MAIN ISSUES OF IMPROVING THE SEISMIC RESISTANCE OF BUILDINGS

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Abstract: *The article analyzes the terrible earthquake that occurred in Turkey in 2023 and its consequences, as well as the causes of damaged buildings from a structural point of view. It also provides information about the location of tectonic plates in the country and their movements. The article contains opinions on measures to prevent the repetition of the mistakes made in the reconstruction of buildings destroyed by the earthquake in Turkey and measures to protect the population from seismic hazards.*

Keywords: *Seismic hazard, seismic activity, tectonic plates, aftershock, seismic wave, modernization, safety of buildings, seismic strength.*

INTRODUCTION

Ensuring the reliability of buildings and structures in seismically dangerous areas remains one of the urgent issues of modern construction. Soil types and other adverse conditions often complicate the design and construction of seismic areas. The most dangerous situation occurs in the construction of buildings and structures in conditions of high seismic activity. In particular, one of the regions with such complex conditions is Turkey.

About 50,000 people died and more were injured as a result of a strong earthquake that occurred in Turkey and Syria on February 6 of this year. Turkey is located in a seismically dangerous area, and this area experienced strong earthquakes in 1939-1999. In general, at least 76 earthquakes have been recorded in this country since 1900, and the number of their victims has reached more than 90 thousand people.

To understand why earthquakes occur repeatedly in Turkey and some other regions of the world, it is necessary to consider that the earth's crust is a kind of puzzle, and at the same time it has a relatively dynamic nature consisting of many parts, that is, it consists of several huge oceanic plates and several continental plates of the earth's crust. should be taken.

In seismically active areas, it has been known for a long time, but it is still impossible to accurately predict the time of an earthquake. But we can prepare for them.

Results: As can be seen from the rates, some of the collapsed buildings may have been built before modern earthquake safety regulations came into force. These buildings are not designed for earthquake forces of this magnitude (Figure 2).

Earthquakes are extremely powerful, and due to their close proximity to the Earth's surface, they generate a large amount of destructive earthquake power. We need to carefully study the fallen buildings and learn from this terrible event. Only in this way can we make our buildings and cities safe against future earthquakes.

At the same time, from the point of view of the safety of buildings during earthquakes, not only the construction method, but also the ground surface on which the buildings are built plays an important role. Therefore, the harder the soil is, the better. If the soil layer is made of granite, it is a solid ground , if it consists of sedimentary rocks, such as sand or clay, it is considered unsuitable as a soil.

According to experts, adverse conditions related to increased surface movement are more likely to occur in soft soils, which cause a condition known as the "crush effect". As an example, if you press down on a sandy soil over and over again, water will collect there, "and the soil will become unstable."

According to experts, the amazing collapse of houses in Turkey can be due to various reasons. In particular, geodesists and designers say that in some cases in the republic, a beamless frame system was used, relying only on columns without supporting beams. As a result, a unified spatial system that received horizontal and vertical seismic forces was not created.

Experts say that one of the main reasons is that the built houses may have been built taking into account weaker earthquakes, or it is concluded that they lost the necessary seismic strength during the use of the buildings. Even if the building is built correctly, after some time, due to the influence of natural conditions, a case of loss of seismic priority can be observed. Therefore, it is necessary to develop a system of continuous monitoring of the technical condition of houses in seismic areas and to implement its control.

Before the start of construction, it is necessary to conduct additional special seismological and seismotectonic studies by the ordering organizations. Traditional methods of increasing the seismic resistance of buildings and structures include the creation of a reinforced concrete system, reinforcement with shotcrete, the introduction of additional reinforced concrete and metal frames, and the use of reinforcement systems based on external reinforcement using carbon and basalt fibers. Most importantly, one should not forget about the quality control of construction materials brought to the construction site.

Failure to comply with building regulations.

