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Impact of Earthquakes on Artificial Structures

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Annotation: This article provides information on the effects of earthquakes on bridges and presents the results of analysis.

Keywords: bridge, earthquake, effect, restoration, bridge support, piles. The construction of buildings and structures, as well as the design of various structures are being carried out in Uzbekistan, including many artificial structures such as reinforced concrete girder bridges, overpasses, and viaducts, underground and above-ground metropolitan areas [1-3].

Regardless of the presence of significant advances in the Design, Calculation and operation of various structures in seismic regions, the theory of earthquake resistance of Bridges is far behind in relation to the general earthquake resistance theory, since the share of damage in Bridges is less than the damage of structures in areas that have suffered casualties from earthquakes, which leads to the fact that Humanity has appeared to live under the influence of an earthquake, one of the natural disasters. During his conscious activity, lnson has been “fighting” against this effect in one way or another. It is able to reduce the damage caused by natural disasters to a minimum, even if it does not manage to prevent natural earthquakes. This is called Dynamic Force when the force acting on a building or artificial structure changes its value and the position it occupies over a relatively short period of time. From the effects of such force, time-varying deformation and migration occurs in the system as shown in Figure 1. From the action of dynamic force, acceleration occurs at the points of the elements of the system, and as a result, inertial forces are generated in the elements. The amount and direction of tension, deformations and migrations that occur in a building or artificial structures due to the action of dynamic forces becomes variable over time. In the process of exploitation of buildings and structures, they are influenced by various dynamic forces. Examples of these are wind and moving forces, forces acting on the surface of a building or artificial structures from the blast process, seismic forces acting through the base grunt [7, 8].

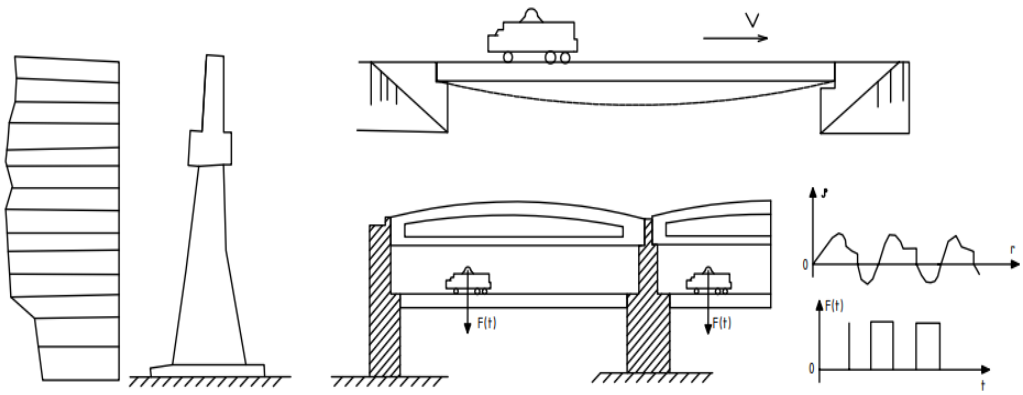

Figure 1. Dynamic forces acting on artificial structures Causes of seismic damage to artificial structures those below:

1. Horizontal seismic forces generated from oscillatory movements of structure masses resulting from vibrations of ground grunts;

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2. Vertical seismic forces caused by the vertical organizer of the seismic oscillations of the grunt;
3. The seismic horizontal pressure of the grunt on the walls and columns of the trailer causes additional seismic voltages in the structures;
4. Increase in Mountain printing on the obdelka of tunnels in the conditions of an earthquake;
5. Seismic pressure of water (hydrodynamic) on intermediate supports of bridges;
6. A decrease in the lifting capacity of some grunts during an earthquake [7, 9].

During an earthquake, the operation of the bridge structure can be affected by the proximity of the bridge to the Earthquake Center and the location conditions. Both of these factors will depend on the intevsivity of earth tremors and earth deformations, as well as the variability of these effects along the length of the bridge. During the 1995 Hyogo - Ken Nanbu (Kobe) earthquake, a collapse occurred on high roads and bridges adjacent to or built within Osaka Bay. Crashes were caused by several types of factors [10, 11]. First many bridges were built on Sand-Gravel terraces (alluvial deposits) located on a gravel-sandy-clay grunt with a depth of less than 10m, a situation that led to the expansion of the rocks.

Figure 2. 1995 Hyoge-Ken Nanbu earthquake. Nishinomy-ko bridge

Also in Figure 3 is the fall of Higashi-Nada viaduct, in Route 3

It has been shown that 637 Poles suffered moderate to large damage, more than 1,300 intermediate devices were damaged, and about 50 intermediate devices required replacement.

Figure 3. 1995 Hyoge-Ken Nanbu earthquake. Higashi-Nada viaduki

The main load falling from the bridge is received by the supports. The supports must be flexible enough to be able to withstand the deformations they are exposed to. Consequently, during strong earthquakes, the supports undergo large noelastic deformations [12]. Failure of the support can lose the

ability to carry a vertical load. Breaking the support is the main cause of bridge collapse. Incorrect bending of details on concrete supports can lead to malfunctions that combine several mechanisms, as shown in Figure 4.On steel supports, however, local turns cause artificial structures to slowly collapse. Such malfunctions are especially common on old bridges.

Figure 4. Hanshin express road

In the next example, we can see the impact of earthquakes on bridges. One such earthquake occurred in Taipei on September 18, 2022. As a result of an earthquake of magnitude 6.8 (Figure 5) caused the collapse of the Gaoliano bridge in the city of Hualyan. The bridge was completely restricted to the movement of cars [8, 10, 11].

Figure 5. Taipei 2022 Gaoliano bridge

Bridge supports are more prone to damage such as subsidence and displacement. When the grunt under the foundation is to some extent soft, attention should be paid first to such damage. The amount by which the bridge sinks or shifts each of its supports can vary in different places on the river bed. Therefore, it is necessary to take into account the specific features of grunts in each place [13-16]. Even when one part is a stand-alone support standing on solid ground and the other part on soft ground, the structure can suffer uneven subsidence that causes only a slight deviation. As an example, Figure 6 shows the collapse of intermediate devices of large bridges and damage to their supports during an earthquake.

Figure 6. Consequences of the Taiwan earthquake (1999.)

In conclusion, it can be said that in the process of an earthquake, movements along the planes of tectonic disorders cause burrs and displacements that go up to ten or more meters. Such phenomena also lead to damage to bridges and tunnels. In most cases, damage to structures is formed as a result of the joint influence of the above reasons. Attention should be paid to the following, taking into account these injuries:

1. The application of modern methods in the design of seismically solid buildings and structures is a requirement of the period. Naturally, with an increase in the scale of construction, the costs of antiseismic activities will also increase. Therefore, in earthquake-resistant construction, it is necessary to pay attention to the fulfillment of the requirements of the state of seismic tension of structures at the lowest cost;
2. It is necessary to study the experience of bridging the developed countries in the construction of artificial structures in our country. Solving the problem of ensuring the earthquake resistance of buildings and structures will lead to a great social effect in the future by preserving the life of people and the material wealth that has arisen in society with great love.

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