

**DETERMINATION OF DISPLACEMENT OF FIVE-STOUREY BUILDING
UNDER ACTION OF SEISMIC FORCES**

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Abstract

In this article, seismic forces affecting a five-story building were incorrectly distributed, as a result of incorrect placement, displacements were detected in the building. design works were performed in accordance with the current standard. general information about the construction site, geometric indicators of the building, dynamic characteristics of the building, strength and mechanical indicators of construction materials were taken from the location of the building and analyzed.

Keywords. Seismic forces, geometric indicators, dynamic forces, stability, earthquake, dynamic characteristics.

Introduction

When calculating the effect of seismic forces, the following were taken into account: general information of the construction area; geometric indicators of the building; General information of the building according to the regulatory document building regulations 2.01.03-19 "Construction in seismic areas"; dynamic characteristics of the building, strength and mechanical indicators of construction materials; consolidation of loads; statement and analysis of calculation results; conclusions and recommendations.

The general appearance of the building is rectangular in plan, the main walls are columns of baked brick, and the beams are restored from cast-iron and concrete structures. Five floors of a commercial consumer services building and a residential building are separated by an antiseismic seam, the planned dimensions of which are 30.0x12.0 m. The total height of the building is 19.9 m (5 floors of the attic). The distance from the floor level to the ceiling of the building is 3.0 m.

1. General information about the building and the construction area

1. Structural system of the building: 4-story building.
- 2 Construction indicators of the area:
 - 2.1. Seismicity of construction site - 7 points (BR 2.01.03-19, Appendix 2);
 - 2.2. Normative snow load: II - region $s_0 = 0.7$ kPa (70 kgs/m²) (BR 2.01.07-96, Appendix 5).
 - 2.3. Normative pressure of wind speed: II - district $W_0=0.38$ kPa (38 kgs/m²) (BR 2.01.07 96),



3. The indicators of the building according to the regulatory document:

- 3.1. The building's responsibility class is I (first);
- 3.2. Reliability coefficient by appointment: $\gamma_n=15$ (BR 2.01.07-96, Appendix 7).
- 3.3. Category of responsibility of the building - III (third);
- 3.4. Coefficient of responsibility: $K_o= 1.2$ (BR 2.01.03-19, table 2.3);

2. Geometric indicators of the building

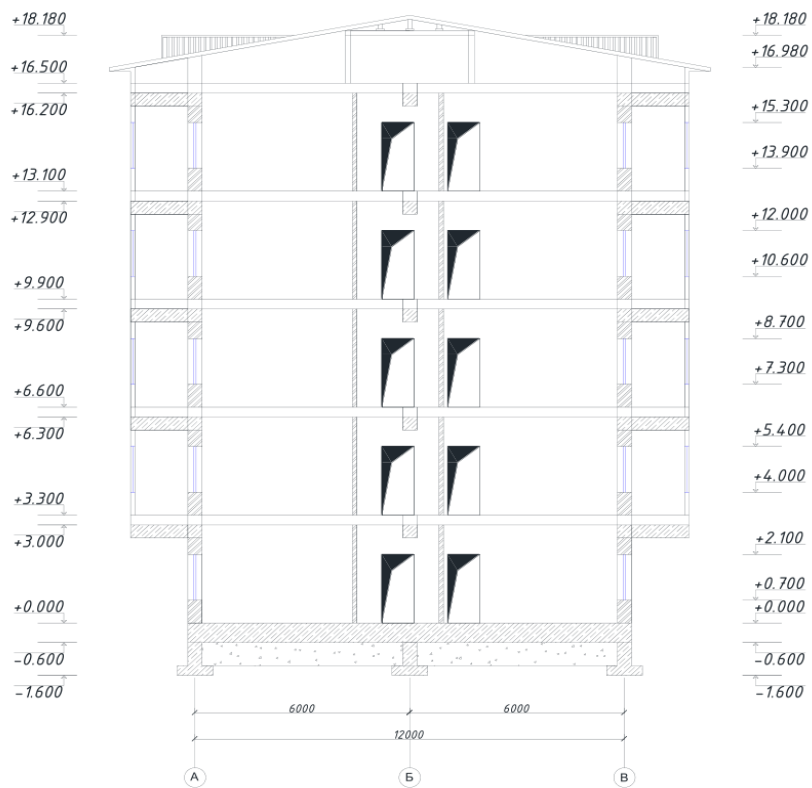


Figure 1.1. 1-1 section of the building.

