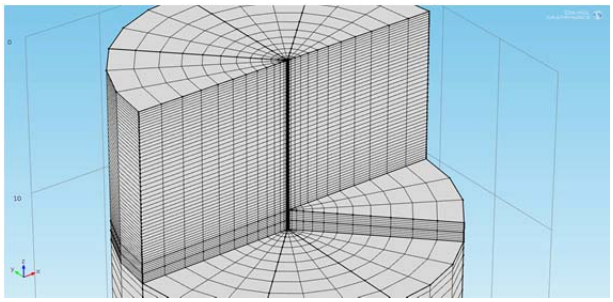
Seminar 1 - EXPERIMENTAL AND NUMERICAL STUDY OF ENERGY GEOSTRUCTURES



Summary.

The concern about the increase in global energy demand has lead to acceleration in the scientific, technological and industrial research on renewable energy sources and their technical applications so as to limit the use of fossil fuels (that nowadays still provide more than 80% of the total energy consumption) and the resulting environmental pollution. The heat contained at low temperatures and low depths in the first layers of the Earth represents one of the most common forms of renewable energy (*i.e.,* Low Enthalpy Geothermal Energy - LEGE). The most recent applications have enlarged the number of technical solutions for exchanging heat with the surrounding and underlying soil and are generally termed *energy geostructures*. The key feature of these technologies is the possibility of using the structures in direct contact with the soil like heat exchangers through the installation of the heat-carrier fluid tubes into the concrete. Examples of energy geostructures are: foundations, retaining walls, bulkheads or tunnels.

A promising technical solution for exploiting LEGE is obtained by using small-diameter foundation elements in underpinning projects: the Energy Micro-Piles (EMPs). EMPs represent a different perspective in the field of LEGE use in civil engineering, mainly related to the retrofitting of existing buildings, where the enhancement of the thermal features can be obtained together with the improvement of the structural set up.

To provide a better understanding of the EMP response to the temperature variations and to make a first evaluation of their large-scale applicability as sustainable energy systems, two full-scale prototypes of EMPs have been installed at the Engineering Campus of the University of Perugia. Currently, the thermal response of only one of the two prototypes has been investigated, both by means of preliminary field tests, namely the Thermal Response Test (TRT), and a series of 3D FE analyses.

The model has been calibrated on the TRT results and then used to make a prediction of the long-term behavior of the prototype in typical operating conditions of the GSHP system during the summer regime. In addition, a parametric study has been carried out by varying some key functioning parameters in view of an optimization of the EMP technology.