Thermal response test

Objective

Analysis of the data based on the measurements of a real thermal response test provided on the "Moodle of the Course".

Introduction

The town of Thonon-les-Bains is studying the construction of a new school. This building should be carried out within the framework of the sustainable development established and supported by the city. The buildings department envisaged for this building a construction based on a concept respectful of the environment, with use of geothermal system for energy needs. In this exercise, real TRT data from the Project is provided.

A geothermal borehole, 100 m in length and 132 mm in diameter, have been employed for TRT as a part of this project. The characteristics of borehole are given in the table below. Fig. 1 shows the illustration of one of the geothermal boreholes.

	Geothermal borehole
Drill length (m)	100
Drill diameter (mm)	132
Geothermal borehole length (m)	100
Arrangement of circulating tubes	Double-U
Type of circulating tubes	Polyethylene
External diameter of the tubes (mm)	32
Wall thickness of the tubes (mm)	2.9
Filling material of the borehole	Bentonite and cement
Circulating fluid type	Water
Flow rate during the test (liters/h)	480-720

During the thermal response test (i) heat carrier fluid is circulated for 15 hours without turning on the heating, (ii) after the first stage, the heat was injected for 6 days into the geothermal borehole (Heat injection 49.7 W/m). The data measured during the TRT are provided on the Moodle.

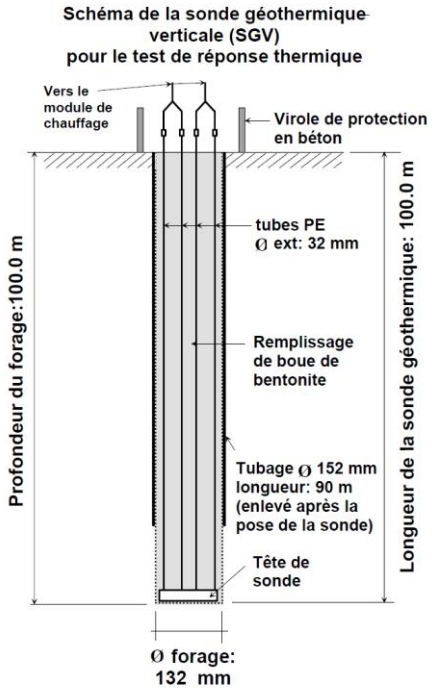

Fig. 1. Illustration of the geothermal boreholes used in the Project

As learned during the course, the measurements of in-situ thermal response test (TRT) can be employed to determine the following properties of the soils:

- undisturbed ground temperature (T_0): determined from the temperature data recorded before the heat injection
- effective thermal conductivity of the ground (λ)

Use the TRT data provided to:

1. Determine the undisturbed ground temperature. Comment briefly on the reason behind the difference between the actual ground temperature and the ones determined from the TRT data.
2. Illustrate the measured quantities during a TRT (i.e., T_{in}, T_{out}, internal temperature, external temperature, flow rate).
3. Compute the ground thermal conductivity. Briefly comment the accuracy of the method adopted for the defintion of the thermal conductivity.
4. Imagine the ground thermal conductivity value will be used for the design of an energy geostructure and the thermal conductivity value is calculated from a pile. Would you recommend it to be used? Briefly comment on your choice.

Content of the report

The report must contain a description of the experimental equipment and parts that constitute the mini-module. A description of how to install and run the test. The results elaborated by the test and a brief critical comment of the latter.