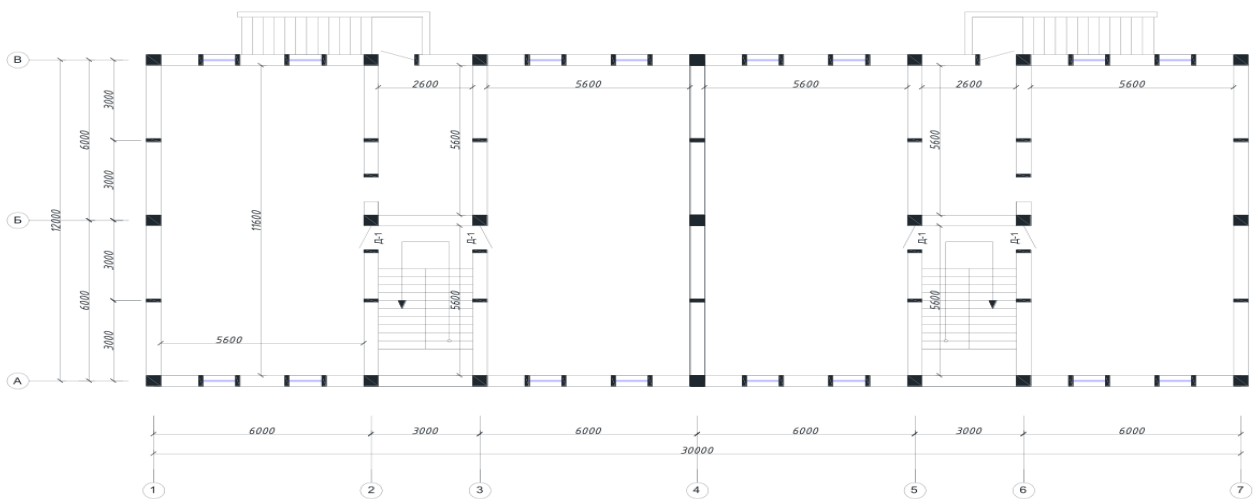


Figure 1.2. 1st floor wall plan.

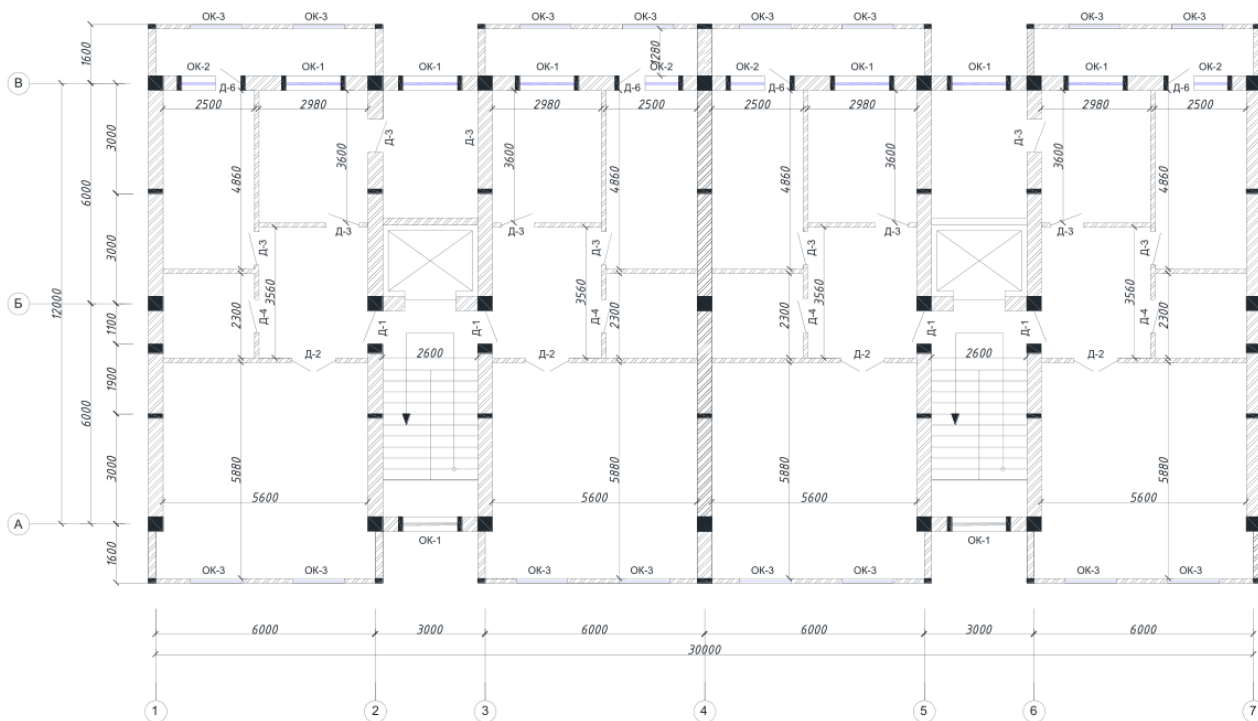


Figure 1.3. Floor 2-4 wall plan.

