EUROPEAN INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH AND MANAGEMENT STUDIES

VOLUME03 ISSUE05
DOI: https://doi.org/10.55640/eijmrms-03-05-41 Pages: 199-206

EVALUATION OF PARAMETERS OF SEISMIC INSULATING FOUNDATION WITH DAMPING LAYER OF BUILDINGS AND STRUCTURES

Bekzod Akbarovich
Doctoral Student (Phd) O.Z Aglamov Tashkent Architectural And Construction University (TACU) Of The Republic Of Uzbekistan

ABOUT ARTICLE

Key words: Seismic isolation, seismic suppression, seismic protection, damping, economic efficiency, dynamic circuit modifications, dynamic vibration dampers.

Received: 21.05.2023
Accepted: 26.05.2023
Published: 31.05.2023

Abstract: The article considers modern methods of seismic suppression and seismic isolation. A simple approach to solving the issue of seismic protection - increasing the stiffness and reinforcement of structures can be used for most buildings of a simple design scheme, however, the use of special methods allows you to reduce the cost of construction while maintaining high reliability. In addition, for buildings of complex design, unique and high-rise, it can be almost impossible to use the traditional approach. New effective methods of seismic isolation are needed. Such solutions involve a change in weight and stiffness, damping the system depending on its movements and speeds. Thus, the use of seismic insulation in correct design can significantly increase such indicators as: building reliability, safety, financial characteristics of the structure.

INTRODUCTION

Ensuring the seismic stability of the "foundation - foundation - construction" systems in order to reduce damage from seismic impacts is the most important problem of modern construction science and practice. The consequences of earthquakes are massive deaths, huge material damage associated with the destruction of infrastructure, housing stock, industrial facilities and transport. In the last 50 years alone, devastating earthquakes have killed more than 5 million people; property damage is in the tens of billions of dollars.

Up to 80 percent of the territory of the Republic of Uzbekistan belongs to seism active areas with seismicity from 7 to 9 points on the seismic scale adopted in the Republic. This circumstance

necessitates the further development of the theory and practice of ensuring the seismic resistance of systems, including the base, foundation and building structures of buildings.

Currently, the problem of increasing the seismic resistance of foundations, foundations and building structures of buildings is solved by two methods - traditional and using special devices for seismic protection and seismic insulation. Traditional methods include increasing the strength characteristics of soil foundations, using more advanced design solutions, using modern technologies, high-strength materials, strengthening the bearing building structures of the buildings and structures in operation, as well as taking into account the incoming initial information regarding the predicted seismic impacts and the behavior of the structure elements under extreme impacts.

There are two ways to increase the seismic resistance of a building:

traditional - by increasing the section of the structure;

special - load reduction due to modification of the dynamic scheme of the building or structure operation.

Traditional methods are applicable for the bulk of structures, the design apparatus is very well developed, significant construction experience has been accumulated [3, 4]. However, for technically complex and unique buildings, this approach often does not apply, or gives an overly resource-intensive and, accordingly, financially unsatisfactory result. Special methods, which will be discussed below, are used both for unique buildings (practically without alternative) and for simpler ones, allowing to reduce construction costs while increasing the reliability of the buildings being built [5].

The purpose of the considered measures is the same - to reduce economic losses to ensure seismic protection while maintaining high reliability and safety of buildings [8]. As a result, the operational quality of buildings is improved and comfort for people who are or live in the building is increased.

Along with this, over the past 15-20 years, the use of unconventional methods to increase the seismic resistance of structures, implemented in various structures of seismic insulating foundations, dynamic dampers of seismic vibrations, systems with degrading rigidity, etc. has become increasingly widespread. The development of theoretical and experimental foundations of this direction is contained in the works of M.T. Usbaev, Yu.R. Leiderman, T.R. Rashidov, T.Sh. Shirinkulov, H.Z. Rasulov, V.T. Rasskazovsky, K.S.A Bdurashidova, abroad - in the works of A.D. Abakarov, Y.M. Aizenberg, A.T. Aubakirova, T.A. Belash, E.N. Bellendira, V.S. Belyaeva, V.V. Bolotina, L.N. A. Borodina, A. Bykhovsky, I. I. Goldenblat, S. E. Erzhanova, J. Zhunusova, B.G. Koreneva, I.L. Korchinsky, V.S. Polyakova, L.M. Reznikova, E. Rosenbluta, O.A. Savinova, L.L. Soldatova, A.M. Uzdina, T.N. Chachava, G. Shulman, J.M. Kelly, D.Li, V.Robinson, R.M. .Skinner, D.Smeet, W.W. Chang, et al.

