# MODELING OF SEISMIC PROTECTION USING VISCOUS AND DRY FRICTION DAMPERS

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**Kalit so'zlar:** seysmik izolyatsiya; seysmik izolyatsiyalangan binolar va inshootlar, seysmik qarshilikni pasaytirish qatlami, faol seysmik izolyatsiya.

– **Аннотация.** Обеспечение сейсмостойкости зданий и сооружений - фактор, который необходимо учитывать, особенно при строительстве в сейсмически-активных районах. Цель настоящей статьи заключается в разработке методик количественной оценки надежности системы «основание – фундамент с устройствами демпферующего слоя (сейсмоизоляции и сейсмозащиты) -здание». Реализация этой цели позволит осуществлять обоснованный выбор наиболее надежного варианта устройств сейсмоизоляции и сейсмозащиты с учетом особенностей всех элементов системы.

**Ключевые слова:** сейсмоизоляция; сейсмоизолированные здания и сооружения; сейсмостойкость демпфирующий слой, активная сейсмоизоляция.

**Abstract:** Seismic resistance of buildings and structures is a factor that must be taken into account, especially during construction in seismically active regions. The purpose of this article is to develop methods for quantitatively assessing the reliability of the system "foundation - foundation with devices for a damping layer (seismic isolation and seismic protection) - building". The implementation of this goal will make it possible to make a reasonable choice of the most reliable option for seismic isolation and seismic protection devices, taking into account the characteristics of all elements of the system.

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

**Introduction.** Ensuring the seismic resistance of the "foundation - foundation - structure" systems in order to reduce damage from seismic effects is the most important problem of modern construction science and practice. The consequences of earthquakes are massive loss of life, huge material damage associated with the destruction of infrastructure, housing, industrial and transport facilities. In the last 50 years alone, as a result of devastating earthquakes, the number of human victims has reached more than 5 million; material damage is estimated at tens of billions of dollars. Up to 87 percent of the territory of the Republic of Uzbekistan belongs to seismically active regions with seismicity from 7 to 9 points according to 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 with the use of special seismic protection and seismic isolation devices. Traditional methods include increasing the strength characteristics of soil foundations, using more advanced design solutions, using modern technologies, high-strength materials, strengthening the supporting building structures of the buildings and structures in use, as well as taking into account the incoming initial information regarding the predicted seismic effects and the behavior of building elements under extreme impacts. Along with this, over the past 15-20 years, the use of unconventional methods of increasing the seismic resistance of structures, implemented in various designs of seismic foundations, dynamic absorbers of seismic vibrations, systems with degrading stiffness, has become increasingly widespread. 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-like nature of the design models of objects and seismic effects complicate the comparison of the results obtained and complicate the choice of the most effective version of seismic isolation and seismic protection devices.

A characteristic and important feature of the problem of comparative assessment of the reliability of foundations, foundations and building structures of structures with various options for seismic isolation and seismic protection devices is the incompleteness and unreliability of the initial information, both in relation to seismic effects and in relation to the properties and behavior of building elements with a combination of static and seismic loads.

As you know, the purpose of using any design of seismic isolation and seismic protection devices is to fulfill two basic requirements: to reduce inertial loads on the base, foundation and building structures and to limit the displacement of the building relative to the base. However, it is no less important, and ultimately the determining condition for the choice of seismic isolation and seismic protection devices, is to ensure the reliability of all these elements that form the building system. Until now, there are no methods for quantitatively assessing the reliability of such systems, which make it possible to compare various options for seismic isolation and seismic protection devices and select the most reliable one. This circumstance is one of the reasons hindering the use of various devices for seismic isolation and seismic protection - despite the fact that the results of theoretical and experimental (including field) studies in this area convincingly prove their effectiveness. The development of such techniques on the basis of an 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 isolation and seismic protection devices, taking into account the characteristics of all elements of the building system.

**Methods of research.** The purpose of this article is to develop methods for quantitatively assessing the reliability of the system "foundation - foundation with devices for a damping layer (seismic isolation and seismic protection) - building". The implementation of this goal will make it possible to make a reasonable choice of the most reliable version of seismic isolation and seismic protection devices, taking into account the characteristics of all elements of the system. The structure can be more robust, but not necessarily cost effective because both weight and inertial seismic loading can increase even more. New effective methods of seismic protection are required. Such solutions imply a change in mass and stiffness, damping of the system depending on its movements and speeds. To date, more than 100 patented designs for seismic isolation of buildings and structures are known. During earthquakes, foundation structures are rarely damaged. Despite this, the importance of foundations in ensuring the seismic resistance of buildings is great. Foundations are the first to perceive seismic shocks and transmit them to the upper parts of the building. The system "foundation-foundation-building" affects the change in the dynamic properties of the building, which accordingly changes the magnitude of the seismic loads acting on it. At the base of the walls of the preserved architectural monuments, soft pads (at the level of the top of the foundations) were found made of reed cushions, plastic clays and other local materials. The architects of Central Asia strengthened the weakened junction between the foundation and the plinth. The thickness of the seam here reached the height of a brick. During the construction of mausoleums in rocky soil, the pits were filled with loose earth, sand, and the foundation was erected along them. With this solution, the concentration of stresses in the foundations decreased, and the ground pad partially damped high-frequency ground vibrations during earthquakes. Other engineering solutions were used to reduce the impact of earthquake-vibrating foundations on the underground parts of buildings. Roller supports, foundations with spherical ends were proposed.

