شبكة المعلومات الجامعية

بسم الله الرحمن الرحيم

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار

Ain Shams University

Faculty of Engineering

Irrigation and Hydraulics Department

Modeling the Effect of Downstream Drain Geometry on Seepage through Earth Dams

A Thesis submitted in partial fulfillment of the requirements of the degree of Master of Science in Civil Engineering (Irrigation and Hydraulics)

By

Amr Reda Refaiy Basuouny Refaiy Gaballa

B.Sc. in Civil Engineering – Irrigation and Hydraulics Dept. - 2016

Ain Shams University - Faculty of Engineering

Supervised by

Prof. Nahla Mohamed AboulAtta
Professor of Irrigation Design
Irrigation and Hydraulics Department
Faculty of Engineering Ain-Shams University

Dr. Neveen Yousif Saad
Associate Professor
Irrigation and Hydraulics Department
Faculty of Engineering Ain-Shams University

Dr. Doaa Anas El-Molla
Assistant Professor
Irrigation and Hydraulics Department
Faculty of Engineering Ain-Shams University

Cairo – (2021)

Ain Shams University
Faculty of Engineering
Irrigation and Hydraulics Department

SUPERVISOR COMMITTEE

Name: Amr Reda Refaiy Basuouny Refaiy Gaballa

Thesis: Modeling the Effect of Downstream Drain Geometry on Seepage through Earth Dams

Degree: Master of Science in Civil Engineering

Name and Affiliation	Signature
Prof. Dr. Nahla Mohamed AboulAtta Professor of Irrigation Design Irrigation and Hydraulics Department Faculty of Engineering - Ain-Shams University	
Dr. Neveen Yousif Saad Associate Professor Irrigation and Hydraulics Department Faculty of Engineering - Ain-Shams University	
Dr. Doaa Anas El-Molla Assistant Professor Irrigation and Hydraulics Department Faculty of Engineering - Ain-Shams University	

Research Date: / / 2021

Postgraduate Studies

Authorization Stamp: The thesis is authorized at: / / 2021

College Board Approval
/ / 2021

University Board Approval
/ / 2021

Ain Shams University
Faculty of Engineering
Irrigation and Hydraulics Department

EXAMINERS COMMITTEE

Name: Amr Reda Refaiy Basuouny Refaiy Gaballa

Thesis: Modeling the Effect of Downstream Drain Geometry on Seepage through Earth Dams

Degree: Master of Science in Civil Engineering

Name and Affiliation	Signature
Prof. Dr. Abdallah Sadik Bazaraa Professor of Irrigation and Drainage Faculty of Engineering - Cairo University	
Prof. Dr. Abdel Kawy A. Mokhtar Khalifa Professor of Hydraulics Irrigation and Hydraulics Department Faculty of Engineering - Ain-Shams University	
Prof. Dr. Nahla Mohamed AboulAtta Professor of Irrigation Design Irrigation and Hydraulics Department Faculty of Engineering - Ain-Shams University	
Dr. Neveen Yousif Saad Associate Professor Irrigation and Hydraulics Department Faculty of Engineering - Ain-Shams University	

Date: 13/7/ 2021

Researcher Data

Name	Amr Reda Refaiy Basuouny Refaiy Gaballa
Date of birth	24/11/1993
Place of birth	Giza, Egypt
Last academic degree	B.Sc. in Civil Engineering
Field of specialization	Irrigation and Hydraulics Engineering
University issued the degree	Ain Shams University
Date of issued degree	2016
Current job	Demonstrator at Irrigation and Hydraulics Department, Faculty of Engineering, Ain Shams University

Statement

This thesis is submitted as a partial fulfilment of Master of Science in Civil Engineering (Irrigation and Hydraulics), Faculty of Engineering, Ain Shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

Student Name

Amr Reda Refaiy Basuouny Refaiy Gaballa

Signature

.....

Acknowledgement

First, my unlimited thanks to Allah!

I would like to express my deep appreciation and sincere thanks to Prof. Dr. Nahla Mohamed AboulAtta, Professor of Irrigation Design, Irrigation and Hydraulics Department, Faculty of Engineering, Ain Shams University, for her sincere mentoring and teaching since I was an undergraduate student and also for the assistance and valuable advice throughout this work.

Grateful thanks are due to Dr. Neveen Yousif Saad, Associate Professor, Irrigation and Hydraulics Department, Faculty of Engineering, Ain Shams University, for her kind guidance and encouragement throughout this work.

Deep gratitude and thanks are due to Dr. Doaa Anas El-Molla, Assistant Professor, Irrigation and Hydraulics Department, Faculty of Engineering, Ain Shams University, this is in fact because of the long journey of mentoring, guidance, patience and encouragement since I was an undergraduate student and up to this level. Thanks for everything!

My thanks and gratitude are also extending to Prof. Dr. Mohamed Abdel Hamid M. Gad, Professor of Hydrology, Irrigation and Hydraulics Department, Faculty of Engineering, Ain Shams University, for his useful assistance and valuable advice.

Thanks a million for Eng. Hossam A. Elshafy, Lab Manager of Misr Raymond Foundations Company for his massive support during the testing process of the soil samples.

Thanks a bunch for all my work partners whom were always supportive to me.

Much obliged to Mr. Hani, Irrigation and Hydraulics Department Research Laboratory Member at the Faculty of Engineering, Ain Shams University for his patience and support during the experimental work.

Last but not least, I would like to thank my family for their support; specially my father and my mother. Special thanks to my brothers and my lovely sister. for their support, patience and understanding during periods of hard work. I would also like to deeply thank my beloved wife for fulfilling my soul and empowering me to go the way!

Abstract

This research investigates the effect of downstream drain's geometry on seepage through homogeneous earth dams founded on an impervious foundation. A permeability tank experimental model and SEEP2D numerical model are used in the study. The dam's failure in the case of no drain is experimentally observed to point out the drain's importance. The case of homogeneous earth dam with downstream slope protection is also studied experimentally to simulate the case of no drain while avoiding the dam's failure. The effect of the drain's geometry on the seepage characteristics is evaluated by considering different scenarios for its height, length, and angle. Three cases for reservoir filling are studied. Sensitivity analysis is also performed to evaluate the drain's most effective geometrical parameter. The results show that the most effective geometrical parameter of the downstream drain is its length, while its height and angle have almost no effect. Increasing the drain's length increases the seepage discharge and the distance between the phreatic line and downstream face and reduces the pore water pressure leading to more safety. Design charts and equations are provided.

Keywords: Seepage; Earth-fill dam; Downstream drain; Experimental permeability tank; SEEP2D numerical model; Hydraulic structures.

Table of Contents

List of Figures