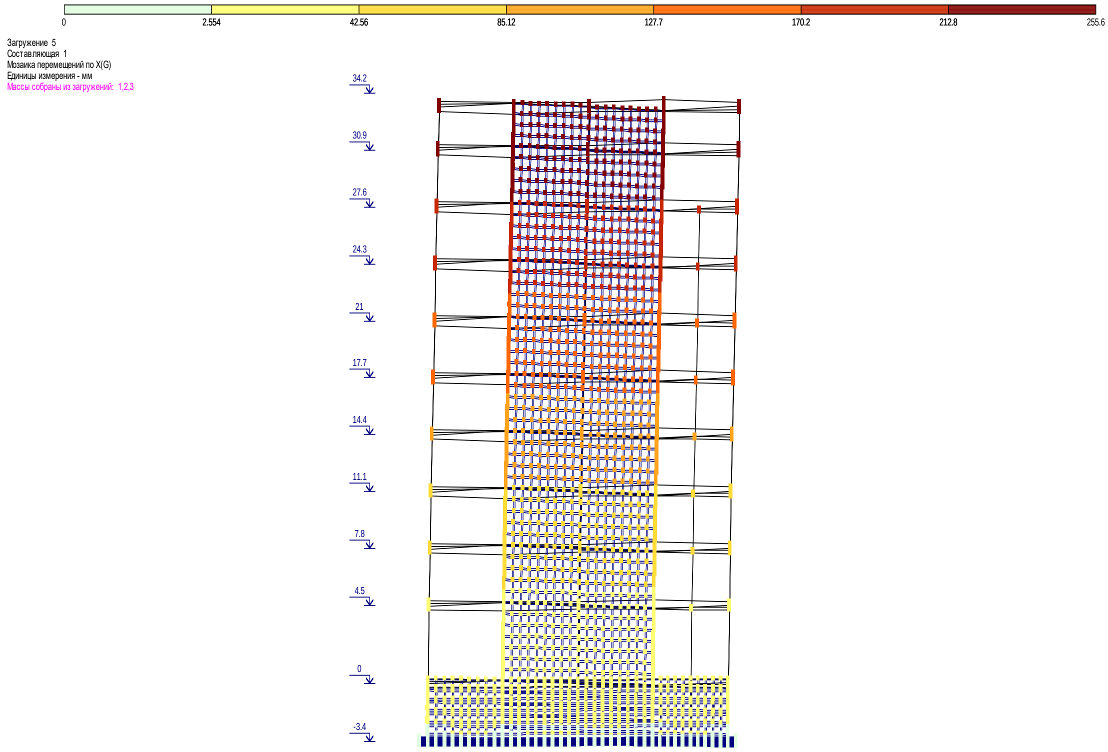

b)

