

METHODS OF SEISMIC PROTECTION OF BUILDINGS.

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Annotation. In modern earthquake-resistant construction, very urgent importance is attached to ensuring the reliability of buildings and structures, provided that additional materials, funds and labor costs are rationally spent on their seismic intensification. This article provides information on ways to ensure the earthquake resistance of buildings.

Key words: seismic isolation; seismically isolated buildings and structures; seismic resistance damping layer, active seismic isolation.

Introduction. The traditional method of ensuring earthquake resistance of structures involves increasing the load-bearing capacity of structures by increasing their size and strength of materials, and in buildings with brick walls, seismic belts, reinforced concrete inserts, additional strengthening of walls, the intersection of longitudinal and transverse walls are used. All this requires a significant increase in the amount of building materials and tools. An increase in the amount of materials leads to an increase in the rigidity and weight of the structure, which in turn leads to an increase in inertial loads. Traditional methods and means of protecting buildings and structures from seismic impacts are currently fundamental in construction practice. They include a large complex of various activities aimed at increasing the load-bearing capacity of construction structures, the design of which is domestic and foreign construction. When designing, as a rule, it is recommended to adopt symmetrical design schemes and achieve an even distribution of the rigidity of structures and masses. The requirement of equal strength of the elements of supporting structures must be observed, weak nodes and elements should not be allowed, their premature release can lead to the destruction of the structure, until its load-bearing capacity is exhausted. In buildings and structures made of prefabricated elements, it is recommended to place joints outside the zone of maximum movement, it is necessary to ensure uniformity and monolithic of structures due to the use of reinforced prefabricated elements. In structures and their compounds, conditions must be ensured that facilitate the development of plastic deformations, while ensuring the overall stability of the structure.



Materials and methods. Constructive solutions of partitions during an earthquake should ensure the independent operation of each of them. This is achieved by installing antiseismic seams that can be combined with temperature or sediment. In addition, buildings are characterized by antiseismic seams, if its adjacent plots have differences in height of 5 m or more (if the calculated seismicity is 7 points, it is possible not to arrange antiseismic seams in one-story buildings up to 10 m high). Stairs in buildings are provided indoors with window openings in the outer walls. The location and amount are determined by the calculation in accordance with the regulatory Fire Protection documents; it is recommended to take at least one staircase between the antiseismic seams. Interior floors and cladding, which act as stiffness diaphragms, ensuring the distribution of seismic load between vertical load-bearing elements in multi-storey buildings

To avoid the possibility of dangerous resonant vibrations of the first flexible basement building in earthquakes with large dominant periods, V. Kucherenko [6,18] developed the construction of buildings whose joints were removed. The solar system is called flexible and is designed to reduce inertial loads in a building that occurs during seismic exposure. Adaptation to seismic effects is achieved by the use of special structural elements that increase the rigidity of the structure in its initial state and are extinguished when the amplitude of the seismic vibrations of the structure reaches a certain threshold level. In this case, all seismic loads must be fully accepted by the supporting structures of the structure in the case when additional solid connections are disabled. The disadvantage of this technical solution is that after the burned contacts are destroyed, they must be immediately restored during an earthquake, which is not always possible in practice.

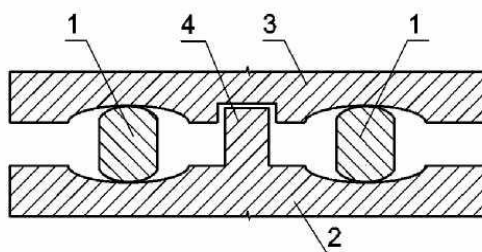
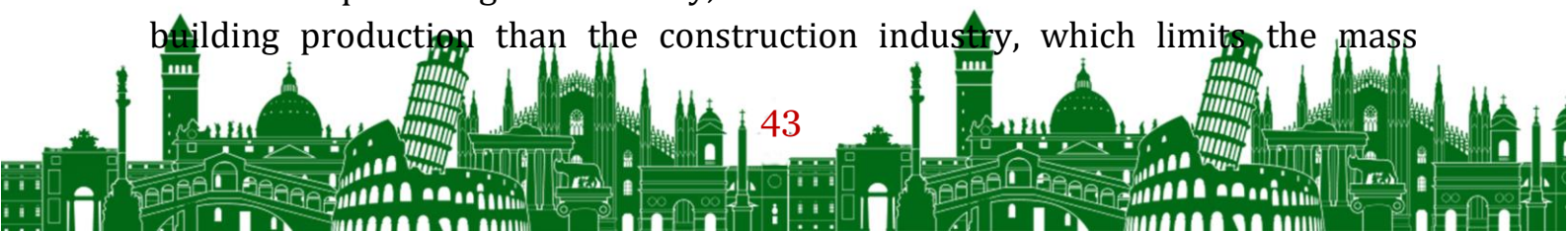


Figure 1. Design solution OKF 1-kinematic supports; 2 - Support Foundation; 3 - lower cladding of the building; 4-slip shock absorbers.

The production of racks with spherical ends and high-precision rolling surfaces requires higher accuracy, which is characteristic of more machine-building production than the construction industry, which limits the mass



application of this design.