3. General information of the building according to the normative document BR 2.01.03-19 “Construction in seismic areas”

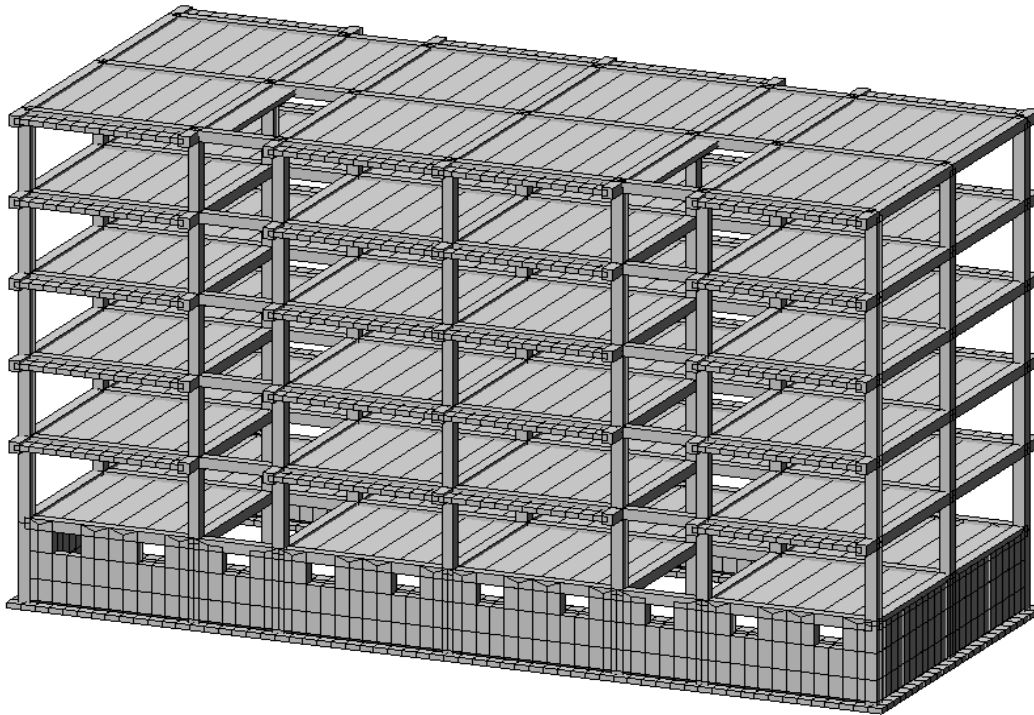
Calculation of the impact of seismic forces of the building was carried out using the LIRA 9.6 program complex. According to BR 2.01.03-19, the normative indicators of the building are presented in Table 3.3 below. Table 1.1. Normative indicators of the building.

Naming of calculation indicators	Coefficient
1. Counting number of vibration forms	10
2. Matrix of mass	Diagonal
3. Coefficient correcting seismic forces	1,0
4. Responsibility coefficient of the facility, (BR 2.01.03-19, 2.3 - table)	1,2
5. Coefficient that takes into account the frequency of earthquakes (BR 2.01.03-19, Table 2.4)	1,25
6. Coefficient that takes into account the number of floors of the building (BR 2.01.03-19, 2.10 - table 2.10)	1,5
7. Regularity coefficient, p.2.25 (BR 2.01.03-2019, 2.12 - table)	1,0
8. Coefficient that takes into account the seismicity of the area, (BR 2.01.03-19, Table 2.7)	1.0
9. Address index, (BR 2.01.03-19, table 2.2)	II
10. Ground category, 1.1. table (BR 2.01.03-19,1.1 - table)	II
11. Decrement of oscillations, (BR 2.01.03-19, table 2.9)	0,3



4. Durability and mechanical indicators of construction materials

The following mechanical indicators were obtained for concrete structures: $E = 300000 \text{ kgs/cm}^2$, Poisson's coefficient $\mu=0.2$, betonning solishtirma og'irligi $\gamma=2500 \text{ kgs/m}^3$.



