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SURVEY AND RECONSTRUCTION OF LOW-RISE REINFORCED CONCRETE FRAME BUILDINGS

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Abstract
This article examined the technical condition of a 2-story retail and household complex located in the city of Tashkent, and provided the necessary recommendations for reconstruction. The building is a reinforced concrete frame system and the survey process used existing methods and computer software.

Keywords Frame, reinforced concrete, reconstruction, reinforcement, defect, damage, deformation, method, survey, wear, assessment of technical condition.

INTRODUCTION

Technical inspection is a process that includes control, testing, analysis and evaluation of building structures and structures.

The main purpose of the technical inspection of structures of buildings and structures is to determine the current technical condition, identify the degree of physical wear and tear, defects, and determine the operational qualities of structures; predicting their behavior in the future [1].

Inspection of the technical condition of building structures is an independent area of construction activity, covering a range of issues related to ensuring the operational reliability of buildings, carrying out repair and restoration work, as well as developing design documentation for the reconstruction of buildings and structures.

The volume of surveys of buildings and structures is increasing every year, which is a consequence of a number of factors: their physical and moral deterioration, re-equipment and reconstruction of industrial buildings of industrial enterprises, reconstruction of low-rise old buildings, changes in forms of ownership and a sharp increase in prices for real estate, land plots, etc.

It is especially important to carry out surveys during the reconstruction of old buildings and structures, which is often associated with changes in existing loads, changes in structural schemes and the need to take into account modern building design standards. During the operation of buildings, due to various reasons, physical wear and tear of building structures occurs, a decrease and loss of their load-bearing capacity, and deformation of both individual elements and the building as a whole.

To develop measures to restore the operational qualities of structures, it is necessary to conduct their examination in order to identify the causes of premature wear and decrease in their load-bearing capacity [2].

It is obvious that the inspection of buildings and structures should be carried out by specialized organizations and specialists with knowledge in various fields of construction science, as well as knowledge of the features of technological processes in industrial buildings.

Inspection of buildings is carried out in order to determine their suitability for normal operation or the need for repair, restoration, strengthening or restrictions in operation, both individual structures and buildings as a whole.

The general purpose of surveying the technical condition of building structures is to identify the degree of physical wear and tear, the reasons causing their condition, the actual performance of structures and the development of measures to ensure their performance [3].

Inspections are carried out during the reconstruction or restoration of buildings, during a long break (more than one year) in the construction of buildings, when defects and damage are detected in structures, during accidents, as well as when the loads or functional purpose of the building change.

Inspection of structures in order to determine the technical condition and residual life of chemical enterprises is carried out in the following cases [1, 4]:

- detection of defects and damage (category “A”) during periodic and extraordinary inspections;
- after fires and natural disasters;
- after an accident in a workshop or in workshops of similar industries;
- as prescribed by the Gosgortekhnadzor authorities;
- when production technology changes or its conservation;
- the need to have a conclusion on the condition of industrial buildings and structures in order for an organization to obtain a license to operate production facilities and facilities;
- expiration of inspection periods or standard operating periods;
- when the owner changes;
- when insuring an organization;
- to determine the economic feasibility of repair or reconstruction;
- with an increase in normalized natural and climatic influences (seismic, snow, wind influences).

Main part

After checking the technical condition of the building, based on the results obtained, a recalculation was made from the LIRA SAPR 2021 program.

After checking the technical condition of the building, the following was established:

Characteristics of the building.

The building of the retail and household complex was designed taking into account the customer’s requirements and has a rectangular plan with dimensions in the axes of 40.6x24 m, divided into 3 blocks. The dimensions of the first block in axes are 9.6x24m, the second block is 24x24m, the third block is 6x24m which has a rectangular shape with a protruding facade of the front part in the shape of an arc. The building has a 2.4m high ground floor.

There is a second light in the central 2nd block.

Construction began around 2007. At the time of the inspection, the building was not in use and renovation work was being carried out.

During the examination it was determined

Foundations – monolithic reinforced concrete slab 400mm thick.

The basement walls are monolithic reinforced concrete 400mm thick.

Monolithic reinforced concrete columns - dimensions 400x400mm and Ø400mm.

Crossbars – monolithic reinforced concrete 400x400(h)mm.

