Geological and numerical modelling of Thermal Ground Potential for building's heating and cooling, using low temperature shallow geothermal: The “Pietralata Pilot Site” (Roma Capitale Area, Italy)

Nunzia Bernardo and Fabio Moia
Ricerca sul Sistema Energetico - RSE Spa, Sustainable Development and Energy Sources, Italy (nunzia.bernardo@rse-web.it)

The study shows the result of a detailed analysis aimed at verifying possible application of the technology related to the exploitation of low temperature geothermal resources for direct uses, with particular reference to the heating and cooling of public and private buildings in Rome, in order to enhance and improve its building stock.

The analysis started with collection and consultation of geological, stratigraphic, hydrogeological and thermal data available from bibliography and previous studies of the area. This represented a fundamental and useful step to determine a potentially suitable sector, both for geological and thermic characteristics of the lithologies recognized in the area. Pietralata, north east of Rome, was selected as "pilot site" out of 15 areas identified on the basis of the collected information. Within this pilot site, a High School - Technical Institute was recognized a suitable public building for the test.

The entire school complex has been discretized into three blocks. The analysis was made preliminarily for block 1, which is the largest, by calculating the heating energy requirements based on the climatic zone and the structural parameters of the building using the CARAPACE software (CAlcolo Resistivo Annuale Prestazioni Assetti Climatizzazione Efficienti), developed by SSE Department of RSE.

Starting from these needs, the analysis was carried out by hypothesizing and sizing a field of closed loop probes capable to meet 30% of the total energy needs expected for the building. Results thus highlighted, were a conclusion drawn by 16 probes with an average depth of 95 m each.

The analysis and the determinations made on the bibliographic basis were then validated with the experimental data derived from a geognostic survey by drilling up to a depth of 100 m from the surface, and conditioned for a Geothermal Response Test to determine the experimental value of the thermal capacity $W/(m^2*K)$ of the lithologies.

From the aforementioned, the possibility to optimize the thermal conductivity profile of the ground was derived, in respect to the $\lambda$ values corresponding to the stratigraphy derived from the survey.
The results, thus arrived, confirm the worth of the preliminary estimates and demonstrate how a field of 12 probes with a depth of 100 m each is enough to satisfy 30% of the energy needs of the users considered.

It must be also the focal point that Pietralata area is not the optimum in terms of thermal conductivity of the ground and lithologies, wherein the value of lambda was found to be around 1.6 W/(m*K). Nevertheless, the results established the correctness of the preliminary hypothesis in the applicability of the geothermal technology for the heating and cooling of existing buildings in the city of Rome.

The study was an experimental activity carried out with Roma Capitale Municipality - Infrastructure Department.