The Investigation of Extra Seepage of Gheisaragh dam and Remedial Method

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Abstract

Gheisaragh dam is an earth fill in East Azarbayjan province of Iran which is completed in 2005. The main problem with the dam operation is seepage with ascending rate through the foundation and abutments which leads to piping with considerable sinkholes in downstream. From the comprehensive geological studying in the dam site, it was disclosed that major part of dam foundation involved gypsum veins and pockets and gypsum marl. The chemical test of water sample obtained from piping sinkholes indicates significant increase in the amount of Mg++, Ca++ and So4-- content which is a sufficient evidence for dissolving of the gypsum veins due to the seepage through the foundation ground.

In this paper, at first geotechnical features of the dam site and foundation and result of the chemical tests are investigated. Then, the causes of piping occurrence are indicated. According to importance of dam safety, the treatment methods are investigated for rehabilitation of dam foundation. Then the effect of each method is evaluated by numerical analysis. Finally, best method economically and practically is selected. In this method, impervious concrete cover is established on the upstream slope and a cement-bentonite cutoff wall is constructed in upstream heel of dam.

Keywords: Gheisarag Dam, Extra Seepage, Remedial Method.

1. INTRODUCTION

It is estimated that gypsum or anhydrite deposits underlie approximately 25 % of the land surface [1]. Only 10 % of these deposits outcrop [2]. At these outcrops, or where gypsum or anhydrite stratum occurs in depths of a few hundred meters, gypsum karst has evolved. Therefore, extensive areas of gypsum karst exists worldwide [3]. Dissolution of gypsum veins in a dam construction site may lead to intensive leakage through foundation [4]. Intensive seepage through core and foundation of a dam is one of the important issues in the geotechnical engineering and if it is not controlled numerous problems, such as, slope instability and erosion, liquefaction, foundation ground wash out, unexpected settlements, immersion of downstream agricultural lands, piping and so on, may be encountered during dam operation life. Most of the serious problems from piping have resulted from progressive backward erosion of concentrated leaks, which develop through or under the dam. The erosion starts at the point where the seepage water discharges and works toward the reservoir, gradually enlarging the seepage channel [5].

Gheisaragh dam is one of these cases. From comprehensive field examinations in reservoir and foundation ground of the dam, it was disclosed that major part of the construction area is underlain by gypsum veins and pockets and gypsum marl. In this paper, at first geotechnical features of the construction area are dealt with. Then, hydraulic performance of foundation ground and results of the chemical tests are examined and interpreted. Finally, the recommended measures for prevention of the discharge flux development are explained and evaluated.

2. Gheisaragh Dam

Gheisaragh dam is an earth fill dam with central clay core, which has been constructed some 120 km to Tabriz city in the north west of Iran. The height of dam from bed rock and river bed is 18 m and 16 m respectively. Also the length and width of dam crest is 1000 m and 6 m correspondingly. The embankment construction was completed in 2005 and the reservoir impoundment started immediately afterward.

The main purpose of this dam is to supply the water of Chaky Chay river required for irrigation of 325 hectares agricultural lands at downstream of the dam. The capacity of the dam reservoir is 2.6×106 m3. Construction operation of the dam started in 2002. Because of special topography of the valley, the reservoir