Thanks to the work of these scientists, the foundations of the methodology for assessing the reliability of building structures and buildings for various purposes in conditions of seismic impacts are laid.

Currently, dozens of different design options for such devices have been proposed. However, the lack of a uniform methodology for assessing their reliability, the fan nature of the design models of objects and seismic impacts make it difficult to compare the results obtained and complicate the choice of the

most effective version of seismic insulation and seismic protection devices. A characteristic and important feature of the problem of comparative assessment of the reliability of the bases, foundations and building structures of buildings with different versions of seismic insulation and seismic protection devices. It is incomplete and unreliable initial information, both with respect to seismic impacts and with respect to the properties and behavior of building elements in the combination of static and seismic loads.

As you know, the purpose of using any design of seismic insulation and seismic protection devices is to fulfill two main requirements: reducing inertial loads on the base, foundation and building structures of the building and limiting the displacements of the structure relative to the base. However, no less important, and in the end, the determining condition for the choice of seismic insulation and seismic protection devices is to ensure the reliability of all these elements that form the building system. To date, there are no methods for quantifying the reliability of such systems that allow comparing different options for seismic insulation and seismic protection devices and choosing the most reliable. This circumstance is one of the reasons restraining the use of various devices of seismic insulation and seismic protection - despite the fact that the results of theoretical and experimental (including full-scale) studies of this direction convincingly prove their effectiveness. The development of such methods on the basis of the appropriate methodological base is an important and urgent problem, the solution of which will make it possible to make a reasonable choice of the most reliable option for seismic insulation and seismic protection devices, taking into account the peculiarities of all elements of the structure system.

Today, with the development of science and technology, research in this direction is especially relevant. This fact is highlighted by recent devastating earthquakes.

Since seismic impacts are transmitted to the building through its underground part, primarily foundations, the insulation of the above-ground part from the underground is the most natural way to reduce seismic loads on the framework. This method of protection is called seismic isolation. Its use allows you to reduce the amplitudes of vibrations of the system and reduce inertial forces in the structures of the above-ground part of the building.

For more than 1,500 years, builders separated the structure from its base, using soft material gaskets as an intermediate layer at the top of the foundations. For example, in the III-VII centuries. many large buildings of Central Asia were created on sand pillows. In the X-XVII centuries, pillows made of pure clay were used with an obligatory layer of reeds in the lower part of the walls. However, imperfect technology and low-quality building materials led to the shortness of these measures and isolation ceased to fulfill its function over time.

To date, seismic isolation remains an important and urgent issue, as evidenced by the fact that seismic isolation systems are included in the regulatory framework of the Republic of Uzbekistan. However, the authors do not give a detailed classification of seismic isolation methods, calculation methods and design solutions, therefore, an in-depth study of this issue on modern scientific works by Uzbek and foreign scientists is necessary.

Increasing the rigidity and strength of structures is not always possible to achieve the required seismic resistance of the building. It is necessary to know and correctly use various methods of seismic protection. They use various techniques for reducing inertial forces in the system: changing the mass and stiffness of individual structures or parts of a building, damping the system, creating inertial masses oscillating in antiphase with a frame, etc. Many solutions are patented back in the 2nd half of the 20th century, but many new effective measures are added. Currently, there are more than 100 existing patents for structural solutions for seismic insulation of buildings and structures.

Seismic-resistant buildings are known in which seismic loads are reduced by incorporating a damping layer into the foundation structure.

The task is to develop a design solution for the seismic insulation mechanism and assess the effectiveness of its introduction into the foundation structure.

The purpose of the work is to study the behavior of the damping layer (seismic insulation) included in the foundation structure under seismic impacts and in the development of methods for quantitative assessment of the reliability of the systems (seismic insulation) "heterogeneous soil base - foundation with a damping layer - building." The implementation of this goal will allow the reasonable selection of the most reliable version of seismic insulation and seismic protection devices, taking into account the peculiarities of all elements of the system.

Evaluation of reliability of foundations, foundations and building structures of buildings under conditions of intensive seismic impacts is characterized by significant differences from the problem of evaluation of reliability of mass production facilities located under conditions of stationary dynamic (for example, vibration) impacts or other rather well-defined dynamic loads characterized by time stability and repeatability.

It is proposed to perform the seismic isolation mechanism as follows.

