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DETERMINATION OF STRESS-STRAIN STATE CONSTRUCTION FRAME BUILDINGS BASED ON NUMERICAL SIMULATION TOOL SURVEY

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Statement of the problem.

Recently, in Ukraine, concrete workers , masons , fitters and installers often have low qualifications during construction and therefore a low degree of skill. This has a significant impact on the quality of work performed in the construction of buildings and structures.

The purpose of this study is to determine the stress-strain state of the structures frame residential building with initial technological imperfections using numerical simulations based on instrumental examination .

The main material.

Constructive solutions.

The object Survey is a nine- frame building . Floor height is 3.60 m. The building has a complex shape in plan with a maximum size of 19.0 x 21.60 m. Structural layout of the building is a full concrete frame (Fig. 1) . Foundations for building are solid slab of reinforced concrete. The ground floor is under the building. Project class of concrete frame members - C20/25 . Columns frame buildings have step 6m, 4.8m and 3m. Column width of columns in a grid of 6 x 6 m is 400x400 mm, and in smaller increments axes - 300 x 300 mm . Slabs are flat beamless. Along the perimeter of the stairwell concrete diaphragm mounted in the center elevator shaft of reinforced concrete.

The frame during the survey had a number of defects and damages , such as blowholes and voids on the surface of the concrete elements as a result of bad vibrations concrete, chipped concrete, reduction of column sections; irregular concreting of bearing structures with a deviation from the design position, deviation from the alignments axes columns visible to the naked eye openings in the plates with cutting of fixtures . During the geodesic executive survey frame elements set columns deviations from the design position in the range of 3 to 96 mm (Fig. 2) with variations of the minimum and maximum values at all levels of overlap. It also had deviations from this fixed axis alignments in the two planes. Misalignment values of columns in all cases are different elevations on the clean floor slab and bottom slab to the next floor.

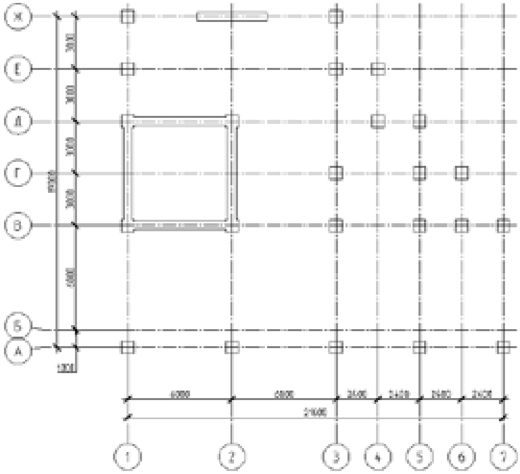


Fig. 1. Location plan of the vertical bearing elements of the building

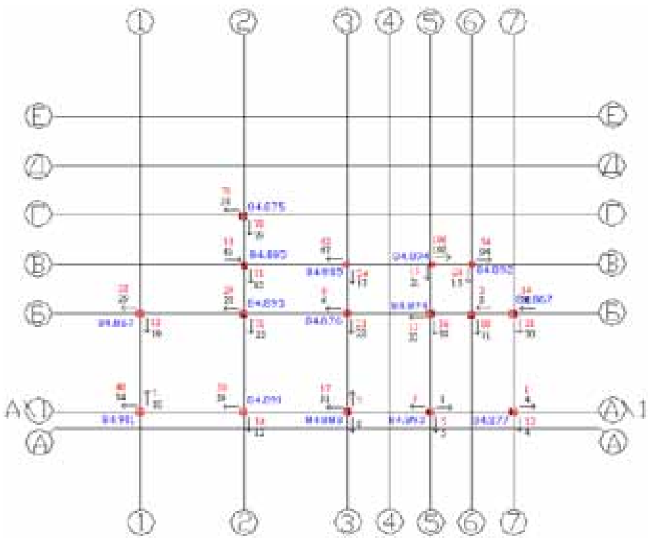


Fig. 2. Deviations from the columns of the first floor design position
(in the numerator - the top of the column, the denominator - the bottom of the column)

To verify the strength of materials constructions carried instrumental examination, namely the test of strength of materials by nondestructive method (Device «Onyx - 2.4»). Concrete columns, walls, beams, slabs, diaphragm stiffness of the elevator shaft were exposed for instrumental inspection. The deviation from the classes of concrete elements to C8/10 , C32/40 was revealed as the results of statistical processing.

