Heat Pumps & Cooling Distribution Systems

Ground source heat pumps can operate in reverse-cycle mode providing chilled water to cool a building and operates in a similar manner to a chiller. This is a modification that needs to be specified at the order stage as physical changes are required to the heat pump at time of manufacture.

However there are some considerations that need to be taken into account when using a ground source heat pump for chilling:-

At the end of a heating season the ground arrays will normally be operating at around 0 to 5 °C. The amount of time for the array to return to 'normal' ground temperatures depends upon the type of array (drilled vertical ground arrays will generally remain cool for a period of time, where as horizontal ground arrays will quickly return to the surrounding ground temperature due to a higher solar gain and especially after a period of rain). However the ground temperature will generally be cooler than the surrounding air temperature in Summer.

This colder temperature can allow a degree of passive or 'free' cooling to occur if the building has passive beams or an underfloor cooling system. This is simply achieved by passing the contents of the cooling system through a plate heat exchanger with the ground array fluid passing through the other side. This system completely bypasses the heat pump and the only energy used is the power required by the water pumps. How effective this cooling is and for how long depends upon the amount of cooling required and again the type of ground array.

A reverse cycle heat pump can also be used to provide 'active' cooling where the heat pump is used to generate chilled water (usually at 6 to 12 deg C, although with underfloor distribution systems this might be higher to avoid condensation forming on the floor). For a ground source heat pump to actively cool, modifications need to be made to the unit at the time of manufacture.

There are various different types of cooling distribution systems available (see over).

The figures provided are purely nominal, and will vary for each application depending on the nature of the building, and the design of the cooling distribution system.

Cooling Distribution Systems					
	Buffer tank required	Typical flow/ return temperatures °C	Typical cooling densities W/m	Antifreeze protection required °C	Special controls required
Fan Coils	No	6 & 12	50 to 300	-10	No
Active chilled beams	No	6 & 12	10 to 70	-10	No
Passive chilled beams	Yes	18 & 24	5 to 50	-5	Yes
Underfloor	Yes	16 & 21	5 to 39*	-5	Yes

* This figure is restricted by the dew point & space design condition, spacing of underfloor pipes and the floor covering.

Typically with a design condition of 25degC air temp (delivers a radiant comfort effect of 24degC), underfloor pipe spacing at 150mm, tile floor covering and a MWT of 18.5degC, the system will deliver in the region of 20-25 W/m2 whilst still keeping above the dew point at a relative humidity of 50-60%.

However, if cooling densities start to approach these theoretical design conditions, ever more sophisticated and more accurate controls will be required to be certain to prevent condensation forming on the floor, which would otherwise form a hazard.

In all cases: -
1. The cooling distribution system will require a level of antifreeze protection along with an inhibitor.

2. The cooling water temperature should be managed via an auxiliary control system, not part of the GSHP.

3. A buffer tank is required as part of a cooling distribution system, not part of the GSHP

4. A flow sensor should also be used as an interlock to stop the heat pumps running if there is no flow around the cooling distribution system.

5. Where multiple heat pumps are used and the heating load may be the predominant load; design consideration should be given by the specialist consultant as to the provision of number and types of heat pumps, buffer vessels with control valves to ensure the correct operation of the system to deliver the requirements.