The condition of existing residential buildings with a sliding support in the foundation in the city of Bishkek

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Abstract: This article is devoted to the analysis of the current state of residential buildings with a sliding support in the foundation, in the city of Bishkek. The residential buildings under consideration were built at different times, according to different designs and different structural and planning schemes with seismic protection systems. As you know, with sliding supports, it is possible to significantly reduce the horizontal loads transmitted to the bearing above-ground structures of the building if it is possible for them to slip relative to the foundation. A detailed analysis and review of these existing residential buildings with a seismic-isolating sliding belt in the foundation using various structural and planning schemes and materials has been performed.

The constructed experimental residential buildings with seismic protection systems, according to the results of the work performed, it is recommended to use sources of energy absorbers, consisting of rubbing surfaces of steel, fluoroplastic and a layer of bulk material placed between them.

1 Introduction

At present, ensuring the seismic resistance of buildings and structures is becoming increasingly urgent due to the huge scale of construction in areas located in a zone of high seismicity. As is already known, with sliding supports, it is possible to significantly reduce the horizontal loads transmitted to the bearing above-ground structures of a building by allowing them to slip relative to the foundation. Part of the energy transmitted to the structure is spent in this case not to overcome the resistance of bonds in the structure, but to overcome the friction forces of sliding. In Japan, USA, CIS countries, former USSR republics and other countries dozens of different proposals on special systems of seismic protection have been developed, many of which are implemented in construction practice.

In the Kyrgyz Republic, the first technical solutions for foundations of buildings with fluoroplastic seismic insulating support were proposed by L.Sh. Klimnik and developed by V.P. Chudnetzov and L.L. Soldatova.

In some residential buildings with such seismic protection systems or with sliding belts in the foundation, engineering seismometer stations are installed. They should be installed:
2 Analysis of existing buildings with seismic-isolating sliding supports

The designs of existing buildings differ from each other. These buildings were built at different times, according to different designs, using different structural and planning schemes and materials. The intensity of seismic effects for all buildings except for buildings on Ivanisina Street 83, according to the "Map of complex seismic microzonation of Bishkek" is 9 points.

The first dormitory buildings built in the 1980s in Bishkek on Mesarosh Street with unfavorable soil conditions. Three-storey brick building built, has an H-shaped shape in the plan with the façade to the west. Each of the buildings of the dormitory has dimensions in plan 13.8 x 40.8 m. Structural scheme of the building of corridor type is solved with two internal longitudinal bearing brick walls, slabs-reinforced concrete. Staircases are prefabricated. The height of the premises is 3.0 m. The thickness of external load-bearing walls - 510 mm, internal - 380 mm, brick partitions - 125 mm. There are basement and cellar premises under the surveyed building. The general view of the dormitory building is shown in Fig. 1.

Fig. 1. General view of the dormitory building on street Mesarosh, Bishkek
The seismic-insulating sliding belt is located between the building foundation and the upstand. The structural elements of the belt are sliding supports, elastic limiters of horizontal displacements, horizontal reinforced concrete stops and vertical ties. Frunzegor project, in cooperation with CRIBS named after V.A. Kucherenko, designed five- and nine-story large-panel buildings based on the 105 series, equipped with two systems of seismic protection - the seismic isolating sliding support and the dynamic vibration dampener. Experimental large-panel houses were built in the Alamedin-1 neighborhood, 78, street Ivanisina 83, and in the 12th microdistrict [4].