Analysis of results .

The results of the tests identified deviation from the design strength of concrete in the lower side in the following columns :

1st floor - in the axes В / 5 (C8/10); Д / 3 (C8/10); А1 / 1, Б / 2, В / 2, В / 5, В / 6, Г / 4, Д / 1, Д / 4,Е / 1 (C12/15);

2nd floor - the axes А1 / 1, В / 5, А1 / 7, Б / 1 (C8/10); А1 / 2, А1 / 3, Б / 2, В / 2, Г / 2, Д / 3 (C8/10); А1 / 1, Б / 6, Б / 7, Г / 4 (C12/15) ;

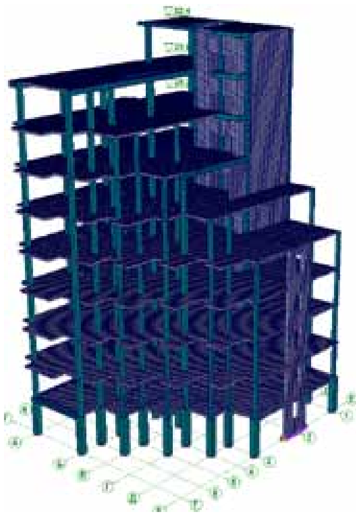
3rd floor - the axes А1 / 1, А1 / 2, А1 / 3, А1 / 5, Б / 1, Б / 2, Б / 3, Б / 5 (C12/15);

6th floor - the axes В/6 (C12/15).

In other columns the strength of concrete corresponded to project or was higher.

Stress-strain state of the building was carried out in the program complex SCAD Office.

a)



b)

Fig. 3. Real-a) and calculated -b) building model

To determine the stress-strain state by numerical method (finite element method) , we calculated the «ideal» and deformed design schemes with taking into account the actual strength and the resulting deflection of the vertical columns . We The finite element model of the deformed skeleton was compiled. Deviation from the vertical columns were given absolutely rigid inserts obtained geodetic survey deviations. The actual concrete class was appointed for each column. It was set during instrumental nondestructive testing.

Studies have shown that taking into account the initial imperfections , the calculation of spatial nine-storey building , taking into account the deviation from the vertical columns in two mutually perpendicular planes , and the actual (reduced and increased) concrete strength , the magnitude of effort for individual columns vary independently from the floor level .

Found that in the columns of the first floor frame transverse forces and bending moments are maximal in size in comparison with columns overlying floors. Revealed that from the second to the ninth floor intensity of shear forces and bending moments in each column changes nonlinearly, in both large and smaller side. This is not happening regularly but randomly , with the required reinforcement of individual columns in the calculation based on the identified imperfections exceeded actual reinforcement project from 18 % to 55% (payment scheme excluding initial imperfections).

Conclusions.

1. When analyzing the stress-strain state of a nine-building frame-receiver design scheme with the initial technological imperfections revealed that the magnitude of effort in the columns from the second to ninth floors varies randomly. Transverse forces and bending moments deviate either higher or lower the side. At the same time the required reinforcement of individual columns in the calculation based on the identified imperfections exceeds the actual reinforcement project from 18% to 55% (payment scheme excluding initial imperfections) .

2 . Based on the results of the determination of the actual stress-strain state of a nine-frame building, was carried out strengthening of structural elements in accordance with this effort.

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