Ain Shams University
Faculty of Science
Geology Department
****

Geo-engineering study to evaluate the efficiency of the Aswan High Dam layers for the rock-fill part

ATHESIS

SUBMITTED FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN SCIENCE (ENGINEERING GEOLOGY)

BY

MAMDOUH HALFAWY BOSHNAQ

M.Sc (Geology)

Supervised by

Prof. Dr. Samer AbdelTawab
Professor of Engineering Geology
Geology department
Faculty of science
Ain Sham University

Prof. Dr. Abdel Nasser M. Helal
Professor of geophysics
Geophysics department
Faculty of science
Ain Sham University

Dr. Karam S. Farag
Doctor of geophysics
Geophysics department
Faculty of science
Ain Sham University

Dr. Sameh M. Moustafa
Doctor of geophysics
National Research Institute of Astronomy and Geophysics
Aswan, Egypt

To
Geology Department
Faculty of Science
Ain Shams University
2017

APPROVAL SHEET

NAME: Mamdouh Halfawy Abdel Aziz Boshnaq

THESIS TITLE: Geo-engineering study to evaluate the efficiency of the Aswan High Dam layers for the rock-fill part

DEGREE: DOCTOR OF PHILOSOPHY IN SCIENCE (ENGINEERING GEOLOGY)

SUPERVISIONS:

1-Prof. Dr. Samer Abdel-Tawab Elsayed (Professor of Engineering Geology, Geology department, Faculty of science, Ain Shams University).

2-Prof. Dr. Abdel-Nasser M. Helal (Professor of geophysics, Geophysics department, Faculty of science, Ain Shams University).

3-Dr. Karam S. Farag (Doctor of geophysics, Geophysics department, Faculty of science, Ain Shams University).

4-Dr. Sameh M. Moustafa (Doctor of Geophysics, National Research Institute of Astronomy and Geophysics, Aswan, Egypt).

EXAMINATION COMMITTEE:

1-Dr. Layla Abdel Majeed Fayed (Professor of Engineering Geology, Geology department, Faculty of Science, Cairo University).

2-Prof. Dr. Mohammad Hamed Abdelal (Professor of geophysics, Faculty of Education, Ain Shams University).

3-Prof. Dr. Samer Abdel Tawab Elsayed (Professor of Engineering Geology, Geology Department, Faculty of science, Ain Shams University).

ACKNOWLEDGEMENTS

In the name of God, I would like to acknowledge the people who provided me assistance throughout the last few years leading to successful completion.

I would like to recognize and thank my supervisors; Professor Samir Abdel-Tawab Elsayed, (Geology Department, Faculty of Science, Ain Shams University), Professor Adel-Naser M. Helal, (Geophysics Department, Faculty of Science, Ain Shams University), Doctor Karam S. Farag, Geophysics Department, Faculty of Science, Ain Shams University) and Doctor Sameh M. Moustafa, (National Research Institute of Astronomy and Geophysics) for their time, expertise, wisdom, clear guidance, critical vision, encouragement and motivation.

Moreover, I am grateful to Doctor Asmaa Al-Moddather, (Soil Mechanics Department, Faculty of Engineering, Cairo University), for her kind continuous support and encouragement. I am appreciative of Doctor Mohammad S. El-Banna, (Sand Dunes Department, Desert Research Center, Cairo, Egypt), for his guidance and encouragement.I am appreciative of Engineer Amal Karmy, (General Manager of Technical Researches, Aswan High Dam Authority), for her continuous support in various stages of this thesis.

Finally, I would to express my love and gratitude to my brothers for their support and encouragement.

DEDICATION

This dissertation is dedicated to my lovely wife and to the two lights of my life Mayar and Marwan, for all their overwhelming support and encouragement through the past several years

Mamdouh H. Boshnaq

Ain Shams University
Faculty of Science
Geology Department
****

Geo-engineering study to evaluate the efficiency of the Aswan High Dam layers for the rock-fill part

ATHESIS
SUBMITTED FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN SCIENCE (ENGINEERING GEOLOGY)

BY
MAMDOUH HALFAWY BOSHNAQ
M.Sc (Geology)

Supervised by

Prof. Dr. Samer Abdel Tawab
Professor of Engineering Geology
Geology department
Faculty of science
Ain Sham University

Prof. Dr. Abdel Nasser M. Helal
Professor of geophysics
Geophysics department
Faculty of science
Ain Sham University

Dr. Karam S. Farag
Doctor of geophysics
Geophysics department
Faculty of science
Ain Sham University

Dr. Sameh M. Moustafa
Doctor of geophysics
National Research Institute of Astronomy and Geophysics
Aswan, Egypt

To
Geology Department
Faculty of Science
Ain Shams University
2017

ABSTRCAT

Aswan High Dam is one of a zoned embankment dam; it has been constructed in 1970, since 45 years. It is unique in a certain way, in particular as a result of its hydro-geological, geometric and hydrological parameters.

The objective of the present study is to evaluate the efficiency of the Aswan High dam, by using numerical analysis computer programs to model a variety of seepage flow conditions and stability in the dam. It is a process in which the problem is represented as it appears in the actual condition of real world and is interpreted in abstract form, which could be applied to other similar hydraulic structures the with help the theories of limit equilibrium method (LEM), finite element method (FEM) and non-destructive geophysical technique (GPR), the computer programs Slide 6, Seep/W and Reflex 7.2c are used in the analyses.

The obtained results showed that the smallest coefficient of the stability factor in all dynamic conditions with the help of LEM does not decrease lower than the standard ones, and it concluded that: at the upstream wedge; the value of the design stability factor more than the value of the calculated stability factor about 1.19 times and at the downstream wedge; the value of the design stability factor more than the value of the calculated stability factor about 1.01 times.

The difference in the results between the measured and the calculated of seepage and exit gradient with the help of FEM varies significantly in the case of the Aswan High dam. The difference could not only be attributed to a different method of calculating the seepage but also may be defect in

the indicator measurements of the filtration velocities for a net of monitoring wells (Piezometers).

The comparison between each of the measured and calculated for seepage and exit gradient results showed that; The values of calculated exit gradient more than the values of measured exit gradient about 26 -31 times, while the rate of calculated seepage less than the rate of measured seepage about 7.5 – 12 times. When the development of the water level in the reservoir increasing from level +147.00 to level +183.00 the rate of seepage increases by about 1.6 times and the exit gradient increases by about 2.81 times. The results of the calculated rate of seepage (FEM) has reasonable proportional to the actual development of the water level in the reservoir, while the measured rate of seepage (50%) hasn't reasonable proportional to the actual development of the water level in the reservoir. The exit gradient values and rate of seepage are decreased when (k_{shell}/k_{core}) increases. The preferable ratio of (k_{shell}/k_{core}) for the high dam is 10^6.

An inversion model was built by using Reflex 7.2c program in order to adapt it to the physical reality which will be simulated to calculate the synthetic travel times and then the velocity of the GPR wave.The result of generated model of the calculating synthetic value of radar wave velocity is about 0.125 m/ns and this velocity value has been applied in the present study. The core clay and the embankment with the help of geophysical technique (GPR) did not detect presence of any caves, or cracks, in the constituent layers of the dam, however the whole terraces levels demonstrates a slightly subsidence in the subsurface layers at station 20+00.The overall status of the dam is satisfactory.

CONTENTS

LIST OF FIGURES