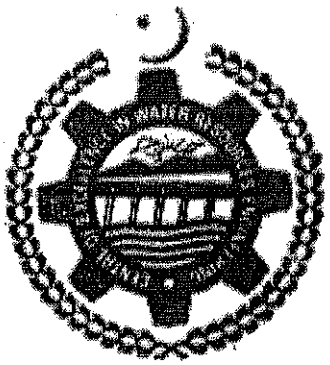
THESIS

SIMULATION OF BREACH OF A NATURAL DAM IN EARTHQUAKE AFFECTED AREAS OF AJK



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ABSTRACT

Failure of dams can cause heavy damages in shape of floods which results in loss of property and people. The loss of property is certain but loss of life can vary dramatically depending upon the extent of inundation of floods, size of the area, size of population at risk and length of warning time available. Artificial or man made dams are well compacted, properly designed considering geological, hydrological and hydraulic conditions prevailing at the dam site so there are rare chances of their breach, even then there is a chance of their failure as many examples of dam failure can be seen in the world's history. In contrast to artificial dams, natural dams formed as a result of some natural disaster mainly land sliding due to earth quake, as no planning and human interventions are involved in their development and construction, so there is a greater chance of their failure and community living in the downstream of the dam is always under threat.

The Hattianbala dam is an example of natural dam formed as a result of land sliding, as a massive earthquake with Richter scale 7.6 hit the valley of Kashmir on October, 08, 2005. This land sliding due to earthquake blocked the path of the Karli nullah out falling into River Jhelum and as a result of this blockage in its path, a reservoir is formed. The dam site is located at 34^0 08' 30'' N and 73^0 43' 100'' E and the elevation of Hattianbala dam top is 1130 m (amsl). The city Hattianbala with the population of about 40,000 is located 5 Km downstream of the dam. The recent earthquake caused a lot of causalities in the area. This area lies in heavy rainfall region; this makes the city and its economic activity under risk of flood in case of breach of this natural dam. To ascertain the expected damages resulting from the failure of this dam it was important to

asses the locations of the dwelling of the people near the Hattian city; site was visited to get information about elevation of the important structures that can come in danger with the expected breach. Elevations were noted with the help of Global Positioning System (GPS). This data was verified with the Google earth software and GT sheets of the area. Authorities have noticed the alarming situation prevailing at Hattianbala dam, investigations were carried out and it was decided to construct an open cut spillway at the dam to give passage to flow which tends to rise above the dam top. This study has been taken up to determine the flood levels for various breach scenarios and their impact on the infrastructure downstream of the dam.

Computer model HEC-RAS was used to determine the maximum water surface profiles at each cross section of the Karli nullah under various dam breach considerations. Input data needed for the HEC-RAS was geometric data, flow data and dam data. Cross sectional data of the nullah was taken from Topographic sheets with the contour interval of 50 m and was validated with Google Earth Software. Dam data was obtained from NESPAK as the dam height was 60 m {elevation of dam top is 1130 m and bed is as 1070 m (amsl)}, length of the lake upstream of the dam was 2000 m and average width of the lake was 360 meters. Flood inflow data was not available for this catchment, it was synthesized using HEC-HMS. 1-Day maximum rainfall data of Balakot station (being nearest available data) for the 35 years was taken from SWHP, frequency analysis were performed using Log-Pearson III to deduct it against 100 years return period. This 1-Day maximum rainfall of 100-years return period was used with SCS type-I curve to get the hourly distribution. This hourly rainfall data was then used in HEC-HMS as an input data to synthesize inflow hydrograph of the catchment. This resulted in inflow flood

hydrograph with peak discharge as 1450 cumecs and volume as 21930 (1000M^3). This information was used as input data in HEC-RAS. Before the simulation of dam break analysis, HEC-RAS model was validated for the study with historic flood of year 1992 and by interviewing the locals of the area about the observed flood level of year 1992. Comparable results were seen with the observed and computed water surface levels, so model was considered to be satisfactory for this study. Simulations were performed with different scenarios developed for trapezoidal breach shape considering the breach depth (10 m, 20 m, 30 m, 40 m, 50 m), breach width (40 m, 50 m, 60 m), failure time (4:00 hours) and side slope (1:1, 0.5:1, 1.5:1.0) of the breach. These scenarios were tested to evaluate the worst flood level generated with the scenarios. Due to very coarse nature of river geometry data, the computed maximum water surface levels were increased by 1.0 m as a factor of safety. The results of simulation under different conditions of the breach showed that a maximum water surface level of 881.2 m (amsl) is obtained with the breach depth as 50 m, breach width as 60 m, failure time as 4 hours and side slope 1.5H: 1.0V. The elevation of Hattianbala Road Bridge invert is 883 m (amsl) and is 1.8 m above peak flood level at the bridge.

The elevation of different important assets of the area e.g. Hattianbala Bridge is at 883 m (amsl), Hattianbala Bazar 886 m (amsl) while nullah bed at this position is as 871 m (amsl). Houses, farms and other economic assets of the people are 12 to 15 m higher than the nullah bed. The maximum water surface level determined for worst breach condition remains below than the soffit level of Road Bridge and the general dwellings along the nullah length. So there is no additional threat due to probable dam breach. However tree/vegetation and debris which are usually associated with high flood flows can

seriously cause blockage in flow path resulting in localized rise of flood and damage to economic assets. This study has been carried out by using the topographic sheet of 50 m contour interval, which results in very approximation, so it is recommended that the future study should be done by using more detailed topographic data.