

# ARMENIA EARTHQUAKE

**REPORT OF THE SOVIET EARTHQUAKE INVESTIGATION TEAM ON THE ARMENIAN EARTHQUAKE OF DECEMBER, 1988**

Provided by Mihran Agbabian, University of Southern California, January, 1989. (The original was translated verbatim into English, and subsequently edited -- G. Brady)

**FINDINGS AFTER THE INVESTIGATION OF THE 1988 SPITAK EARTHQUAKE, AND SUGGESTIONS IN SECURING SEISMIC STABILITY IN BUILDINGS AND STRUCTURES, AND IN PROTECTING THE POPULATION AND SAFETY OF UNIQUE EQUIPMENT DURING AN EARTHQUAKE**

I. The catastrophic earthquake, which occurred on December 7, 1988 at 11:42 local time, in the northern part of the Armenian S.S.R., brought about destruction and damage of most buildings and structures in cities and villages, as well as innumerable deaths. Initial results of the investigation of the earthquake reveal that damage was specific. Most framed and nine-story framed panel buildings were completely destroyed. Stone buildings, even when constructed with antiseismic measures, were considerably damaged, or had collapsed. In large areas there was great deformation of railroads and distorted tracks. Rockfalls occurred in the mountains. Wide cracks appeared in the soil. Bridges were greatly damaged.

In the city of Leninakan, industrial buildings and trade centers completely collapsed. The chemical plant in the city of Kirovakan was wrecked. In Spitak, commercial buildings were completely destroyed. Educational institutions such as schools, nurseries, maternity wards and hospitals, in most cases, collapsed. Village buildings and individual homes in Spitak and its environs were destroyed. There were cases of settlement into the soil of buildings of 1-3 stories.

All of these facts reveal that the intensity of the earthquake shaking in the area of the epicenter was not less than 10 (on the scale in use in the USSR) and it was 9 in Leninakan. The recording on the seismometer at Leninakan (USS GOST 6249-52) confirms this.

The reasons for the destruction could have been insufficient study of the seismic situation, insufficient consideration of real geological/engineering conditions, duration, direction and spectrum of the earthquake ground motion, as well as low quality of construction. The provision of intensity measuring devices in the areas where cities and villages suffered the most should also be considered, as well as some other provisions described in standard documents.

This earthquake could be called the Spitak earthquake of 1988.

II. This earthquake demonstrates the exceptional urgency and importance of undertaking undelayed measures in procuring seismic resistant buildings and structures, and to protect the population and unique equipment in case of an earthquake.

The scientific research being conducted in the present Program 074.03, regarding the reinforcement for seismic resistance, is insufficient, with lack of consideration and inadequate financing.

It is extremely important to develop larger and fundamental scientific research programs, in this area, with an effort of research work in the institutions situated in the area of TSNSSK, and detailing the more important responsibilities of the republics which are subject to earthquakes. The research program should provide for the creation of mathematical models, taking into account realistic working conditions of buildings and structures during earthquakes. Specially, interaction with the soil, characteristics of seismic waves with wider use of automated design (project development) systems, including further development

of scientific approaches and new means of engineering analysis, calculation and rate setting of specific buildings and structures for seismic effects. Creation of an experimental basis and detailing effective methods of experimental research, in order to improve the seismic resistance of existing buildings and structures, as well as on very large models during strong shaking, and also on shaking tables with programmed operations, or with the help of vibrating machines. With this in mind, it is imperative to take measures to secure the necessary equipment and apparatus locally as well as from foreign countries.

It is necessary to have a completely new approach for the recording of strong earthquakes, and towards engineering strong-motion recording in buildings and structures.

It is important to have higher standards for scientific construction of seismological instrumentation as well as seismic resistant construction apparatus, and means for their production.

On the basis of the above, the fundamental revision and perfection of standards and regulations of construction (SNP) in seismic regions is necessary, with consideration of vertical seismic vibrations. Seismic zoning of the U.S.S.R. should also be revised.

While new decisions will be taken considering the division into seismic zones and revision of SNP, the design and construction of new buildings and structures in the regions of Leninakan, Kirovakan, Stepanavan and Spitak should be based on intensity 9.

III. The problem of the quality of construction and design in ensuring seismic resistance of buildings and structures is very important. Not a single building with the highest standards of seismic design and scientific data would survive a strong earthquake, if high standards of construction were not observed in earthquake

areas. The Tashkent, Gazli, Kayrarumsk and Papsk earthquakes are examples of this fact.

It is extremely important to develop new approaches in good quality construction in seismic regions, observing a heightened sense of responsibility of participants.

In the meantime the situation of housing resources (funds) and the responsible authorities should be considered and strengthened.

The number of stories should also be considered in order to attain seismic resistance. In seismic regions it is imperative to develop underground commercial and public transportation facilities, where the probability of seismically stable structures is higher.

The existing limitations on steel construction and reinforced concrete construction with rigid frames, should be considered unlawful.

Not enough attention is given to village dwellings. There is not enough supervision of construction. Also, there is a lack of antiseismic measures in private construction. There is a need of regulation in this area.

IV. The study of earthquakes, and in particular the Spitak earthquake of 1988, shows that the population is not adequately protected from the consequences of a strong earthquake, and so the undertaking of necessary measures to secure their normal lifestyles should become a priority in seismic areas. It should be mentioned that after an earthquake in the U.S.S.R., no special services are in existence to help the population. It is important to create earthquake preparedness programs, rescue and rehabilitation systems, as well as clearing of earthquake debris.

The execution of these measures, in our view, should be at the center of attention of the central government and the republics.

It would be appropriate to create permanent government commissions, at the level of the Union, and at the level of the local republics, in order to organize and bring about seismically resistant buildings

and structures, and to assure the safety of the population and the protection of unique equipment during earthquakes.

-- Prepared by the Soviet investigation team of 14 members.

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