

HVAC & R

Nation

AN AIRAH PUBLICATION

FEATURE

Large-scale residential geothermal

Skills WORKSHOP

Refrigerant leaks and corrosion



IN THE DRIVER'S SEAT

INSTALLING AND MAINTAINING PORTABLE AC AT MAJOR EVENTS

The thrill of the drill! Three to four hours of drilling is required before geothermal loops can be lowered into the ground.



BELOW GROUND, ABOVE PAR

“

All houses will be connected to their own heat pump and geothermal loop that will reduce household heating and cooling energy costs by over 60 per cent.

”

Targeting both innovation and leadership in sustainability, Fairwater is the first project in New South Wales to be awarded a 6 Star Green Star – Communities rating, and aims to provide home owners with sustainability benefits into the future.

One of these is a commitment by Frasers Property Australia to install geothermal air conditioning systems to each of the 950 new homes being built on the site, making it the largest residential geothermal installation in the Southern Hemisphere.

A major development on a former golf course in the western suburbs of Sydney is set to feature the largest residential geothermal installation in the Southern Hemisphere. **Sean McGowan** reports on the Australian technology that is expected to reduce cooling and heating energy costs by over 60 per cent.

Purchased by Frasers Property Australia in 2011, the former Ashlar Golf Course site in Blacktown has been rezoned for the residential development of approximately 1,300 homes and apartments. The estate is known as Fairwater.

As Western Sydney's newest community, the 38ha site combines a mix of detached and semi-detached dwellings along with 9.5ha of public open space. There is 1.5ha of ponds, wetlands and waterways linked by walking and bicycle paths.

GREEN STAR BENEFITS

The use of the QPS Geothermal solution at Fairwater contributed significantly to the development being awarded a 6 star Green Star – Communities rating.

Of the 81 points achieved by the project, 10 were directly related to the geothermal installation including:

- Industry capacity building
- Incentive programs
- Greenhouse gas emissions
- Peak demand reduction
- Innovation.

“The installation of the geothermal loops is relatively easy for QPS given our heritage in ground engineering (but) we needed a robust heat pump to compliment this, which was a key reason for partnering with a company such as ActronAir.”

QPSG partnered with ActronAir to develop its own heat-pump solution. Product development and robust testing was conducted at ActronAir’s manufacturing facility in Sydney after QPSG installed a number of geothermal loops for this purpose.

Each home is fitted with standard fan-coil units, including wall-mounted thermostat controls, which connect to the heat pump. All interconnecting refrigerant pipe, electrical and controls are installed as per any standard system.

DRILLING DOWN

Also known as ground-source heat pumps (GSHPs), geothermal systems for heating and cooling work in much the same way as conventional direct exchange (DX) systems – except that the condensing loop is installed in the ground where stable sub-surface temperatures are taken advantage of.

Their installation is completed in two stages – the in-ground works and above-ground works.

But given the scale of the Fairwater development, it was critical that QPSG completed the installations around the normal build processes and programs of the development.

“We worked with the Frasers Property building team to establish a methodology that allows for the new works to be completed with no impact to the build,” says Costello.

Works on each home site only commence after Frasers Property nominate the location of the heat pump in the completed construction drawings.

A survey marker is then placed to mark the location for the geothermal loop – typically 200 mm off the proposed slab.

The QPSG drilling crew then drill a well, measuring at 125mm in diameter, to a specified depth. This process takes between three to four hours, depending on the depth and ground conditions encountered.

Once the well is drilled to the required depth, a geothermal loop is suspended above the well before being slowly lowered into the well to depth. A “trammie tube” is attached to the end of the loop before installation, and is used to inject a special geothermal grout the length of the vertical bore.

According to Costello, the placement of this grout is an integral part of the system. It guarantees thermal transfer between the installed loop and the surrounding ground. And, it also performs a secondary function by providing environmental protection against surface water pollution of ground water.

When in place, the geothermal loop is capped off.

The slab is then poured and the home is constructed. Normal interior rough-in and fit-off is undertaken by Fraser Property Australia’s nominated air conditioning contractors.

After the home is built and landscaping is completed, QPSG connects the heat pump to the geothermal loop, and commissions the system before hand-over.

IN OPERATION

The heat pump has been designed to be both compact and quiet – both important factors given the density of the Fairwater development.

Measuring 600mm by 600mm, and standing 890mm high, the units have no external fan or condenser coil, allowing them to operate at just 51dB.

All houses will be connected to their own heat pump and geothermal loop, which is expected to reduce household heating and cooling energy costs by more than 60 per cent.

