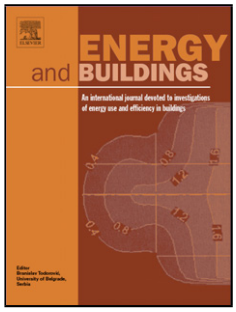

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Improvement of Borehole Thermal Energy Storage Design Based on Experimental and Modelling Results

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Abstract

Underground Thermal Energy Storage appears to be an attractive solution for solar thermal energy storage. The SOLARGEOTHERM research project aimed to evaluate the energetic potential of borehole thermal energy storage by means of a full-scale experimental device and heat transfer models. Analysis of the experimental data showed that a single borehole is not efficient for storage. Application of a 1D analytical model showed that the heat transfer fluid in the geothermal probe lost 15 per cent of its energy at a depth of 100 m and 25 per cent at 150 m. A 3D multilayer numerical model was then developed and validated against the experimental data. This model was then used to simulate different configurations over many years. Lastly, a theoretical approach to optimising design of a borehole thermal energy store (BTES) was proposed. A relation was established that enables comparison of the storage characteristic time of any vertical BTES to an optimum one. Based on these experimental, modelling and theoretical results, guidelines are formulated to optimise the design of vertical borehole fields with an objective of inter-