The walls of the above-ground floors are brickwork 400mm thick (including plaster)

The lintels are monolithic reinforced concrete of different sections.

Roof structure - metal and wooden rafter structures

The roof is corrugated.

The stairs in the building are monolithic reinforced concrete and metal.

The blind area along the contour of the building is asphalt concrete.

Figure 1 - Situational diagram

Figure 2 - Building facade

Accepted stiffnesses of structural elements

Type	Dimensions (mm)	Material
Reinforced concrete frame		
Columns type 1	400x400	Concrete B20
Columns type 2	Ø 400	Concrete B20
Crossbars	400x400	Concrete B20
Monolithic areas	Thickness 200mm	Concrete B20
Basement wall	Thickness 400mm	Concrete B20
Foundation	Thickness 400mm	Concrete B20
Metal elements		
Top chord of the truss	2 ∟100x10	Steel 245
Bottom chord of the truss	2 ∟90x6	Steel 245
Truss braces type 1	2 ∟100x10	Steel 245
Truss braces type 2	2 ∟50x5	Steel 245
Truss posts	2 ∟50x5	Steel 245
Connections	2 ∟50x5	Steel 245
Spacers	2 ∟50x5	Steel 245
Upper purlins	Channel No. 12P	Steel 245

Load table

No.	Load name	Standard value (kg)	Reliability factor	Estimated value (kg)
	For flooring (kg/ m^2)			
	Permanent			
1	Prefabricated floor slab	330.0	1.1	363.0
2	Hall floor	200.0	1.2	240.0
3	Roof covering	75.0	1.1	82.5
4	Hall ceiling	145.0	1.2	175.0
	Short term			
5	Useful for the hall floor	300.0	1.2	360.0
6	Useful for roofing	50.0	1.3	65.0
7	Snow load	50.0	1.4	70.0
	Other constants			
8	Own weight of the structure	automatically	1.1	automatically

General characteristics of the building accepted for calculation

Longitudinal reinforcement class	**A-III**
Transverse reinforcement class	**A-I**
Dimensions in plan (axial)	24.0m x 24.0m (trapezoidal)
Estimated height of the basement floor	3.40m
Estimated height of the 1st floor	3.90 m
Estimated height of a typical floor	3.90 m
Estimated height of the attic floor	No
Estimated height of the entire building	13.70 m
Building walls: Brick	**Not** involved in the work of the frame
Type of soil conditions by subsidence	see geology
Artificial base for foundations	Structurally
Dynamic loads according to KMK 2.01.03-19 [5]	
Responsibility factor of the structure	1.0
Earthquake frequency factor	1.2
Number of storeys coefficient	1.0
Regularity coefficient	1.0
Site seismicity coefficient	1.0
Seismicity of the construction area	9 points
Soil category by seismic properties	II (second)
Estimated seismicity	9 points
Region index	I
Oscillation Decrement	0.3
Type of load	Combination coefficient, ψi
Permanent (Loads 1,2,3,4)	0.9
Temporary long-term (no)	0.8
Short-term (for floors and coverings) (Load 5.6)	0.5
Construction type	**Limit inelastic deformation** according to KMK 2.01.03-19 [5]
Foundation	10
Monolithic basement wall	10
Monolithic areas	7.5
Reinforced concrete columns	5
Crossbars	7.5

Results.

