TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
PULCHOWK CAMPUS

THESIS NO: G015/070

Numerical Modeling of Location Optimization of Drainage Gallery in Gravity Dams

by

Robin Ranjan Singh

A THESIS
SUBMITTED TO THE DEPARTMENT OF CIVIL ENGINEERING
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE
DEGREE OF MASTER OF SCIENCE IN GEOTECHNICAL ENGINEERING

DEPATRMENT OF CIVIL ENGINEERING
LALITPUR, NEPAL

NOVEMBER, 2016

COPYRIGHT

The author has agreed that the library, Department of Civil Engineering, Pulchowk Campus, Institute of Engineering may make this thesis freely available for inspection. Moreover, the author has agreed that permission for extensive copying of this thesis for scholarly purpose may be granted by the professor who supervised the work recorded herein or, in their absence, by the Head of the Department wherein the thesis was done. It is understood that the recognition will be given to the author of this thesis and to the Department of Civil Engineering, Pulchowk Campus, Institute of Engineering in any use of the material of this thesis. Copying or publication or the other use of this thesis for financial gain without approval of the Department of Civil Engineering, Pulchowk Campus, Institute of Engineering and author's written permission is prohibited. Request for permission to copy or to make any other use of the material in this thesis in whole or in part should be addressed to:

_____

Head

Department of Civil Engineering

Pulchowk Campus, Institute of Engineering

Lalitpur, Kathmandu

Nepal

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
PULCHOWK CAMPUS
DEPARTMENT OF CIVIL ENGINEERING

The undersigned certify that they have read, and recommended to the Institute of Engineering for acceptance, a thesis entitled **"Numerical Modeling of Location Optimization of Drainage Gallery in Gravity Dams"** submitted by Mr. Robin Ranjan Singh in partial fulfillment of the requirements for the degree of Master of Science in Geotechnical Engineering.

Prof. Dr Akal Bahadur Singh

Supervisor

Department of Civil Engineering, Pulchowk Campus

Institute of Engineering

Er Prakash Shrestha

External Examiner

Dr Indra Prasad Acharya

Program Coordinator

MSc in Geotechnical Engineering Program

Department of Civil Engineering, Pulchowk Campus

Institute of Engineering

November 2016

ABSTRACT

The topic of the thesis is "Numerical Modeling of Location Optimization of Drainage Gallery in Gravity Dams". An effort has been made here to find out the optimum location of the drainage gallery inside concrete gravity dams using Finite Element Modeling (FEM) analysis of a model. Gravity dam depends upon its own weight for resisting the uplift pressure which is exerted by the seepage of the water through the foundation of the dam. The effect of hydraulic uplift pressure can be reduced by using a drainage gallery inside the gravity dams. The position of the drainage gallery affects the hydraulic uplift force acting on the foundation of the dam. Hence the optimum position of the drainage gallery under gravity dam is found out which results in the maximum reduction factor of hydraulic uplift force acting on the base of the dam. Also the increase in factor of safety of the gravity dam is worked out after providing drainage gallery in the gravity dam.

An isotropic and homogeneous two dimensional model is prepared and analyzed from Rocscience Phase2 v 8.0. Based on the pore pressure obtained from the software, hydraulic uplift force for different upstream water level conditions are calculated manually. The results of numerical model are compared for different water head available at the upstream of the dam and for different positions of the drainage gallery provided inside the dam.

The maximum reduction in the hydraulic uplift force by placing a drainage gallery in the dams depends upon the size of the dam and the water levels maintained at the upstream and downstream of the dam. Different graphs were developed for different upstream and downstream water elevations, which can be referred for finding the optimum location of the drainage gallery.

ACKNOWLEDGEMENT