Seismic protection systems with kinematic support. Among the many seismic insulation devices, one should highlight the class of supporting kinematic foundations (OKF), which is relatively simple in a technical solution that meets production requirements construction work .The OKF implements the mobility of a building or structure relative to a monolithic or prefabricated foundation with stationary support, which is tightly connected to the soil. This goal is achieved with the help of supporting elements (OE), which are the rotational bodies of a certain shape and configuration on which the main structure rests. When a certain level of excitation is reached on the slab of the OE foundation, it becomes possible to create movements of the building relative to the ground. The disadvantage of this technical solution is that with an increase in the number of floors, stress concentrations appear in the zones of installation of load, kinematic supports, respectively, which leads to the expenditure of additional material for strengthening these zones, as well as with the floor.

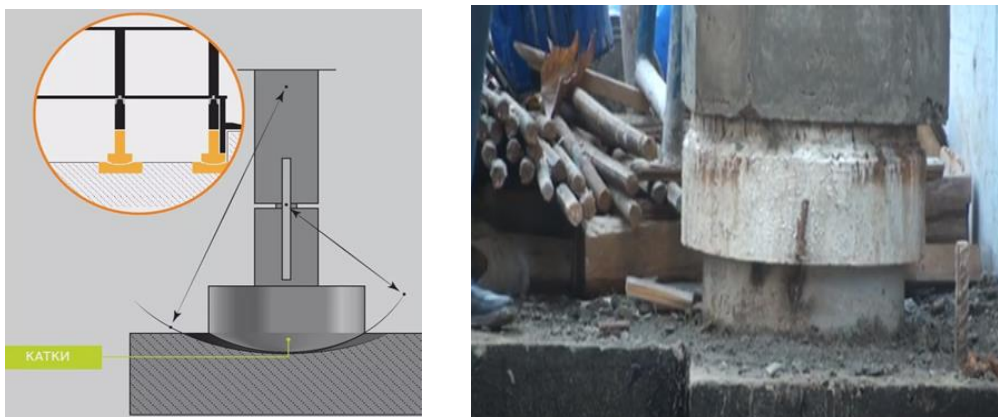


Figure 2. Kinematic foundation and their condition in construction.

Among the many seismic isolation devices, one should highlight the class of supporting kinematic foundations, which is relatively simple in a technical solution that meets production requirements. The difference between kinematic seismoisolating foundations and other seismoisolations is that the seismoisolation of a building is achieved at the expense of the elements that move between its upper part of the ground and the floor. the lower sphere is placed below the center. Spheroidal supports are used in conjunction with dempfer devices ,accessible connections(vklyuchayutshiesya svyazi) and limiting struts (pori ogranichiteli) in order to prevent vibration above the amplitude allowed at the base during an earthquake.

Dynamic vibration dampers. In addition to the systems mentioned above, systems that increase attenuation characteristics are used to reduce the inertial



forces that arise in structures during earthquakes. These systems are especially effective for tower-type structures. Depending on the constructive execution of elastic bonds, dynamic erasers are divided into three groups:

- Maiatnik
- Combined

The disadvantages of this technical solution are the complexity of the systems and the large material costs for their maintenance.

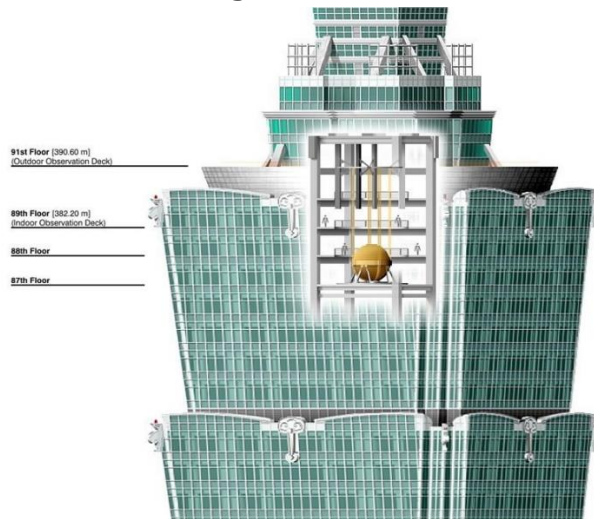


Figure 3. High-rise structures with seismic protection under the influence of wind power

Named for the fact that these pendulum supports are under seismic influence, the insulated structure located on such supports performs movements similar to that of a pendulum with friction. The mandatory components of the pendulum support of any type are one or additional deep spherical surfaces, one or more adjusters, sides on surfaces that slide into them (they limit the horizontal movement of the sliders).

Conclusions. The analysis of existing structural systems, articles, publications and patents in this article shows that the disadvantages of close structural analog systems of seismic insulation do not ensure the overall rigidity and monolithic of the building, as well as the inability of the building to move in all directions in terms of the amount of foundation displacement during an earthquake. At the same time, there are no methods for calculating these tasks when using a computer using the finite element method. Thus, the scientific problem lies in the lack of methodology for modeling the mechanism of seismic isolation, study and analysis of work.

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