Calculation data

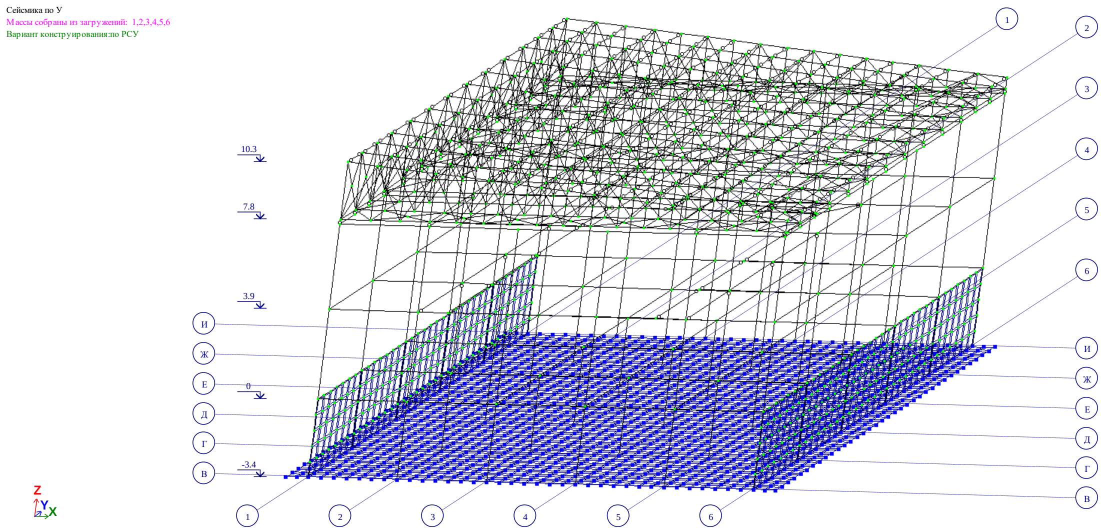

Figure 3. Design diagram of the building

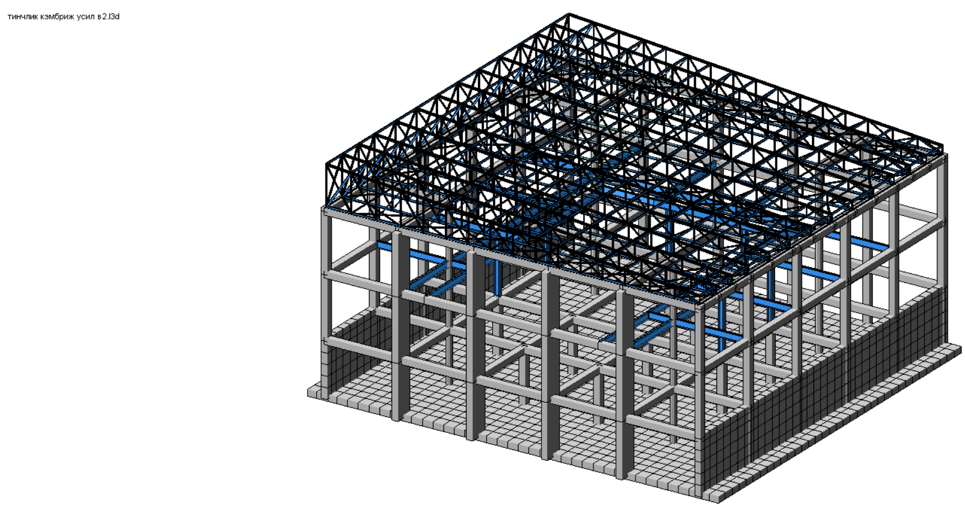

Figure 4. 3D model

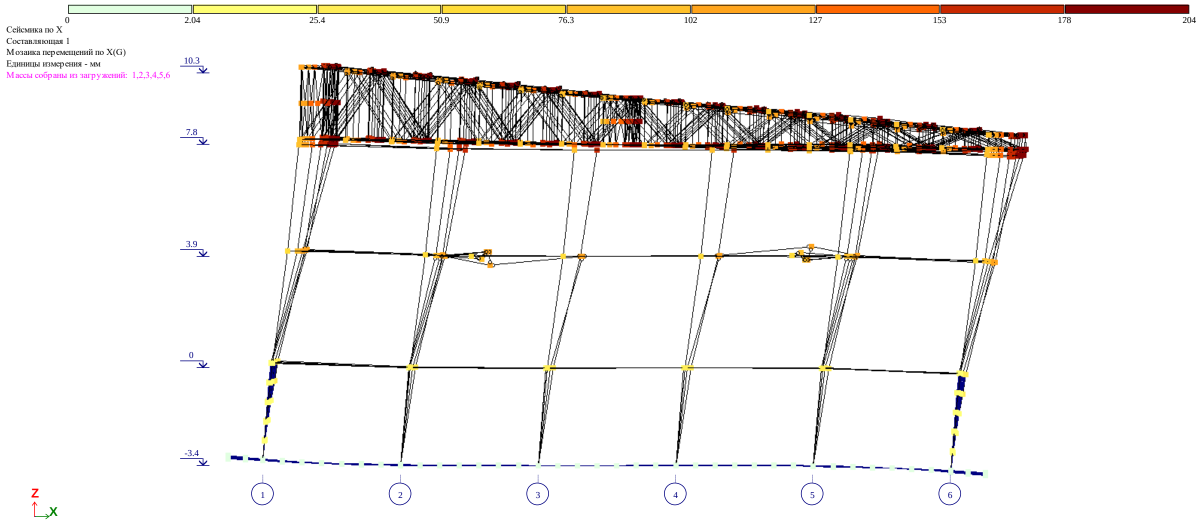

