Earthquakes and Their Impact on Buildings and Structures

Qurbonov Jakhongir Komiljon Ogli

Jizzakh Polytechnic Institute, Faculty of Architecture and Construction
Student of the II stage of "Construction of buildings and structures".
zahongirqurbonov836@gmail.com

ABSTRACT

The article analyzes earthquakes and their impact on buildings and structures.

Keywords: Earthquakes, earthquake resistance, seismic forces.

Earthquakes are one of the most devastating natural disasters that have plagued mankind since time immemorial. That is why there are various myths about earthquakes. Legend has it that the causes of earthquakes are sometimes linked to divine powers, human destiny, or giant animals.

But since ancient times, advanced thinkers have tried to explain the causes of earthquakes in terms of natural phenomena. The aftermath of the powerful earthquakes has shown that this process can cause great material and moral damage to humanity. Buildings and structures, especially in rural areas, can suffer huge losses, as most low-rise buildings are built and constructed of raw and baked brick. Brick buildings are very fragile and unstable in terms of earthquake resistance. But high-quality brick buildings can be well preserved.

Earthquake studies are important in assessing the seismicity of building structures. Researchers who have studied the effects of earthquakes say that the shape of buildings in history also has a significant effect on their seismic resistance. Historically, square, rectangular buildings were less damaged than Г-shaped, П-shaped, and Ш-shaped buildings.

The great scientist Abu Ali ibn Sina (980-1037) first tried to explain the causes of earthquakes in Central Asia on a scientific basis in his famous book Al-Shifa. The great thinker and scientist Abu Rayhan Beruni (972-1048) also wrote a rich pen on the study of earthquakes. Although this work differed somewhat from the modern notion of the causes of the earthquake, it was a bold step towards the mythical notion.

One thousand years ago, Beruni wrote, "Continents move slowly, approaching or moving away from each other, like the leaves of a tree floating on water." In the 20th century, space observations by American scientists in spacecraft proved Beruni's view to be correct. These observations confirmed that the continents move 5-7 cm per year relative to each other.

Great changes are taking place in the field of science and technology in our country. Industry, agriculture and transportation are developing every year, new territories are being developed due to population growth, and the population is growing in low-density areas. The fact that such changes also occur in seismic (seismic) areas puts new demands on experts in the field of earthquake resistance of buildings and structures.

Accordingly, in recent years there have been significant changes in design solutions and construction methods; new efficient building materials, large-scale structures appeared, and the weight of the loads acting on them increased. All this has led to the acceleration of research in the field of seismic stability, the improvement of methods for calculating the impact of seismic forces on buildings, the further development of earthquake prediction.

If we look at the development of the theory of seismicity, we can see that in recent years, theories of probability have become more widespread, a more accurate approach to estimating the magnitude of seismic effects, taking into account the post-elasticity of structural elements and other factors. 'ramiz.

In addition to theoretical research, great work has been done in the field of experimental research. Seismometric stations have been set up in a number of countries, including Uzbekistan. Based on real earthquake records standard accelerometers are used to solve the differential equations of seismic oscillations. In addition to traditional passive methods, active methods of increasing the earthquake resistance of buildings and structures are also developing. Taking into account the conditions of the country, our specialists and scientists are developing the theoretical foundations and methods of active earthquake resistance and are gradually implementing them in practice.

On behalf of the Academy of Sciences of Uzbekistan under the leadership of Academician TR Rashidov developed the "Concept of seismic safety in Uzbekistan" for 2008-20015. One of the priorities of this "Concept" is the practical application and development of the use of active seismic protection in the construction of buildings and structures in Uzbekistan.

Natural testing of buildings and structures has been widely developed. It is noteworthy that some of the tests were performed on program-controlled seismic platforms. However, there is still much to be said for the fact that the problem of earthquake resistance of buildings is a completely solved problem. There are still many problems to be solved.

To understand the causes and nature of earthquakes, it is necessary to know the geological processes that take place on the earth's surface. Scientific observations on the earth's surface have shown that the earth's crust is in constant but very slow motion: some parts of the crust rise, some fall, and some move horizontally. This movement of the earth's crust is called tectonic movement.