Currently, the calculation and design of modern earthquake-resistant buildings largely depends on the correct identification of soil quality, the choice of structures and their sizes, as well as on the material for the manufacture of foundations. In this regard, it becomes necessary to develop new and improve existing methods for calculating the foundations of building structures on a soil base.

The work considers the device between the structure of the foundation of the intermediate layer (damping seismic insulating layer) made of a highly deformable material that provides an adjustable distribution of the reactive pressures of the base and seismic forces.

The efficiency of foundations with a damping layer is due to a decrease in deflections and internal forces in the foundation and can also reduce the intensity of seismic load; reducing its material consumption; expanding the scope of flexible foundations; reduced forces in aboveground structures from non-uniform base sediments. At the same time, the structural simplicity and manufacturability of construction inherent in foundations of traditional forms is preserved.

During an earthquake, a foundation beam with displacement limiters and a lower damping layer will repeat the base oscillations. The upper foundation beam of the building and limiting walls, which makes

it possible to move the building in all directions by the values of the base displacement. due to the small coefficient of friction in the contacts of the "upper and lower damping layer with the foundation beam (Ktr = 0.13)," as well as due to the inertia force of the building, the structure will be at relative rest. The described device, having a friction coefficient Ktr = 0.13, can reduce the intensity of the seismic load by 2.5-3 points, especially at the beginning of the process, when high-frequency oscillations of the base with the highest intensity are observed. (Fig. 1)

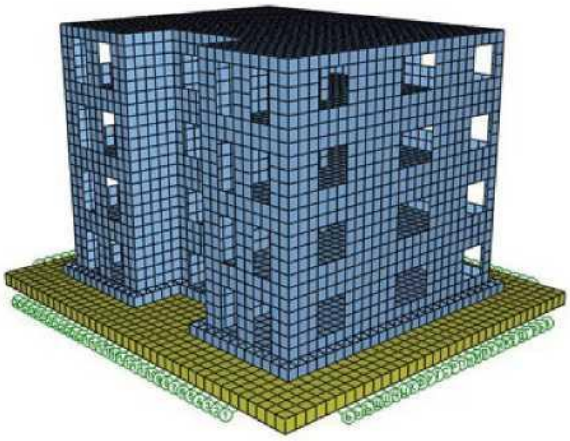
The advantage of the method is the possibility of discrete use of different stiffness when arranging between the upper and lower foundation beams of the damping layer under different sections of the lower foundation beam.

The damping layer, when arranged between the upper and lower foundation beams within the section, is under compression conditions, the compliance of the layer is reduced to the compliance of the point support.

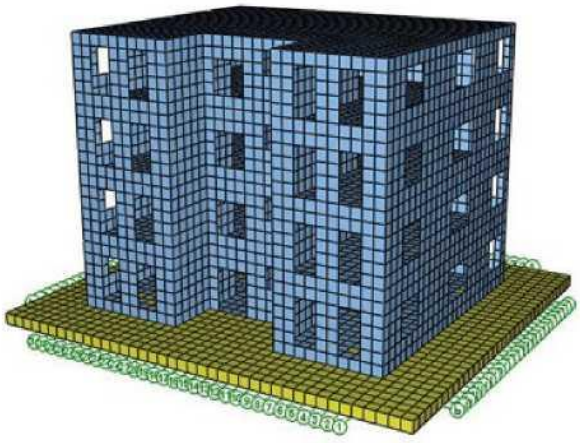
Slight curvature of the surface due to the laying of a damping layer of various thicknesses is not taken into account, the surface of the upper and lower foundation beams is considered flat.

The calculation involves only vertical forces between the lower foundation beam and the non-uniform soil base. It has been shown that the influence of the friction forces and the adhesion of the foundation beam to the base is small and can be neglected in further calculation.