According to the latest regulations, builders in earthquake-prone areas must use high-quality concrete reinforced with steel cores. Columns and beams must be distributed in such a way as to effectively absorb shocks caused by ground shaking, but these rules are not always sufficiently followed.

Experts say that modernization of existing buildings has been carried out very rarely, and at the same time, construction standards have been seriously violated in new buildings.

For example, Japan, a country with a high risk of earthquakes, has very strict building codes and standards. Building safety requirements differ depending on the use of the building and the proximity of the buildings to areas of high earthquake risk.

The 7-8 magnitude earthquake that occurred in Turkey was included in the catastrophic category. Of course, these catastrophic earthquakes cause serious damage to buildings on earth.

Many defects were found in the structures of the houses destroyed during the earthquake in Turkey. Among them, serious defects were found in the structures of the buildings destroyed by the earthquake. The prosecutor's office confirmed that in at least one province affected by the earthquake, the houses were built in violation of laws. Experts pointed out that one of the reasons for such a large number of victims is the poor quality of construction.

Experimental tests have shown that the content of sand and gravel in concrete does not meet the standard requirements. It is known that the size of pieces of gravel in the total mass of concrete should not exceed 3 cm, but in some cases "fist-sized" stones were found in the concrete. Of course, the use of material with such properties significantly reduces the strength of concrete. A significant part of the new houses in Turkey are also built without considering the requirements of seismic safety.

Some of the buildings are split in half, which shows that the construction materials are of extremely poor quality.

Experts say that the reason for the large-scale destruction of buildings is the insufficient assessment of the danger level for this area, as well as the lack of regular monitoring of the safety of buildings by the relevant local authorities.

The earthquake is the first known strong seismic event in the area, so it was unexpected. Seismic risk was not accurately assessed, and as a result, houses were designed and built for a lower level of seismic exposure, which led to much greater destruction. Buildings could not withstand the blows of such a force.

How to make houses stronger. One of the important ways to ensure the priority of buildings in an earthquake-prone area is to install structures on pile foundations. Naturally, when such a constructive solution is used, the probability of the earth shaking vibrations affecting the building during an earthquake is less.

Large-scale damage is not only related to the structure of the building. It is important to connect the load-bearing elements in such a way that during ground shaking, only a certain deformed part of the building slightly changes its linear position.

The magnitude of the earthquake that occurred in Turkey was very large. According to Mehdi Kashani, the epicenter of this earthquake did not occur at a great depth. If it was located deeper, the tremors caused by the collision of tectonic plates would be felt much weaker, and it would take some time for the vibration to reach the surface of the earth.

The construction method is more important than the construction materials. Mehdi Kashani says that construction materials are not an important element when it comes to

earthquake resistance of buildings. According to him, the construction method is crucial. Properly designed concrete can be a good foundation for, say, an earthquake-resistant building, Kashani says. But even a house made entirely of concrete can collapse if the buildings are poorly designed and constructed.

Even if the building is built correctly, after some time, under the influence of natural conditions, a situation of lack of seismic strength will arise. Therefore, the system of monitoring the condition of houses in seismic areas should work well.

Many old building restoration projects in Turkey are notable for the fact that they focus on building additional floors on top of the building. This increases the additional load on the buildings and ultimately makes them unable to meet the seismic resistance requirements. , it was said that they need to be comprehensively reconstructed.

Then there was an earthquake and thousands of buildings collapsed. In the city of Antioch, the consequences of the disaster were so terrible that almost nothing remained of the old buildings. But some of the newly built buildings are crumpled like box houses. However, the modern constructions used had to meet the requirements of seismic safety.

Analyzing past earthquakes, the following were identified as the causes of the devastating December 1988 earthquake in Armenia: poor welding of metal structures, poor quality concrete mixes, poor design solutions, and extremely low utilization rates of buildings. Unfortunately, the same terrible design solutions have been adopted in Turkey.

