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Ground Source Heat Pump on Building Acclimatization in Coimbra, Portugal

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Abstract. The purpose of this paper was the study of different scenarios to the development of the Portuguese demonstration site of GROUND-MED project. This is one of the eight demo-sites in this project which runs under the Seventh Research Programme. The analyses done to the building regards only the energetic component. The first part of the work consists on the thermal simulation of the buildings third floor, done to help in the dimensioning and selection of HVAC components based on the demand of cooling and heating. The second part of this paper concerns the type of boreholes and boreholes heat exchangers selection, taking into account the soil characteristics and acclimatization needs. The simulation of thermal needs was performed in EnergyPlus and the geothermal calculations with the Earth Energy Designer (EED). Many configuration and dimensions are suggested, aiming economical benefits and thermal maximization for the local ground conditions. According to the EnergyPlus calculations, the studied space annual thermal needs totalize 26 MWh in cooling mode and 4.5 MWh in heating mode. The power demand peak is about 48 kW in January and 56 kW in July. To this needs EED calculations showed that 4 boreholes heat exchangers with 107m each are sufficient.

Key words

Ground Source Heat Pumps, Acclimatization, Geothermal Energy, Borehole Heat Exchanger

1. Introduction

The Advanced Ground Source Heat Pump Systems, for Heating and Cooling in Mediterranean climate (the GROUND-MED project), aims to demonstrate the effectiveness of next generation geothermal heat pump (GSHP) systems for heating and cooling in 8 different demonstration sites across South of Europe [1].

One of the GROUND-MED project objectives is to design and monitor a high efficient ground source heat pump, with a measured seasonal performance (SPF) higher than 5 considering operating conditions imposed by both the ground heat exchanger and the building heating/cooling system.

The Portuguese site is located at the northeast bank of Mondego River in Coimbra, a few meters from the margin. The selected building was an old milling factory, converted into the Regional Hydrographic Authority building (ARH), and is mainly composed by offices and laboratories.

Figure 1 shows the building location.

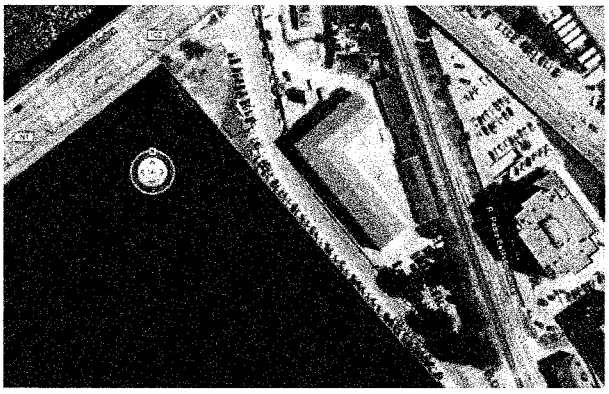

Figure 1 – Coimbra site location (Google Earth)

A notable aspect of this building is its particular characteristics, due to the fact of being a recovered old building, with limestone walls which thickness goes from 0.6 to 1.1 meters. The third floor has the thickest wall with "only" 0.6 meters wide. The wall layers are showed in figure 2.

The ground source heat pumps that will be used on this demonstration site will be developed by CIAT, as well as the new fan coil, and have being developed to distribute air at moderated temperatures.