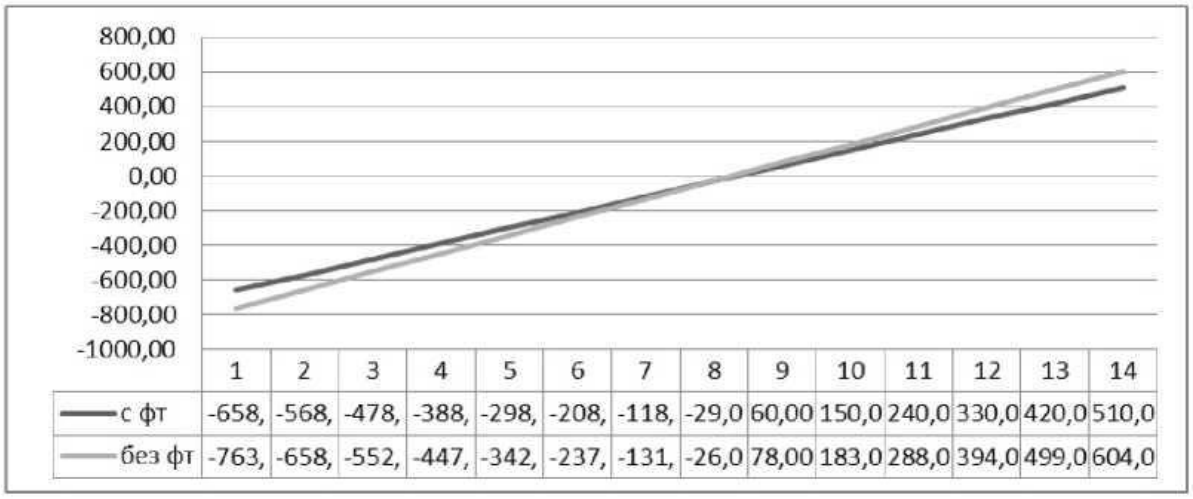
Based on the selected design scheme of the self-isolation mechanism, two buildings were created: one, which includes a seismic isolation mechanism, and the same without it.



Seismic isolated building

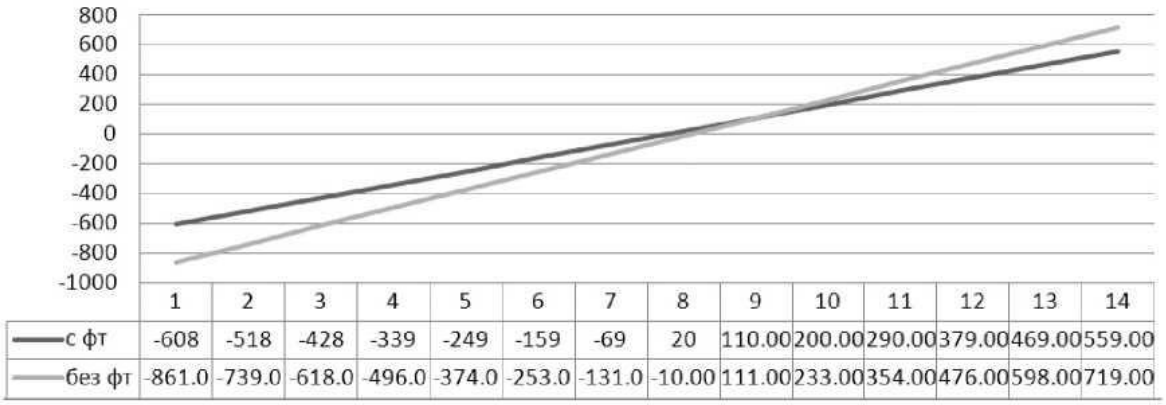


non-seismic isolated building



	1	2	3	4	5	6	7	8	9	10	11	12	13	14
с фт	-658,	-568,	-478,	-388,	-298,	-208,	-118,	-29,0	60,00	150,0	240,0	330,0	420,0	510,0
без фт	-763,	-658,	-552,	-447,	-342,	-237,	-131,	-26,0	78,00	183,0	288,0	394,0	499,0	604,0

Figure 2. Graph of NX stress distribution in structures of a seismically insulated building and a building without insulation [T/m2]



	1	2	3	4	5	6	7	8	9	10	11	12	13	14
с фт	-608	-518	-428	-339	-249	-159	-69	20	110.00	200.00	290.00	379.00	469.00	559.00
без фт	-861.0	-739.0	-618.0	-496.0	-374.0	-253.0	-131.0	-10.00	111.00	233.00	354.00	476.00	598.00	719.00

Figure 3. Graph of NY stress distribution in structures of a seismically insulated building and a building without insulation [T/m2]

Comparison of the results of calculation of a seismically isolated building and a building without a seismic insulation system. Seismic insulation systems confirm the effectiveness of seismic insulation of the building, since when installing a seismic insulation system under the foundations, normal stresses in vertical structural elements decrease by an average of 80%.

Analysis of the obtained stresses revealed the wall section with the highest stresses. To assess the failure of a non-seismically isolated structure, we assume that the simplex with maximum stress concentrations is destroyed. Since under the same loads the stress in the elements of the seismically insulated building is several times lower, the structures of the seismically insulated building are not subject to failure

Based on the results of the study given in the article, the following can be noted.