The structural layout of the building is designed with load-bearing transverse and longitudinal walls in combination with unchangeable floor diaphragms. The connection of the load-bearing walls and floors is made by welding the reinforcement joints with subsequent grouting of the joints with fine-grained concrete. The buildings have one internal longitudinal load-bearing wall. The transverse walls are installed with variable spacing of 3.6 m and 2.7 m. The ceilings are formed of reinforced concrete panels, united in a single whole by welding of the reinforcement and grouting of the joints. To absorb the seismic loads, there is a uniform distribution along the length of the horizontal joint of the metal ties and continuous vertical reinforcement. In this case, in accordance with the standards, 60–70% of the calculated number of vertical reinforcements are placed directly at the intersection of the external and internal walls. The rest of the reinforcement is inserted in the wall panels of the direction in question. The vertical reinforcement distributed in this way is connected in a continuous bonding pattern by welding of the reinforcing bars within the keyed joints of the panels. Shear forces in the horizontal joints of the external and internal joint panels are taken up by dowels.

The building consists of block sections with dimensions in a plan of 10.8 m x 26.1 m. Foundations and basement walls precast-monicolithic concrete blocks with the inclusion of monolithic sections. The main differences of the adopted solution from the dormitory buildings are in the use of 3 mm thick fluoroplastic plates, precast-monolithic walls of the basement, and technical cellar, a more rational scheme of the sliding belt, and in the design of elastic limiters of horizontal and vertical movements. The general view of the building and the sliding belt is shown in Fig. 3.
Fig. 3. General view of the building and the sliding support of Alamedin-1, 78.

Then an experimental nine-storey large-panel house at street Ivanisina 83 was constructed according to the typical project No. III-105-7s for 54 apartments, with a total area of about 3.0 thousand m², developed by the Kirgizgiprostroy Institute. The size of the building in the plan is 39.6 m x 10.8 m, height 29.7 m.

Foundations and basement walls are made of monolithic reinforced concrete B10, the depth of the foundation is 3.5 m. Cross-section of the upper monolithic strapping 600 x 300 mm, 400 x 500 mm grill, concrete class B22.5.

The elements of the sliding support (except for the vertical ties) are located in the space between the upper web and the crossbar. The general view of the building and the sliding chord is shown in fig. 4.

Fig. 4. General view of the building and the sliding support at street Ivanitsina 83.

In 1989-90, buildings were built in the 12th micro district according to the project of "Kyrgyzgiprostroy". Nine-storey, large-panel residential buildings of the 105 series divided by anti-seismic joints. The size of one block in the plan is 39.6 m x 10.8 m, height 29.7 m.

Foundations and basement walls are made of monolithic reinforced concrete B10, the depth of the foundation is 3.5 m. The cross-section of the upper monolithic strapping 600 x 300 mm, 400 x 500 mm grill, concrete class B22.5.
The experience of designing and constructing experimental large-panel buildings in Bishkek on sliding supports and the results of their full-scale tests have revealed the feasibility of constructive solutions of sliding supports with inclined sliding platforms. Their application led to a simplification of structures and allowed for the development of a prefabricated version of the sliding support. The developed solution was used in the design of large-panel buildings in the twelfth microdistrict [8]. The general view of the building and the sliding support is shown in Fig. 5.

Fig. 5. General view of the building and the sliding support of the 12th microdistrict

The space-planning and design solutions adopted in residential building designs should be analyzed for compliance with the requirements of the current CD norms [15].

3 Conclusions

- All buildings in Bishkek with sliding belts are in normal operating condition;
- Since there have been no major earthquakes during the existence of these buildings, there is no visible damage;
- The studies conducted reflect the issues related to further study of the effectiveness of special seismic protection systems and expand the scope of their application;
- The currently used seismic isolation belts in the foundations in the Kyrgyz Republic are the most effective;
- But in spite of sufficient practical experience, they have not yet been massively spread.
The use of energy absorbers of dry friction is rational, as it involves the rubbing surfaces of stainless steel, fluoroplastic, and a layer of loose material placed between them.

In the conditions of realization of energy absorbers, it is recommended to use energy absorbers of dry friction. It is advisable to use energy absorbers of dry friction, consisting of the rubbing surfaces of stainless steel, fluoroplastic, and a layer of loose material placed between them.

It is recommended to proceed from the conditions of realization of energy absorbers.

References


