Frame-panel houses with reinforcement tension in construction conditions and its prospects for seismically active regions

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Abstract The article will consider frame-panel multi-story residential buildings, which are much more convenient to build on a construction site by tensioning reinforcement than ordinary monolithic multi-story buildings. Modern building materials created in the construction industry and the active use of chemical additives in concrete have opened up new ways to save building materials by 20-25%, reducing labor costs and construction time. As a result, we have much stronger and more durable load-bearing structural elements (prestressed floor slabs), and as a result, the whole building responds to increased seismic resistance.

Key words: frame-panel, reinforcement tension in construction conditions pressed sleeve, seismic ball.

Introduction.

The use of prestressing in multi-story frame buildings is a progressive method. It allows the use of high-strength steel to reduce its cost. At the same time, cracks in prestressed reinforced concrete are less likely than in ordinary reinforced concrete, which ensures its durability and hardness.

This system has significantly reduced the types of typical elements in buildings and reduced them to a minimum number, although it has not limited the distribution of space in it, on the contrary, the system has given architects amazing opportunities for distributing space: the foundations of the building, the number of stories, unlimited free distribution of living space. A frame system that, from a statics point of view, has not at all rejected the basic principles of construction of this type of building with reinforced concrete structures.

Main part

The so-called frame-panel system. Building system IMS is a square or rectangular cell. Such a cell consists of four prefabricated columns and one hollow roof plate. On the one hand, these are the main elements of the building frame that perceive vertical and horizontal loads.

The column and the roof panel are connected by pre-stressing the armature passing through the sections of the column and in both directions of the roof plate. After tensioning the armature, the tensioned armature, placed between the roof plates, is covered with monolithic concrete, protecting it from corrosion, thus creating a hidden rod (anvil) from pre-stressed reinforced concrete. First, the armature was stretched only in a straight line, later, due to the increase in the height of the building, the armature was stretched by twisting, т. e. by the epiuric forces (pic. 1).

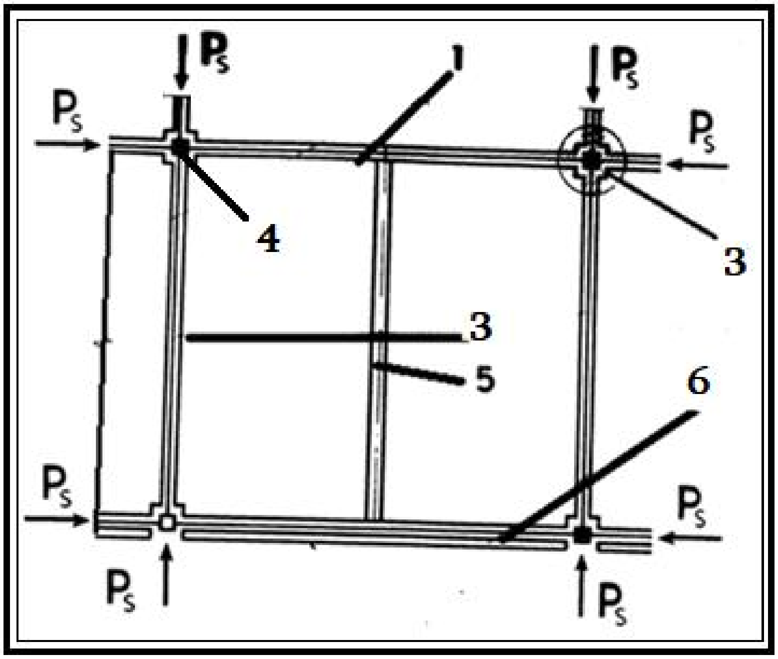

Fig. 1. Frame-panel system with tension reinforcement
Under construction conditions, general view; 1-roofing slab;
2-columns; 3-monolithic section prestressed reinforcement;
5-central seam between roofing slabs; 6-side element.

The frame carries horizontal wind and seismic loads, although the bulk of the loads fall on the stiffness diaphragm. The diaphragms are located between the columns and connected to them at the overlap level by pre-stressed reinforcement.

The main function of the columns is to resist the forces caused by vertical and horizontal loads, especially after concreting, when the stiffness diaphragm and columns are combined.

The frame-panel system is based on the implementation of strict provisions for the connection of individual load-bearing structures to each other in construction conditions with tension reinforcement. The high strength of the nodes determines the reliability of the entire system.

The monolithicity of the frame system is achieved by pre-tensioning. The connection of the column and the roof slab is carried out by pre-tensioning the reinforcement and the generation of large friction forces on the contact surfaces.

The magnitude of the pre-tensioning depends on the span of the building, vertical loads, and the straightness of the reinforcement. Straight-stretched reinforcement is permissible for beams with a span of 5 m. The number of tensioned reinforcement varies from 2 to 4 c. ropes.

As mentioned above, the ropes pass through the holes in the columns between the roof slabs along the entire length of the building and are then concreted with monolithic concrete by vibration, as a result of which the reinforcement is completely protected from corrosion and mechanical damage. In addition, such protection of the reinforcement provides less loss of pre-tensioning, and the frame system is further pre-tensioned.

The structural elements of the frame-panel system are manufactured in a factory-made manner from high-grade B30 fine-grained concrete.

The proposed building is a prestressed spatial structure of columns and beams, the rigidity of which is ensured by concrete diaphragms for seismic resistance. The system is calculated for the following loads: vertical and gravitational, wind, and seismic forces, with a total load on a typical 4.8 m span roofing slab of 600 kg/m².

The reliability of the system, which

immediately raised doubts among many of its specialists, was the rejection of the slab support as a fundamentally established principle, the danger that the slab would slip under operating conditions due to the drop in prestressing, was and remains a doubt for specialists, for which purpose experimental and computer studies were conducted. The selected strength characteristics were taken from two unfinished residential buildings on Guramishvili Avenue in Tbilisi, one up to 7 floors and the other up to three floors (Fig. 1). A computer model was created, where two options were considered:

Fig. 2 . Residential buildings in operation and unfinished

The solution of the set tasks became possible by monitoring 10 completed and 2 unfinished 16-story buildings located in different districts of Tbilisi and then recalculating the model created based on the computer engineering program.

During the inspection and study of ten 16-story buildings, it was found that the buildings do not have any defects, which are not permissible by the norms and would raise doubts about their reliability. The load-bearing elements of the completed and operational residential buildings: columns, roofing slabs, and monolithic seams, where prestressed reinforcement is located, are completely suitable for normal operation.

Conclusion.

Monitoring of buildings constructed and operated with the IMS structural system in Tbilisi showed that changes in the strength of prestressed cables and monolithic concrete have not decreased, on the contrary, after 30–35 years, the strength characteristics of reinforced concrete elements have increased by 25–30%, the stresses in monolithic concrete joints and reinforcement, roofing slabs and columns are equal to the design value, and the changes have not worsened, which proves that the system is reliable for future operation.

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