Building a spatial 3D computational model

5. Consolidation of Loads

A total of 6 loadings were adopted in summing up the external effects, two of which consist of seismic impact forces in the transverse X and longitudinal Y directions.

The calculation of the building is based on the effects of special loads.

Loading 1. Permanent load (the specific weight of the building, $g_f = 1.1$ is accepted with a reliability factor).

Loading 2. Constant load, multi-cavity slab, cladding, insulation, heat-retaining layer, floor, curtain wall, profiled and integral procons (see table 1.2).

Loading 3. Long-term load - useful load (the weight of people and equipment, $\gamma_f = 1$, accepted with a reliability coefficient according to BR 2.01.07-96, clauses 3.10-3.11).

Load 4. Short-term load - snow (paragraph 5.7 of BR 2.01.07-96 according to reliability coefficient $\gamma_f = 1.4$).

Loading 5 and 6. Seismic effects in the corresponding X and Y directions Tashkent city - 8 points.

A summary of the loads is given in Table 1.2 below.



1.2 - table. Aggregation of loads.

№	Naming of loads	Unit of measure	Normative value	Working conditions coeff.	Computational value
1	2	3	4	5	6
1.	The specific weight of the building is accepted with a reliability factor of $\gamma_f = 1.1$				
2.	Permanent loads applied to the coating				
2.1.	Wavy asbestos slate 1750×1130×5.2	kgs/m ²	10,42	1,05	10,94
2.2.	6 m and 3 m integrated progon	kgs/m	24	1,05	25,2
2.3.	Heat preservation layer - expanded clay t=150 mm; $\gamma=800 \text{ kg/m}^3$	kgs/m ²	120	1,3	156
2.4.	Cement-sand mixture layer t=30 mm; $\gamma=1800 \text{ kg/m}^3$	kgs/m ²	54	1,3	70
2.5.	The thickness of the multi-cavity plate is 220 mm	kgs/m ²	115	1,1	126,5
2.	Constant loads applied to the rolling plate				
2.1	Wooden floor, cross-sectional surface dimensions 0.05x0.2 m.	kgs/m ²	77	1,1	84,7
2.2	The size of the cross-sectional surface of a wooden beam is 0.25x0.3 m.	kgs/m ²	115	1,1	126,5
2.3.	Floor covering (linoleum)	kgs/m ²	10	1,2	12
2.4.	Curtain walls (brick wall)	kgs/m ²	100	1,2	120
3.	Long term				
3.1.	Useful	kgs/m ²	200	1,3	260
4.	A short term				
4.1.	Snow load	kgs/m ²	70	1,4	98