According to experts, in a number of cases in Turkey, without supporting beams, the analysis shows that none of the buildings built by the Turkish Housing Authority (TUJB) collapsed. It turned out that none of the 133 thousand 759 houses built by this organization located in the earthquake area were even damaged (Figure 5).

A system built directly on columns was used. In seismic conditions of 9 points, this system is generally an unacceptable structural solution. In particular, in the buildings built as open-air shops on the first flexible floor, it can be seen that there are no walls that can absorb the loads from the second and upper floors. It is natural for the buildings built on the basis of such a system to collapse (Fig. 3).

It should be noted again that most of the constructed buildings have been destroyed due to soil conditions and compaction and lack of engineering services.

Experts say that most of the collapsed houses were built before 1999, that

Figure 3. A building built on the basis of a beamless system.

Experts say that most of the collapsed houses were built before 1999, that is, before the deadly earthquake in Turkey. After this tragedy, building regulations were tightened in the country's earthquake-prone areas.

After the tragedy in 1999, the Turkish government introduced new building codes and a mandatory earthquake insurance system. However, the earthquake that occurred in February this year showed that many buildings were built before 2000 years.

According to the experts, it was found that some pieces of foreign elements, pieces of newspaper, as well as pieces of polystyrene were present in the foundation. According to them, the presence of foreign objects in the foundation had an extremely negative effect on the strength of the entire building, which led to its destruction due to underground tremors. Also, the result of more detailed analysis showed that low-quality materials were used in the construction of the foundation.

As you can see from the photos, the houses, which were destroyed to the foundation, built without specific regulatory requirements, testify to the presence of serious deficiencies in the load-bearing columns.

All the buildings built by TUJB remained usable after the earthquake. Because the buildings built by TUJB were built on an earthquake-resistant seismic protective foundation, and the entire load-bearing system was built on this device (Fig. 6).

When using this structural system, buildings do not collapse during an earthquake. It is certain that this building will not be damaged if construction work is carried out by qualified construction engineers based on adequate structural requirements that are suitable for seismic areas. In particular,
in this case, during an earthquake, the supporting structures inside the buildings may be damaged, but no buildings will collapse.

Thanks to the seismic isolators installed in the floors of the maternity hospital and the children's hospital, the buildings withstood the
earthquake without any damage.

Seismic-strengthened buildings are also based on modern design in China, where even skyscrapers have survived several serious earthquakes in recent decades.

Figure 4. Before and after: A recently built house in Iskandar.

Figure 5. Buildings built by the Turkish Housing Authority

Figure 6. A building installed using seismic isolators.

Our republic has an outdated seismic fogging map developed in early 1996. Naturally, this map is now outdated, and in the future, it is necessary to carry out certain tasks based on its re-study. In particular, when designing objects by region, the parameters should be clarified, and detailed fogging and micro fogging should be carried out.

If buildings are designed taking into account the level of seismicity of the area, on the basis of certain reinforced structures, single diaphragms, seismic protective supports, etc., they can withstand earthquakes. If there is an error in the calculations, if the calculation and design conditions are not taken into account, the building will definitely collapse during an earthquake.

Since high-rise buildings are not a high priority, it is necessary to pay special attention to the design of buildings with a large spatial structure. In developed countries, special attention is paid to monitoring the technical condition of buildings, and today, modern monitoring devices for buildings have been developed.

James Jackson, Head of Science at Cambridge University, said: “It's important to understand that earthquake prediction is not necessary to save lives. You can save them only by building buildings that can withstand earthquakes. Buildings kill people, not earthquakes."

Therefore, in order to build earthquake-resistant buildings and structures in our country in the future, it is urgent to carry out the necessary research to solve the following important issues:

- Creation of a perfect system of building monitoring;
- development of the seismic activity map of the regions based on various bases;
- development and practical use of tested seismic protection tools designed to reduce seismic impact;
- development of special constructions of foundations;
- to solve the issues of placement of buildings (microseismic fogging) taking into account soil parameters.

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