During an earthquake, the movement of soil on the ground of buildings and structures becomes very chaotic and complicated. American seismologist S. Clemenson likens the movement of the ground to a chaotic flight of a propeller. In 1887, Japanese scientist Professor S. Sekiya created a spatial model of a point on the ground using a soft wire to move it during the first 20 seconds of an earthquake (Figure 1, a). This experimental model is based on seismograms of the January 15, 1887 earthquake in Japan. The model is about 12.5 times larger than the actual ground movement. The actual displacement of the soil was about 0.8 cm. Figure 1.1, b, shows a trace of a kitchen tile left on the floor during the 1933 Long Beach earthquake. As can be seen from the pictures, the movement of the soil during an earthquake is very complex, so it is not easy to express it mathematically.

In many parts of the earth's crust, there are cracks called geological faults. Fractures are caused by compressive, tensile, or shear forces. When it comes to the causes of earthquakes, most seismologists agree that the theory of elastic release or elastic return, developed by the American scientist G.F. Reed, is closer to reality. G.F. Reed developed this hypothesis as a result of a detailed analysis of the transverse displacement of 300-400 km along the giant San

Andreas Basin as a result of a strong earthquake in 1906 in San Francisco. His theory is based on the sudden release of the elastic energy of deformation. The following is an example.

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An earthquake in San Francisco in 1906 depicts the movement of a fence wall along the San Andreas Basin. 9 To get a deeper understanding of the mechanics of an earthquake source, let's take a look at the following small experiment. Take a simple glass test tube and insert a spiral spring so that the tip protrudes. We put another test tube, slightly larger and longer in diameter, with the bottom of the test tube in the oil tube, so that half of the oil flows out of the test tube. So we have a simple model of the rocks around the source of a future earthquake. To create a model of the source, we put two wooden boards on top of each other. The contact surface of the slabs is geologically broken, which plays a role. We create the forces that form in the earth's crust with our hands. Holding the outer tube, we place the protruding end of the spring on the side surface of the top plate and try to move it evenly. However, the board does not move smoothly, and the board does not move for some time, even though the outer tube moves towards the board. However, it is possible to observe the contraction of the spring and the gradual displacement of the oil between the walls of the two test tubes. Thus, in "rocks" elastic tension (shortening of the spring) and plastic deformation (penetration of a small test tube into a large one) increase. The friction forces help the board to resist. However, when the spring contracts and accumulates an elastic tension that can withstand the frictional forces between the plates, the top plate instantly moves a short distance - a "break" occurs, i.e. an "earthquake" occurs. The spring expands partially (incompletely) and the tension in the arm decreases. The oil stops flowing under pressure for a while.

However, the process of elastic-plastic deformation of "rocks" continues. After a while, the "fracture" will shift again, and the next "earthquake" will occur.

In real geological conditions, it will take decades for the next shift to occur.

Obviously, this model of the source of the earthquake is a very simplified and approximate model. In fact, the source is surrounded on all sides by rocks, which resist the sliding blocks during sliding.

The location of the break is called the hypocenter or earthquake focus. The surface projection of the hypocenter is called the epicenter. Repeat land. Schematic of the theory of elastic return on the causes of earthquakes. 10 shakes are called aftershocks. The causes of aftershocks are similar to those of major concussions. Along the geological fault, some obstacles (for example, friction, roughness of sliding surfaces) resist the movement of the two blocks, the movement stops and the broken connections are partially restored.

The part of the energy that is not wasted creates tension in the new connections, and after a while, the connections become unstable, and there are new interruptions, new shocks. The epicenter was reported below the ground, however; no tsunami alert was issued. However, there are also aftershocks that are closer in magnitude to the main earthquake.

The earthquakes we have seen are called tectonic earthquakes because they depend on the tectonic movement of the Earth's crust. This group of earthquakes is widespread and is the most dangerous for buildings and structures. The other two groups of earthquakes are related to volcanic eruptions and karst events. They are less common in nature than the former. His strength is also a bit weak.

Earthquakes are divided into the following types depending on the depth of the source. When the depth of the source is up to 70 km, it is called a normal earthquake. Most of the sources are within this boundary. Earthquakes with a depth of more than 300 km are deepfocus earthquakes. Such earthquakes are rare, occurring mainly in the depths of the ocean; characterized by the strength of its energy. The depth of the source of intermediate earthquakes is 70-300 km. The source of the Carpathian earthquakes is located at this depth.

