

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)***

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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

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ABSTRACT

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 $(k_{\text{shell}}/k_{\text{core}})$ increases. The preferable ratio of $(k_{\text{shell}}/k_{\text{core}})$ 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.

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