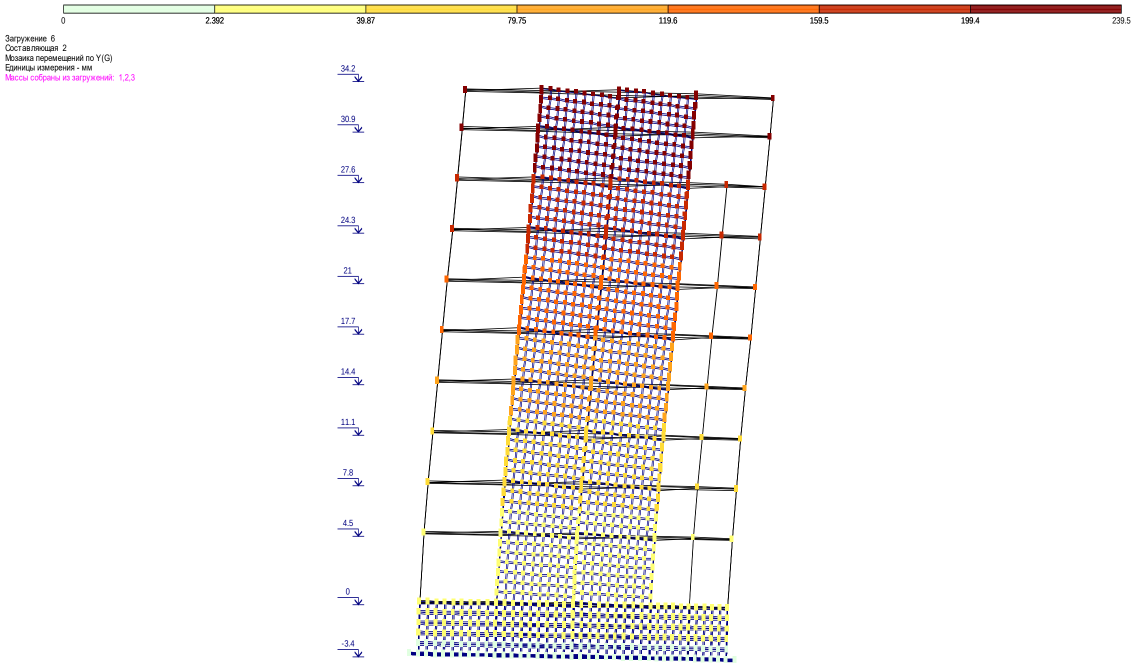

Figure 3. A nine-story frame building under the influence of seismic forces

Movements along the X and Y axes. a – movement of the building along the X-axis; b – movement of the building along the Y-axis;

Movements along axes	Displacements, mm		Permitted migration according to QMQ 2.01.03-19
	Max	$\frac{\partial_{\text{мах}}}{\partial_{\text{м}}} * 100\%$	Displacement, mm

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Moving along the X-axis	255,6	52,32%	H/70=34200/70 =488,5 mm
Y-axis displacement	239,5	49,02%	H/70=34200/70 =488,5 mm

As can be seen from this table, the displacement of the building under the influence of seismic forces did not exceed the norm specified in the regulatory documents. For this reason, seismic strengthening of the building under investigation is not required.

It is necessary to compare the reinforcement of the building columns in the design and during inspection and to determine the reinforcing elements. In this case, we determine the reinforced concrete columns in the building that need to be strengthened, as a result of comparing the percentage of reinforcement calculated as a result of the preliminary design of the building columns and technical inspections. The nine-story frame building, which is the object of the study, was implemented based on the results calculated in the PK Lira 9.6 program.

The percentage of reinforcement calculated as a result of technical inspections and in the initial design of the building columns was compared.

Accordingly, the reinforcement of the columns located at the intersection of the 2, 3 and B-V-G axes of the basement and the 1st floor at the intersection of the 2, 3 and B-V-G axes is required to strengthen these elements.

As a result of the comparison of the reinforcement percentage of the building beams in the initial design and as a result of technical inspections, the reinforced concrete beams (girders) that need to be strengthened in the building were determined. According to this, since the reinforcement percentage of the beams located on the 2nd floor B, axis 1-4 and V axis 1-2 and 3-4 is higher than in the project, these elements need to be strengthened.

Conclusion. The technical condition of the structural structures of the analyzed public building (height, spacing, spacing of transverse walls, block length and other indicators) meets the requirements of the current QMQ 2.01.03-19 for reinforced concrete frame buildings built in 9-point earthquake regions.

It was found that the strength of concrete in the studied reinforced concrete structures did not have a negative effect on their technical condition, and its values were at the required level. It can be considered that the implementation of the measures and recommendations given on the subject of technical research is important in ensuring the operational reliability and durability of this building.

Based on the information obtained from the technical inspections of the nine-story building, a model of the building was created using PK Lira 9.6 software, and seismic forces and loads were given. The results obtained from the calculation were compared with the percentage of reinforcement in the original design of the building, and thus the load-bearing elements that should be strengthened were determined, and suggestions and recommendations were made for their implementation.

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