This article will consider the types of passive seismic protection of building foundations. Deformed model of the problem of systems of passive seismic protection of foundations according to the principle of their operation. (Fig. 1)

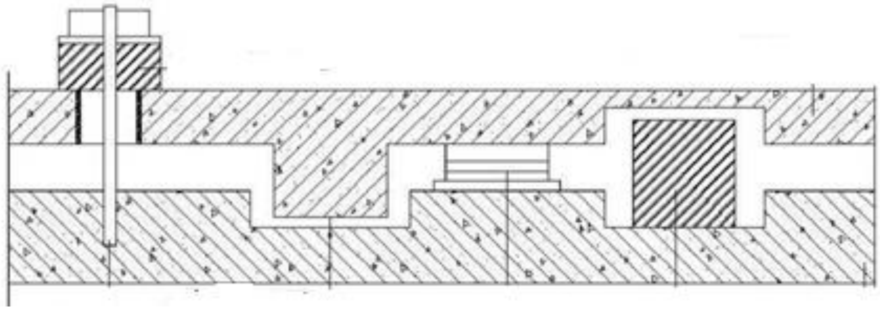

**Figure 1. Scheme of seismic insulating sliding belt elements.**

As a result of studying various combinations of friction pairs in the" sliding belt", an option was adopted using plates made of fluoroplast-4-a synthetic material with a low friction coefficient (tetrafluoroethylene) (0.04-0.1 for steel).

This material does not burn, does not rot, eats up to very high chemical resistance; does not react with concentrated acids and alkalis, does not rot. Maintains its properties in the temperature range from -60 to +60. (GOST 100007-80). A characteristic feature of the behavior of friction systems with horizontal sliding surfaces is the possibility of vibration shift, i.e.is a slow directed movement with a constant or slightly variable speed.

Vibrational shifts are associated with a number of factors, including asymmetry of the impact, a decrease in the effective (accurate) coefficient of friction under the influence of vibration, asymmetry of the supporting structure (one-way connections, yega limiters to unequal space, etc.), as well as the presence of small external forces in the absence of vibrations at the base (strong wind

Due to the effect of vibration displacement, structures with insulating foundations belonging to the first group can "protrude" from the sliding base surfaces under certain conditions.

It should be noted that at relatively low levels of exposure, significant residual shifts can accumulate in the joint venture. The inclusion of shift limiters in the operation of large-Intensity seismic shock leads to the formation of a kinematic pulse, as a result of which the structure can be damaged and even destroyed due to the fatigue of the seismic isolation system. To restore the initial state of the system, the use of additional high-power power equipment is required.

Structurally, sliding supports are made in the form of upper and lower windings, between which separators made of fluoroplast-4 are placed (film with a thickness of 0.5 mm and plates with a thickness of 8 mm; picture. 2).

The effectiveness of seismic insulation was assessed by comparing the parameters describing the state of the experimental fragment with two variants of the foundation: the tightness of the sliding supports and columns. At all stages of the test, the structures of the insulated structure reduce the seismic force by 2.5 times.

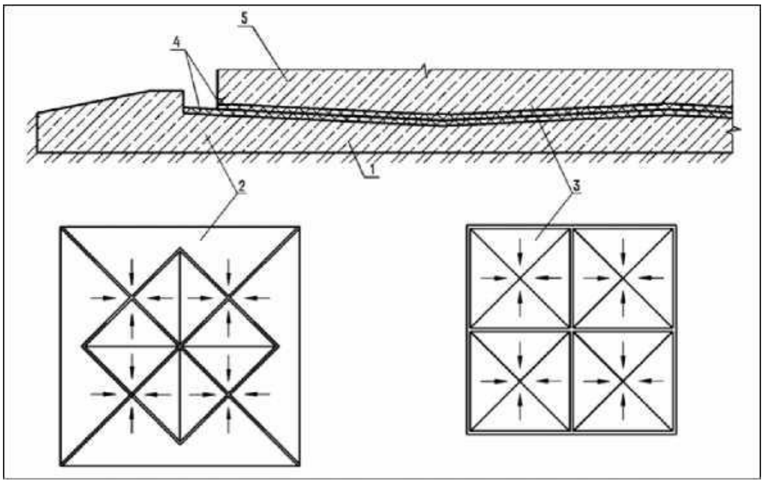


**Figure 2. Seismoisolated building structure.**

1-Foundation; 2 - Foundation side parts; 3-the bottom of the building; 4-fluoroplast plates; 5-building.

**Conclusion.** Conventional measures for seismic protection of buildings and structures are mainly reduced to increasing the bearing capacity of elements and structures. Such seismic protection is carried out in accordance with the building codes "Construction in seismic regions" [5]. At the same time, the measures performed do not reduce seismic loads on buildings and structures, and only take into account.

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