Let's get acquainted with the consequences of some earthquakes in our country. In 1620, an 8-9 magnitude earthquake in the ancient city of Aksi (near Namangan) completely destroyed the city. Large population under the rubble Figure 2.2. The sliding of the fence wall along the San Adreas fracture. Figure 2.3. Experience in earthquake source mechanics. 11 left. As a result of the strong earthquake, the Syrdarya River overflowed and surrounded flooded. Huge trees collapsed by their roots. Repeated earthquakes lasted 6 months.

One of the most terrible earthquakes in the territory of Uzbekistan occurred on December 16, 1902 at 1000 o'clock in the morning in Andijan. That day, three powerful earthquakes devastated the city and its environs. The strength of the first impulse was 8 - 9 points, 1-1.5 minutes later the second impulse with a force greater than 9 points and the third impulse of 8-9 points, which occurred about half an hour later, hit the city. completely destroyed. The aftershocks lasted several months. For the first two days, the ground shook almost incessantly. Then the number and strength of the tremors gradually decreased. There have been occasional earthquakes. The quake killed more than 4,500 people. The damage to the gold account amounted to 12 million soums.

At that time, Andijan was built on the basis of buildings made of cotton, raw bricks, concrete and baked bricks. Consequently, the earthquake resistance of the buildings was not the same, of course. The aftermath of the quake showed that the brick buildings were more durable than others. Guwala-filled buildings are second to none. In terms of seismic resistance, raw brick and cotton-walled buildings are next.

The quake damaged many brick buildings in Tashkent. According to experts, one of the reasons for the damage was the poor quality of bricklaying and the lack of anti-seismic measures. In a number of buildings without anti-seismic belts, the longitudinal walls are separated from the transverse walls. The bricks did not stick well because the grade of the mixture was too low (less than 10). Buildings with anti-seismic belts are almost undamaged.

The Tashkent earthquake occurred on April 26, 1966, at 5:23 local time. Power at the epicenter 8 points, magnitude 5.1, source depth ~ 8 km. The epicenter was located in the center of the city, and as the distance from the center decreased, the magnitude of the earthquake decreased and was about 5 points at a distance of 7-8 km from the center. The main and strong earthquakes lasted 6-8 seconds, and the roar of the ground was accompanied by earthquakes. Cracks up to 2 cm wide and up to 20 m long appeared in the epicenter. The quake was triggered by a tectonic fault in the ground.

In the center of the city at that time there were a lot of 1-2-storey buildings made of mud bricks. The bricks were mostly made of mud, and many buildings did not use anti-seismic measures. Although the collapse of the walls was rare, the 12 walls had large cracks and fissures in the form of slopes and horizontal views. Elements such as heavy cornices and parapet grilles were severely damaged, and some collapsed.

Brick buildings in the 8-point area were also severely damaged. There were cases of separation of longitudinal and transverse walls, which occurred along the seams. The anti-seismic belts of the buildings saved the walls from collapsing.

Schools, hospitals and administrative buildings with many windows, long corridors and long distances between the transverse walls were severely damaged, even in the 6-7 point area. In the 7-8 point zone, the upper floors of the building are more damaged than the lower floors.

More than 30 buildings built in recent years are SNiP II-A. Although it scored 8 points on 12-62, the reason for the significant damage was the poor quality of the mixture. Investigations showed that the brand of the mixture used in the bricklaying was much lower than indicated in the project. This, in turn, caused serious damage to buildings. This means that no matter how perfect the design and calculation, if the quality of construction work is low, the seismic strength of the buildings will not be sufficient.

So, as much as possible, we talked about three strong earthquakes in the first quarter of 2010 in Latin America, a small part of our planet. The list could go on and on. However; we think that's enough to get the point across. In order to visualize the geography of earthquakes on a larger scale, we attach the following table. This table provides information on earthquakes during the first 10 years of the 21st century.

Conclusion.

This sample article describes in detail the measures to be taken in rural areas in connection with the Year of Barkomol Avlod in 2010, including measures to increase the seismic resistance of residential, public, agricultural buildings and structures.

It describes the seismic requirements for low-rise housing, public and agricultural buildings and structures in rural areas, their optimal scale and planning solutions, measures to increase seismicity.

Methods for determining seismic forces and calculating buildings for these forces are also covered.

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