Figure 5. Mosaic of movements along X

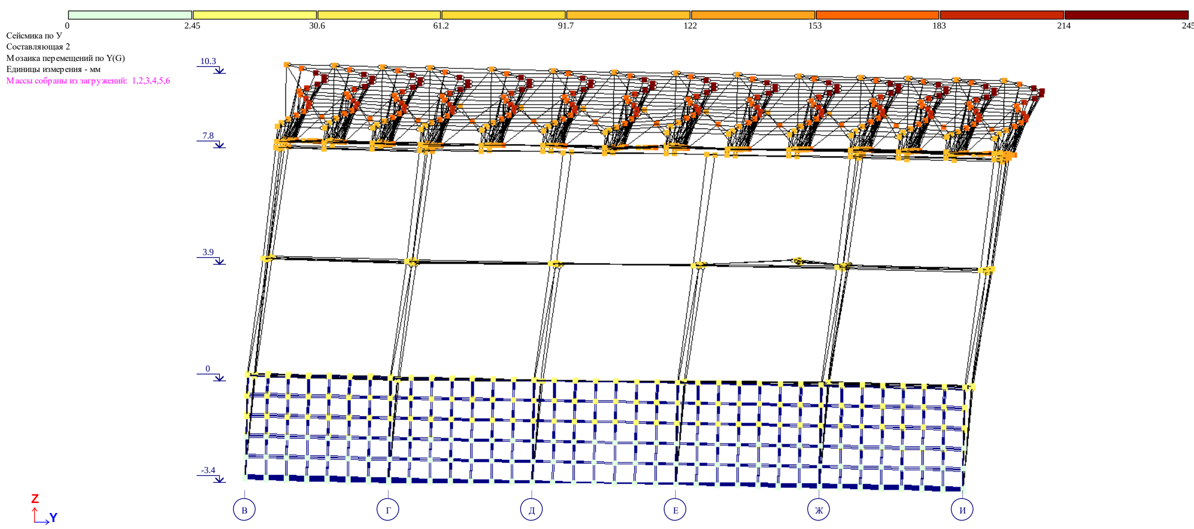

Figure 6. Mosaic of movements along Y Results of calculation of the foundation part

