

Optimization of Advanced Ground-Coupled Heat Pump Systems

A heat pump is a technology in which heating and cooling are provided by a single piece of equipment. In a Ground Coupled Heat Pump (GCHP) system a length of pipe is buried in the ground and the ground acts as a reservoir to store the heat removed from the building in cooling or provide the heat required by the building in heating. GCHPs are used for residential, commercial, and institutional buildings. In many situations, the energy added to the ground for cooling does not balance the energy removed from the ground for heating, resulting in a change in the ground temperature over time. This change can reduce the efficiency of the system. One way to compensate for the loss in efficiency is to use a longer length of pipe, but this can significantly increase the initial cost of the system.

A hybrid system may be a preferable solution in many situations. In a hybrid GCHP (HyGCHP), an additional piece of heating or cooling equipment is used to supplement the GCHP. For example, if the building is heating dominated, a boiler may be added to the system to provide extra heating without increasing the length of pipe used in the GCHP, minimizing the cost of the system. The HyGCHP program was developed by a previous MS student to optimize the design of hybrid systems. The current research will build on this prior work. Currently, most design programs use a Typical Meteorological Year weather file (TMY2) to design a heating/cooling system. The current research will evaluate how the hybrid design changes when actual yearly weather data are used and develop a means to increase the optimization speed of the HyGCHP program.