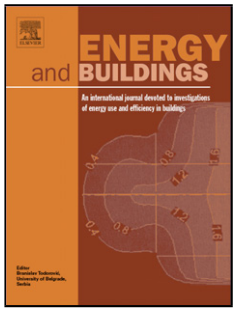


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# Year-round performance assessment of a ground source heat pump with multiple energy piles

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**ABSTRACT**

The year-round performance of a ground source heat pump (GSHP) with multiple energy piles (EPs) is investigated in this study based on a 3D transient heat transfer model. The GSHP heating and cooling capabilities are simulated and assessed according to thermal energy demands of an air conditioned domestic building, its coefficients of performance (COPs) obtained from numerical analyses and experimental tests are compared and the largest difference between them is less than 8%. The maximum heating and cooling COPs of the GSHP are 3.63 and 4.73 respectively in the first year operation period, and the soil final temperature is lower than its initial temperature, therefore the soil is not capable of recovering by itself due to the building unbalanced heating and cooling loads. Finally, the effects of the soil thermal properties on its temperature and the GSHP COPs are investigated and compared between the first year and tenth year operations, and it is found that the soil with low volumetric heat capacity and high thermal conductivity could achieve a quick temperature recovery.

**Keywords:** Energy piles, GSHP, Ground heat extraction/injection, Soil thermal property, COPs

## 1 Introduction

Shallow geothermal energy is one of the most popular renewable energy sources for efficient building air conditioning with GSHP. A typical GSHP system is presented in Fig.1, which consists of three main components: (i) ground heat exchanger (GHE), (ii) heat pump and (iii) ventilation system [1]. In winter, soil temperature is higher than the mean ambient air temperature, and therefore the soil can be used as a heat source for space heating; however, in summer, its temperature is lower than the average outdoor air's and the soil can be adopted as a heat sink for space cooling. Thereby soil temperature is a very important parameter and should be clarified for designing GHE, which is decided by the geographic location and regional climate condition. Numerous

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