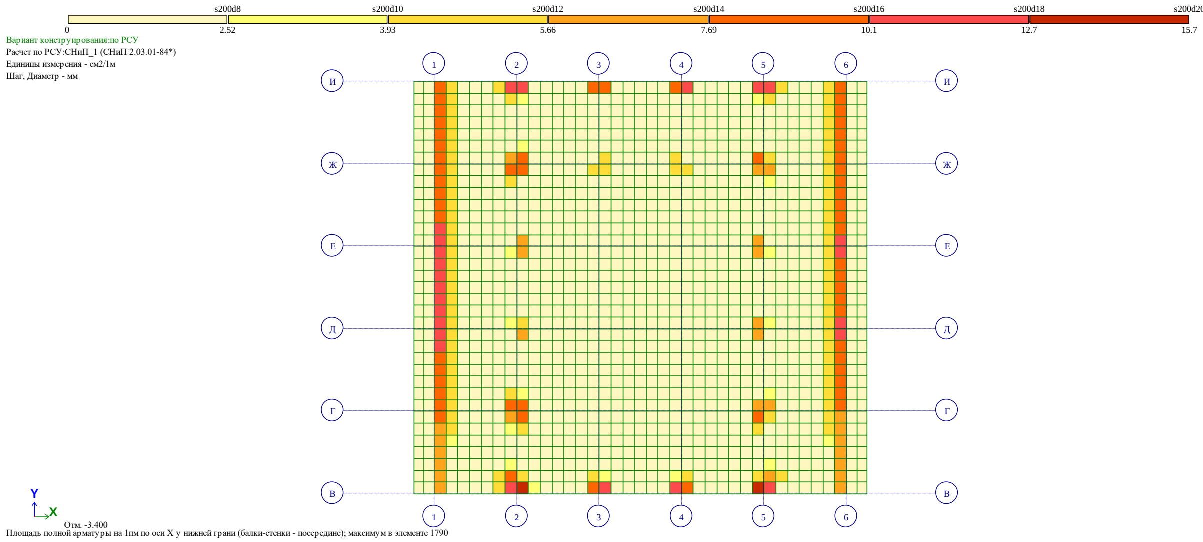

Figure 7. Area of complete reinforcement per 1 rm along the X axis at the bottom edge

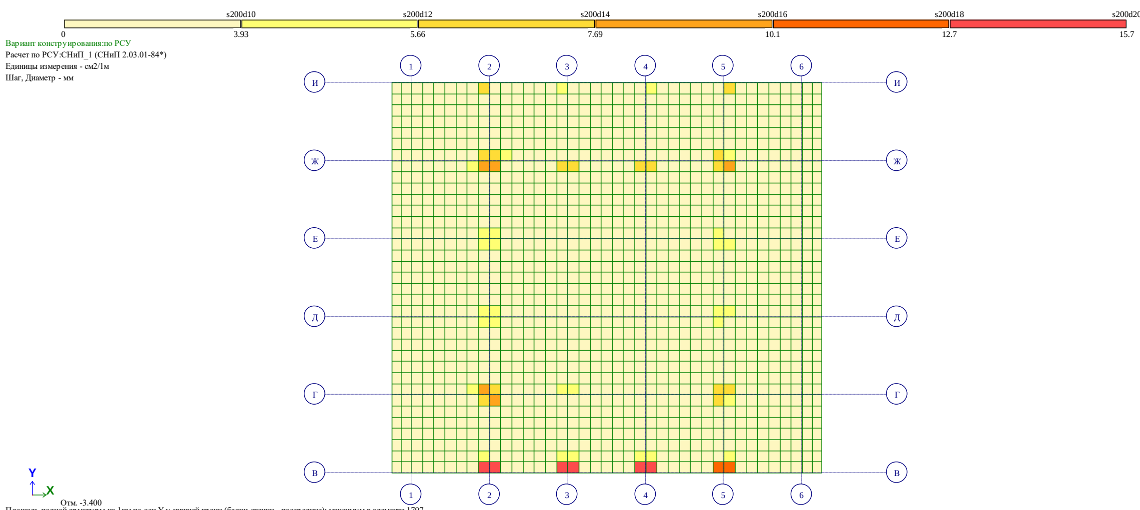

Figure 8. Area of complete reinforcement per 1rm along the Y axis at the bottom edge

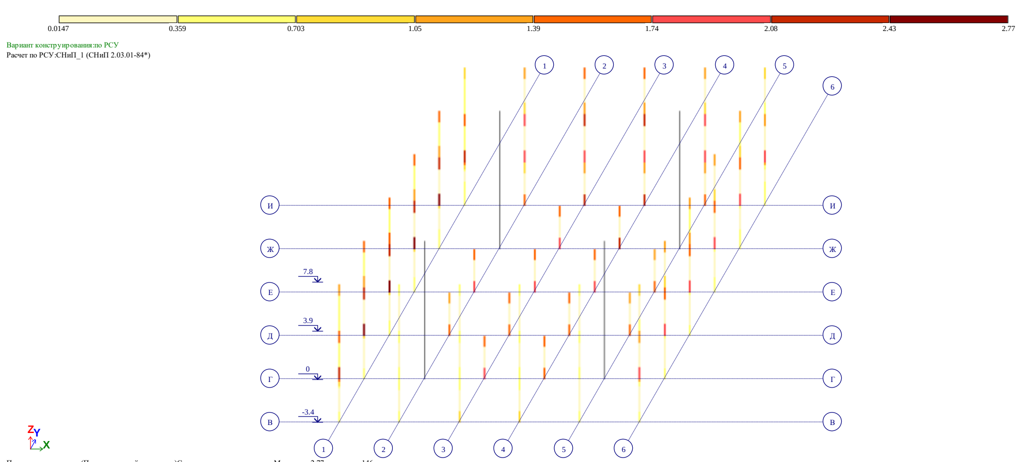

Figure 9. Percentage of reinforcement (Area of total reinforcement) Symmetrical reinforcement. Maximum 2.77 in element 146.

