Ain Shams University
Faculty of Engineering
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Some Geotechnical Aspects of Developing Geothermal Energy in Egypt

By

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STATEMENT

This dissertation is submitted to Ain Shams University for the requirements of degree of **Doctor of Philosophy in Civil Engineering** (Structural Engineering).

The work included in this thesis was carried out by the author in the Department of Structural Engineering, Ain Shams University from 2008 to 2012.

No part of this thesis has been submitted for a degree or a qualification at any other university or institute.

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ABSTRACT

Future generations are going to suffer energy and environmental problems through this century due to fossil fuel resources depletion and global warming of the earth. Low Temperature Geothermal Energy (LTGE) as a sort of renewable clean energy resources represents a hope to overcome part of these problems. LTGE systems are generally used for space heating and cooling purposes. Soil acts as a Heat Exchanger (HE) in ground coupled LTGE systems. Ground Vertical Heat Exchanger (VHE) is considered the most efficient as its expected running costs are less than conventional air conditioning costs by about 35%. Accurate estimate of soil thermal properties plays the key role for successful design of LTGE system.

LTGE extraction potential in Egypt is investigated in this study. A specific location was chosen, investigated, and prepared to conduct this study. Thermal Response Test (TRT) apparatus was specifically built to investigate soil thermal properties. Extracted soil samples were tested in laboratory to assess physical and thermal properties. Available soil physical-thermal correlations were surveyed and applied to the collected soil samples to investigate its applicability and accuracy. Comparison between TRT and laboratory results was conducted in order to investigate the effect of groundwater flow on VHE. Further to experimental work, VHE is numerically modeled to investigate its performance under the effect of the injected heat loads. Finally, a design tool for LTGE system is presented to show running cost savings of this system.

Keywords: Geothermal, Low temperature, Vertical heat exchanger, Groundwater, Heat transfer.

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