Investigation of feasibility and performance of innovative dual function closed-loop heat exchange systems in critical geological environments

(Proposer: Prof. Antonio Galgaro)

The proposed study presents a meeting point between different disciplines, and is articulated by a first screening of the methodologies for using heat exchangers with dual functions, or with double functions of heat and structural exchange or for thermo-electrical production, with the identification of possible points of convergence between geotechnical adaptation interventions and energy needs. This cross comparison would deal with the study of methods and materials that can be used in the construction of ground heat exchangers with particular focus on the thermo-mechanical properties characterizing innovative thermo-foundational probes and heat exchangers with the function of thermal and / or electrical production, which should instead work in environments high temperature, often also chemically aggressive. A further study will be carried out in verifying the effects induced by the operation as a heat exchanger with the subsoil on the structural functions by verifying any changes in the mechanical properties in the different operating conditions. The research activities include an initial in-depth analysis of the literature aimed at identifying previous studies on the experimentation of geo-thermo-structures and investigating the more applicative aspects through the development of numerical models coupled to a physical model in scale.

The development of a FEM model for simulating the thermal behavior of the geostructures studied is planned to follow and in parallel, aimed at maximizing performance in terms of efficiency and verifying the preservation of the quality of the mechanical functions to which it must respond.

The use of a physical model for the execution of tests on a real environment in scale and under controlled conditions, developed by the proponents, already available in the University laboratories, will allow to experiment on scale the thermal operating conditions of the geothermal exchangers, to validate model hypotheses and evaluate any thermomechanical reactions induced by thermal forcing.

Finally, a validation of the numerical and physical modeling approach will be conducted in case studies, including INGV offices in the redevelopment project, identified as suitable and functional for the calibration of the model to complete the research activity.

The planned research is therefore focused in order to produce an applicative and integrated study useful for the design and construction of seismic adaptation systems combined with energy efficiency interventions in buildings, as well as verifying the applicability of innovative solutions of ground-type heat exchangers. closed circuit, in geothermal anomaly environments.

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