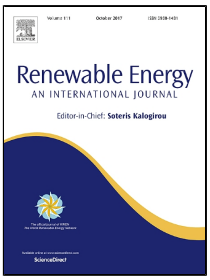
# Accepted Manuscript

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# Influence of Local Geological Data on the Performance of Horizontal Ground-coupled Heat Pump System Integrated with Building Thermal Loads

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## ABSTRACT

Horizontal ground-couple heat pump (GCHP) system incurs lower installation cost compared with the vertical GCHP system. However, the shallow burial depth makes the heat transfer process susceptible to seasonal variations. This paper analyzes the short-term and annual performance of different geothermal heat exchangers' (GHEs) configurations and geological conditions by developing 3D finite element models. Field monitored data of ground temperature and thermal property are incorporated. Six common types of GHE configurations are analyzed, from which the most efficient patterns are identified. The annual performance of optimal GCHP pattern integrated with different types of building loads are analyzed. Major conclusions include (1) application of soil temperature harmonic function as commonly done in the current practice will lead to overestimation of thermal build-up effects underground; (2) utilization of local geological data (i.e., field measured ground temperature and soil thermal properties) helps improve the annual performance of horizontal GCHP system; (3) shift of ground temperature is less significant for GCHP operating in heating dominant areas due to balanced heat injection and extraction. This study indicates incorporating local geological data reduce the GHE design length by 25% to 60% and therefore is a viable strategy to achieve cost effectiveness.

## KEYWORDS

Horizontal geothermal heat pump system, finite element model, building thermal load model, building integration, field monitoring data, geology

## 1. Introduction

The environment issue and fossil fuel crisis have greatly promoted the renewable energy revolution. Geothermal energy, as one type of renewable energy, has been widely explored worldwide. The direct utilization of geothermal energy has been reported to be the most promising renewable energy format, and the total installation capacity at the end of 2014 has increased around 45% compared with that in 2010 [1]. China, United States, Sweden, Turkey and Germany contributed to about 65.8% of the direct-use installed capacity [1]. With the growing awareness and remarkable development of geothermal heat pump system,