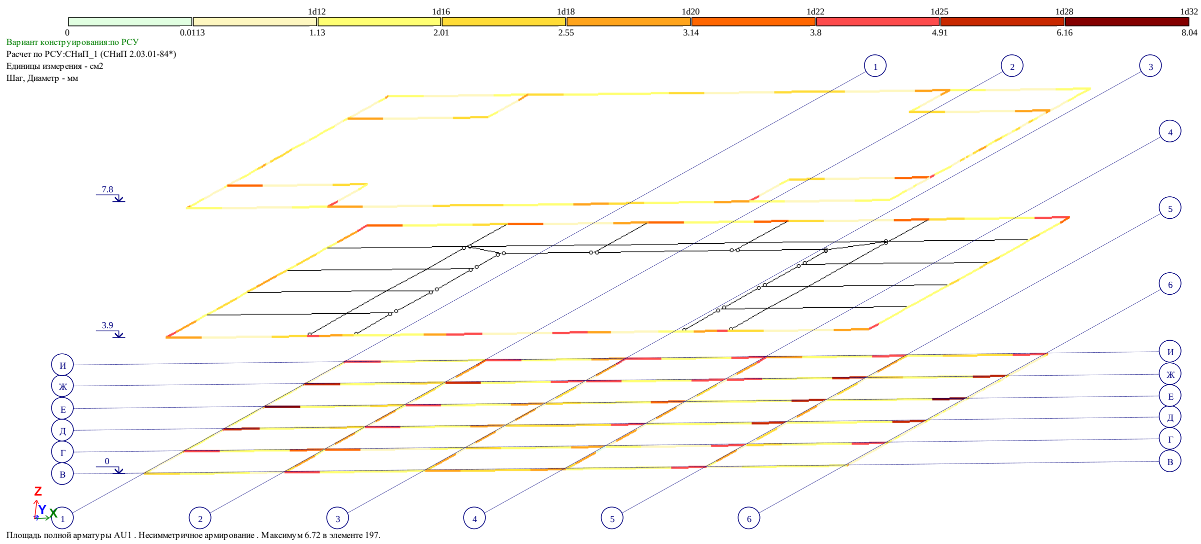

Figure 10. Area of complete reinforcement AU1. Asymmetrical reinforcement. Maximum 6.72 in element 197. Calculation results for metal elements