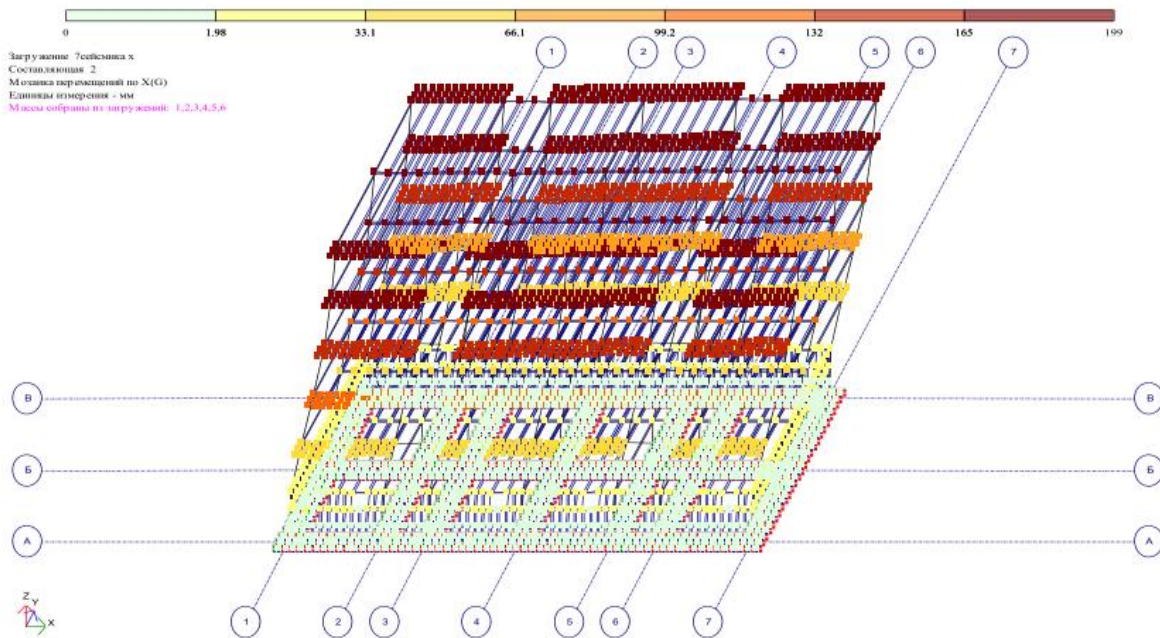


Fig. 1.4 isopoly of equivalent stresses in tension in building structures

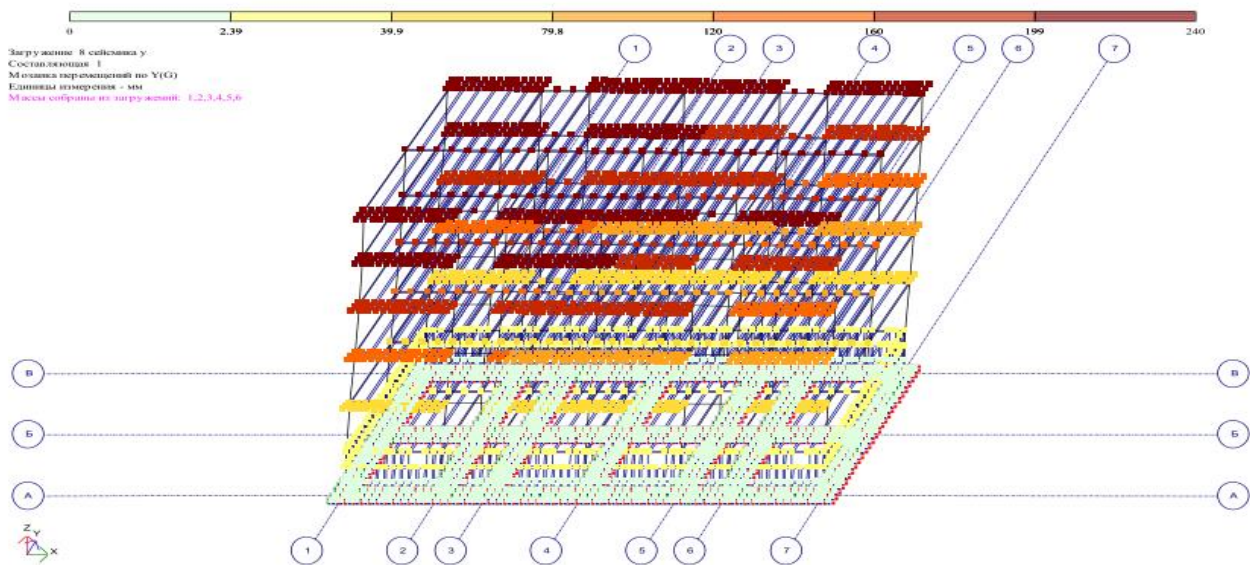


Figure 1.5. Isopoly of displacements of longitudinal walls of the building along the Y axis

Based on the results of calculation of the four-story building under the influence of 8-point seismic forces, the states of deformation and stress of the building, the frequency of specific vibrations of the building, the maximum displacements and stresses of its walls were analyzed.

2. It was found that the characteristic vibration period of the building obtained by theoretical calculation ($T_h=0.23$ sec) is significantly different from the characteristic vibration period ($T_e=0.14$ sec) obtained by recording microseismic vibrations experimentally.

3. There are two reasons for such a difference: firstly, the period of specific vibration is determined by the method of microseismic vibrations through the initial elasticity modulus of the dynamic integrity of the building; secondly - since the partitions of the building are made of wooden beams and do not form a single unified spatial unit, under the influence of 8-point seismic forces, it causes large deformations, especially along the transverse X-axis, as a result of special vibration period will also be large.

6. Conclusion

Based on the results of calculating the effects of eight-point seismic forces, the conditions of deformation and stretching of the building, the frequency of partial vibrations of the building, the maximum displacements and stresses of its walls were analyzed.

The maximum displacement of the building under the action of seismic forces of 8 points along the X axis is $199 \text{ mm} > (1/70)L = 250 \text{ mm}$, i.e. the range 2.12 (Table 2.6), defined in the regulatory document BR 2.01.03-19, meets the requirements for limit values

The building has a maximum displacement of $240 \text{ mm} > (1/70)L = 250 \text{ mm}$ along the U axis with an 8-point seismic force, i.e. the range of 2.12 (Table 2.6), defined in the regulatory document BR 2.01.03-19, meets the requirements for boundary values.



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