Editorial

Special issue on “Shallow Geothermal Energy Systems”

The growing need for renewable energy sources has led to increased interest in shallow geothermal applications for the heating and/or cooling of buildings. The integration of heat exchangers in the elements of the structure that interface with the ground, such as foundations, tunnels, and diaphragm walls, is particularly attractive, due to the inherent cost savings involved in combining a required structural component with the harvesting of geothermal energy. Thermoactive geostructures present the additional benefit of relying on localized resources (the ground) and, therefore, do not need additional infrastructural investments. By providing an alternative to fossil fuels and reducing peak demand from the grid, they also provide an attractive tool towards energy independence and distributed generation with no adverse impact on the environment. However, the widespread application of this sustainable technology is currently hindered by the large disparity in development and uneven regulatory frameworks worldwide.

The first contribution in this special issue summarizes insights on regulatory and policy frameworks from fourteen European countries, revealing a high disparity on legislation, regulations, standards, and institutional support for design and permitting. The review highlights the need for standardized approaches and the importance of institutional support as a catalyst for full competitiveness and market penetration.

Shallow geothermal energy (SGE) systems are based on technologies still under development, with knowledge mostly fragmented across a myriad of publications. The bulk of this special issue, eleven papers, focuses on various aspects of design of SGE systems, starting with a review of monotonic and cyclic thermal loading of single piles and pile groups. The first group of papers explores different aspects of the interactions of piles with the ground, design procedures, and the effects of thermal loading on soil response and pile behavior. Two papers address potential benefits and challenges related to thermally activated diaphragm walls. Another group of papers examines the efficiency of heat exchangers under varying soil moisture conditions. Conversely, a few papers address the interaction of groundwater flow with the heat exchangers when measuring thermal properties of soils or assessing downstream impacts.

SGE systems can be regarded as onsite decentralized energy productions systems as the majority of them require no energy transfer. Their relatively small size brings additional uncertainties in construction due to local or site specific characteristics. Seven papers focus on case studies from different locations worldwide, dealing with a wide-ranging set of approaches: from site investigation, to design and performance, both mechanical and financial, of energy piles and diaphragm walls, efficiency of ground source heat pumps, an innovative hybrid installation combining solar collectors and a ground source heat pump.

Finally, the special issue concludes with a view to the wider issues: integration of ground source heat pumps at the district scale and SGE systems’ contribution to CO_2 emissionsreduction, as well as long term cost savings.

SGE systems can provide a sustainable, cost-effective, and localized contribution to address heating and cooling needs for residential and commercial buildings, while reducing CO_2 emissions and energy infrastructure. Their success requires efficient and reliable technical solutions, but is predicated on developing coordinated policies, as well as effective communication strategies with all stakeholders.

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