1. Seismic insulation systems confirm the effectiveness of seismic insulation of the building, since when the foundation of the building installs a damping layer (seismic insulation), normal stresses in vertical structural elements decrease by an average of 80%.

2. The introduction of a seismic insulation mechanism into the foundation design allows reducing stresses in the structure and, as a result, reduces the likelihood of structure collapse, which ensures the safety of human lives and valuable equipment.

REFERENCES

1. Ganiev A., Tursunov B. A., Kurbanov Z. K. Prospects for the use of multiple vermiculitis //Science and Education. – 2022. – Т. 3. – №. 4. – С. 409-414.
2. Ganiev A., Tursunov B., Karshiev E. Study of physical and mechanical properties of high strong concrete with chemical additives //AIP Conference Proceedings. – AIP Publishing LLC, 2022. – Т. 2432. – №. 1. – С. 050046.
3. Yusuf I., Tursunov B. A. SANOAT CHIQINDISI VA MINERAL QO'SHIMCHALAR ASOSIDA OLINGAN SEMENTLARNING FIZIK-MEXANIK XOSSALARINI O'RGANISH //Journal of Integrated Education and Research. – 2022. – Т. 1. – №. 1. – С. 324-329.
4. Khursanovich T. F., Orologli N. I. The study of physical and mechanical properties of construction gypsum and its study on the construction //ACADEMICIA: An International Multidisciplinary Research Journal. – 2020. – Т. 10. – №. 5. – С. 1990-1995.
5. Tursunov B. A. The usage of composite armature in construction. – 2019.
6. Tursunov B. A. ADVANTAGES AND DISADVANTAGES OF COMPOSITE AND STEEL ARMATURE //Строительные материалы, конструкции и технологии XXI века. – 2019. – С. 87-88.
7. Ганиев А. и др. Особо легких бетонов полученных на основе сельского хозяйственных отходов //Science and Education. – 2022. – Т. 3. – №. 4. – С. 492-498.
8. Shakirov, S. L. T., Tursunov, B. D. S. B., & Odiljanov, A. Z. (2022). THE STUDY OF THE PHYSICAL AND MECHANICAL PROPERTIES AND THERMAL CONDUCTIVITY COEFFICIENT OF ULTRA-LIGHT CONCRETE OBTAINED ON THE BASIS OF LOCAL VERMICULITE. World Bulletin of Social Sciences, 14, 36-39.
9. Муртазин, Э. Р., Рустамов, С. С., & Турсунов, Б. А. (2016). Сейсмостойкость коттеджных поселков. Ученый XXI века, (3-1 (16)), 15-17.
10. Махмудова, Н. А., & Турсунов, Б. А. (2019). ИСПОЛЬЗОВАНИЕ ОТХОДОВ ПРОМЫШЛЕННОСТИ ДЛЯ ПОЛУЧЕНИЯ ГИПСОВОГО ВЯЖУЩЕГО. In ПРОБЛЕМЫ ГЕОЛОГИИ И ОСВОЕНИЯ НЕДР (pp. 393-395).
11. Tursunov, B. A., Akramov, X. A., & Ismoilov, D. (2022). Producing of the optimal ingredients of multi-component cements and research of the physical-mechanical properties. Open Access Repository, 8(7), 49-53.
12. Ganiev, A., Tursunov, B. A., & Kurbanov, Z. K. (2022). Prospects for the use of multiple vermiculitis. Science and Education, 3(4), 409-414.
13. Akramov, X. A., & Ganiyev, A. (2022). To Produce an Effective Composition of Vermiculite Plita and to Study the Coefficient of Thermal Conductivity. The Peerian Journal, 8, 29-37.
14. Mahmudov S. M., Aglamov O., Tursunov B. A. WALL FROM BRICKS, AERATED CONCRETE BLOCKS AND THEIR QUALITIES //Open Access Repository. – 2022. – Т. 8. – №. 9. – С. 95-99.

15. Истамов Ю. Б. и др. Г5 ва Г6 қурилиш гипсининг иссиқлик ажралиб чиқиш хоссасини ўрганиш //Science and Education. – 2023. – Т. 4. – №. 2. – С. 803-809.
16. Istamov Y. B. et al. Pardozbop keramik plitkalarni ishlab chiqarish //Science and Education. – 2023. – Т. 4. – №. 2. – С. 840-846.