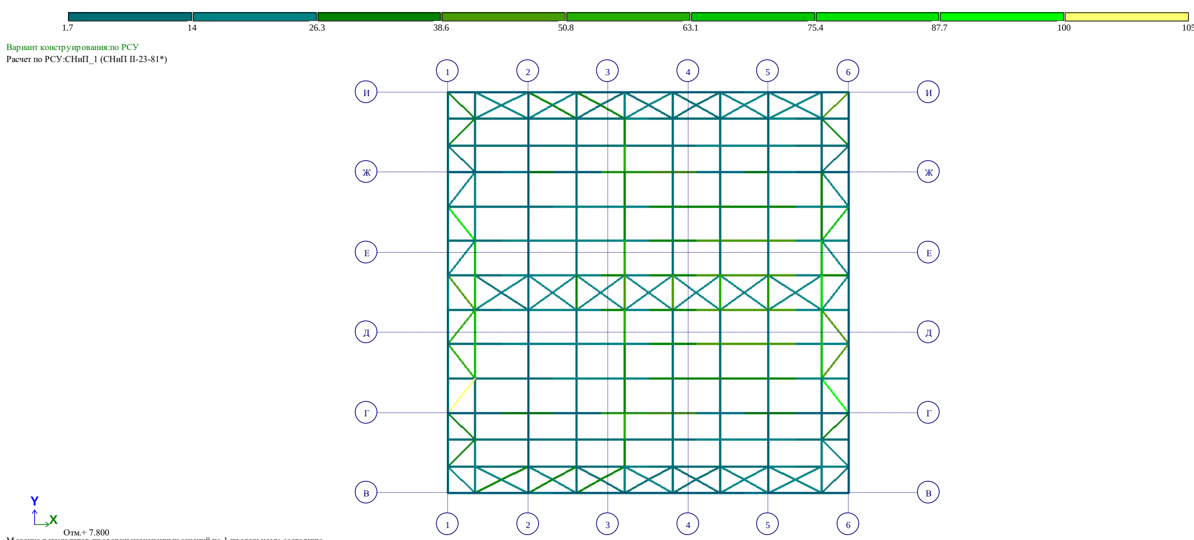

Figure 11. Mosaic of the results of checking the assigned sections for 1 limit state

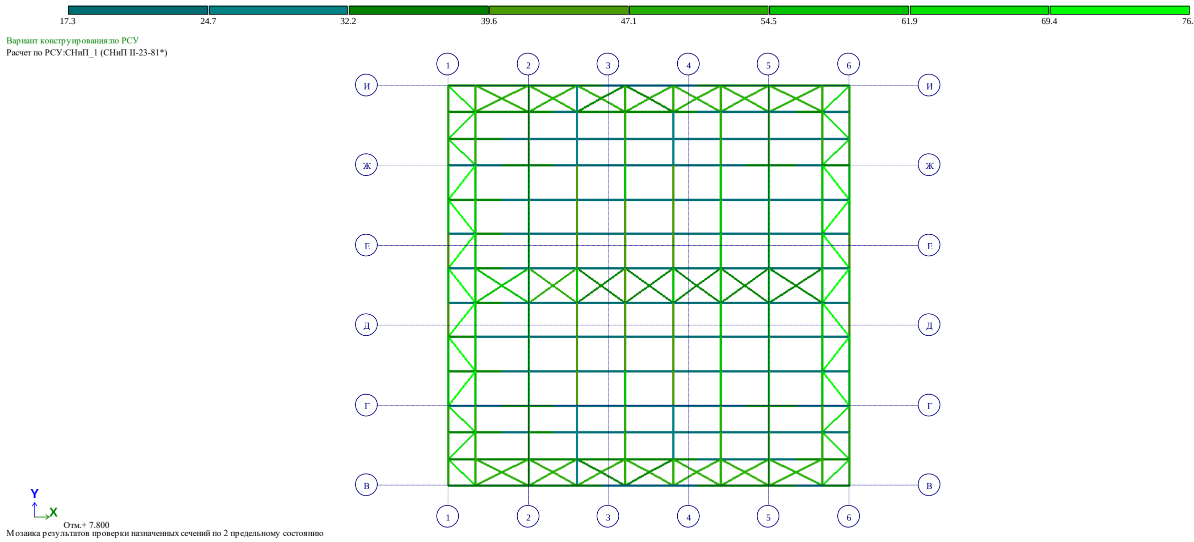

Figure 12. Mosaic of the results of checking the assigned sections for the 2nd limit state

CONCLUSIONS

The technical condition of the inspected structures is assessed as operable technical condition.

1. The obtained values of vertical and horizontal movements of frame structures do not exceed the maximum permissible values.

2. According to the results of strength verification calculations, all frame elements meet the requirements for load-bearing capacity and deformability, as well as local stability.

3. The building of a public building requires the implementation of strengthening measures only in defective areas to ensure the load-bearing capacity requirements for the action of design loads. And these are the fastening points of metal crossbars to the columns that do not correspond to the design values, the absence of bolts on the fastening points, the tightening of some of the bolts is loose, and there are some discrepancies between the diameter of the bolts and the design values. These nodes need to be strengthened.

4. Install bolts with a diameter of 20 mm. At the intersection of elements of vertical connections.

5. In frame joints connecting beams with columns, with a gap defect between the beam flange and the column wall, install a plate with a thickness equal to the size of the gap. The steel grade of the plate should be C245, the width size is 30 mm wider than the beam flange. After installation, weld the plate along the vertical end with the beam flange and the column wall, take the weld leg at the smallest for the thickness of the plate, but not less than 6 mm.

6. The building complies with modern earthquake-resistant construction standards (KMK 2.01.03-19) in all respects except one: flexible fastening of partitions to frame structures is not provided.

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