ANALYSIS OF WAVE PROCESSES IN RESERVOIRS DUE TO EARTHQUAKES

GVELESIANI T. and MATCHARADZE G.

Professor, Doctor of Tech. Sciences, Leding Scientific Researcher. The Georgian Scien. Res. Inst. of Power Engineering and Power Engineering Structures. Depart. of Hydraulic Researches. 70, Kostava st., 0171, Tbilisi, Georgia
(Tel: +995-32-34-14-23, e-mail: tami@mayoffice.ge; tgrigala@gol.ge)
Ph. Doctor. Engurhesi Ltd. 50, Chavchavadze av., 0179, Tbilisi, Georgia.
(Tel: +995-32-29-21-37, e-mail: giapiu@caucasus.net)

Abstract

Wave in reservoir arising during earthquakes due to the impact of primary, seismotectonical dusplacement (STD) at its botton can be of considerable amplitude. In order to avoid the dam overflow event caused by these seismogenic (tsunami-like) waves, it is important to predict their main parameteres (amplidute, period) in designing or operating hydro-projects/dams (especially high earth dams) in mountain and seismic zones with complex geological and tectonical conditions.

On the basis of the observation data analysis, the formulas for assessment the maximum amplitude of vertical displacement (upthrow) at the fault (Dm) and the length of the fault line (L) are obtained based on the design magnitude (M) or intensity I (on the earth surface) of the HPP region.

Depending primarly on the relationship between the length of the fault line (L) and the width of the reservoir (l_1). The computation of the seismogenic waves on the water surface can be carried out based on either 2D or 3D hydradynamic problem solutions.

The solutions of proper mathematical 2D and 3D hydrodynamic problems have been obtained formerly by T.Gvelesiani using the small amplitude waves theory for the reservoirs represented schematically as rectangle (2D case) or as rectangular parallelepiped (3D case). The analysis of the computation cycle results (for 2D case) revealed that the shape of the STD has a different effect on the maximum amplitude of waves at the dam site η_D. In addition the simplified relationship for short-term prediction both the amplitude – η_D (in the case of the rectangular shape of the STD) and duration tr of the water level rising at dam site are obtained.

Theoretical assessment of the results carried out are in good agreement with the observation data concerned with the Helgen dam overflow event by seismogenic waves due to the earthquake of 1959. (Montana, USA).

Keywords: Reservoir; Earthquake; Water waves; Dam; Seismotectonical displacement; Fault line; Dam overflow