

Armenia

Risk Assessment in Case of Possible Facility Failure:

The experience of Azat Reservoir in Armenia

Armenia is an entirely mountainous country with strongly featured relief. The average altitude of the territory is 1800 m above sea level.

Ridges account for nearly 14,000 km² (47%) of the territory. Some 40% of dwellings are located at an altitude of 1500-2000 m above sea level. The mountain areas of Armenia have a rich cultural heritage and are an attractive tourist destination.

Taking into consideration that the whole territory of Armenia lies within a seismically active zone, the seismic hazard value is 0.2- 0.5 g (an intensity of 8-10 on the MSK scale), and that in the past the seismic resistance of buildings and structures has not corresponded to the real seismic hazard, it is evident that there is a high seismic risk level for the territory of Armenia.

The seismic risk level of mountain areas with rugged topography increases sharply owing to seismically induced secondary hazards (landslides, reservoir failure, slope collapse, rock avalanches, etc) causing instability in slopes and rock masses.

The following steps are to be performed for risk assessment:

- reservoir site seismic hazard assessment and compilation of micro-zonation maps;
- reservoir seismic vulnerability assessment;
- risk evaluation of flooded areas in case of reservoir failure;
- preparedness of local authorities and population at the reservoir site and adjacent areas.

Azat reservoir is located at an altitude of 1650 m above sea level and a distance of 20 km from the capital city of Yerevan. General data for Azat reservoir are given below.

- Height of dam: 77 m
- Volume: 70 million.m³
- Surface: 2.85 million m²
- Date of construction: 1976

Reservoir site seismic hazard assessment and micro-zonation map compilation will include:

- earthquake catalogue and database preparation;
- distinguishing possible earthquake sources;
- establishing a ground strong motion attenuation model;
- seismic hazard computation.

Fault tectonics and earthquake epicenters in the area of Azat reservoir are presented in Fig. 1.

The level of seismic vulnerability of Azat reservoir has been assessed according to the following steps:

- estimation of parameters for regionally devastating earthquakes;
- definition of seismic characteristics of the ground at the dam site;
- estimation of ground acceleration at the dam site by altitude;
- visual and instrumental inspection of filtration

The dam risk is determined by the vulnerability (stability) of its construction, its filtration, the condition of outlets, mechanical equipment, availability of control-measuring instruments, as well as the most important factor, which is the size of the population in the zone of possible flooding and the possible property losses.

Some important parameters of seismicity for the Azat reservoir are shown below.

- Peak horizontal acceleration (foundation) share of g: 0.4
- Peak horizontal acceleration (dam) share of g: 0.331
- Leakage and suffusion: High
- Spillway and irrigation: High

Estimation of flooded areas in case of reservoir failure (collapse) is essential for risk evaluation and the amelioration of consequences. Special software program called "Wave2" (hereafter called The Program) was developed for operative estimation of the area that would be flooded by a possible failure of Azat reservoir and the consequences of the resulting wave. The Program allows the definition of extreme values of flooding parameters including the width of flooding and stream velocity as well as the arrival time for

the wave front, top and tail. The level of destruction of buildings and structures, bridges, roads and highways and industrial facilities has been estimated and relevant rescue and emergency actions have been planned.

On the basis of data obtained by using GIS technology a map of the borders of the Azat reservoir and the adjacent area in case of possible flooding has been compiled (Fig. 2).

It may clearly be seen that more than 10 settlements with a population of 90,000 would be flooded in case of the failure of the Azat reservoir. On the occasion of the International Day of Risk Prevention announced by the United Nations, the relevant state management organizations of the Republic of Armenia, together with national government organizations in the Ararat region, local governing bodies in cities and settlements of the region, and ministries, branches and establishments in Armenia, organized and implemented large-scale measures aimed at the protection of the population in case the dam of the Azat reservoir ever burst.



Figure 1: Fault tectonics and earthquake around the Azat reservoir

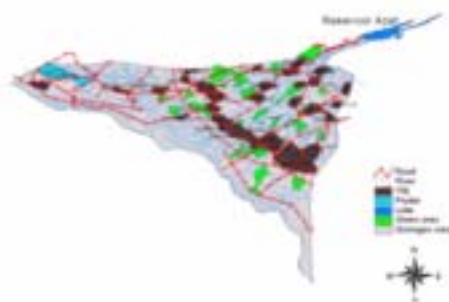


Figure 2: The region adjacent to the Azat epicenters in the reservoir adjacent case of possible flooding

Conclusion and Recommendations

Azat reservoir seismic risk assessment and reduction include the following:

- seismic microzonation map;
- vulnerability assessment;
- assessment of consequences;
- actions undertaken;
- preparedness of local people.

- Background

Reservoir (dam) safety is an essential component of the sustainable development of mountain areas in Armenia.

- Objective

Hazard and Risk Assessment in Case of Reservoir (Dam) Failure

- Term/Time Frame

Two years

- Activities Undertaken

Estimation of losses due to flooding, and population protection

- Major Achievements

Operative estimation of losses and risk reduction in mountain area

- Total Budget

1 million US\$

- Contact Details

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