This work is being conducted by QPS Geothermal (QPSG), a division of Queensland Pre Stress (QPS). It is the only company operating in Australia that self-fulfils all works – in that it not only provides the geothermal drilling services, but also supplies and installs specially designed heat-pump technology through its GeoAir division.

“The nature and scale of this project is a first within the Australian market,” says QPS Geothermal director Paul Costello.



A drill rig in action.

THE GEOAIR SYSTEM



Internal works

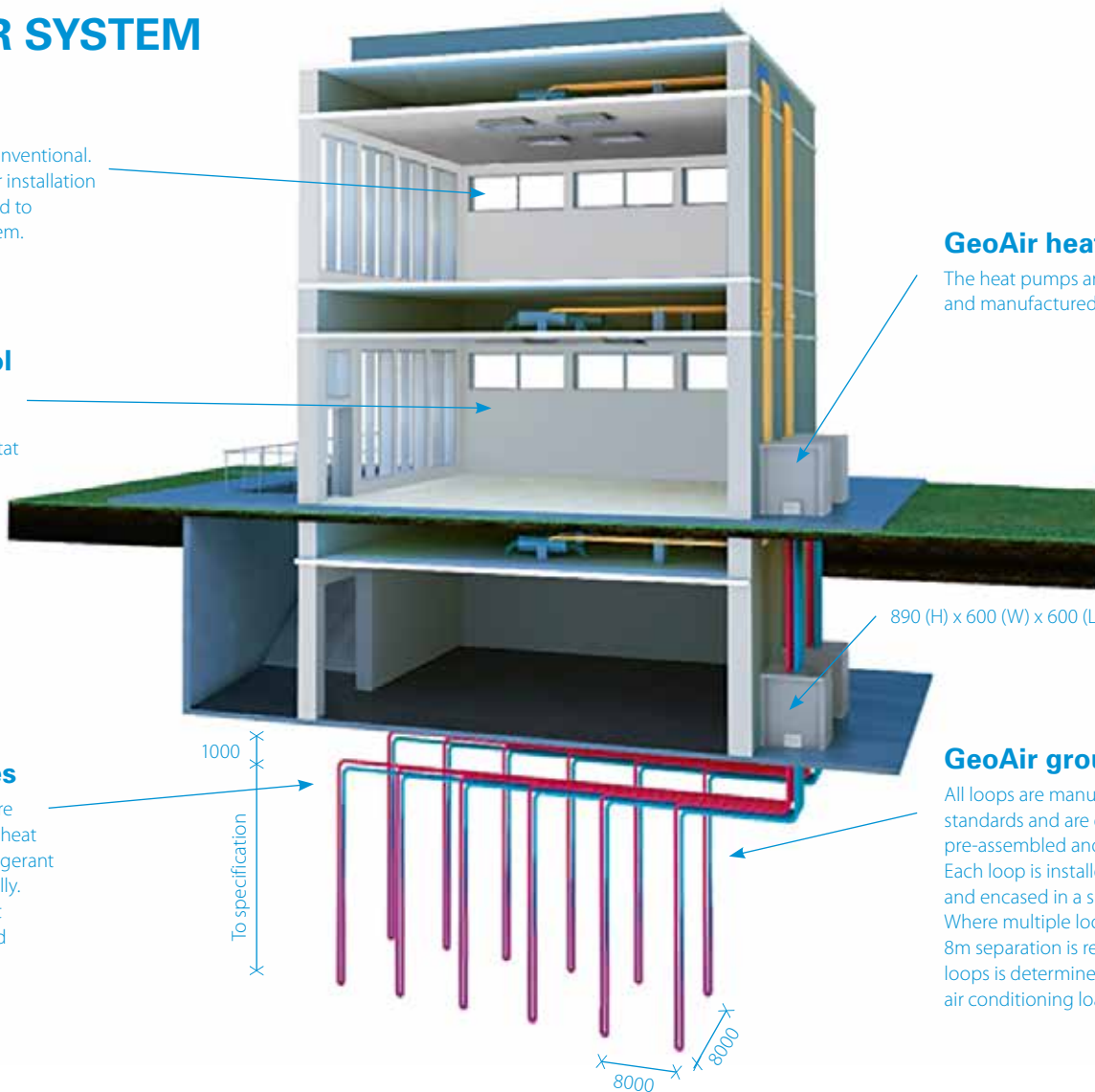
All internal works are conventional. No alternative design or installation methodology is required to accommodate the system.

System control

The system can be controlled either by wall-mounted thermostat or BMS interface

Horizontal lines

Where multiple loops are installed connection to heat pumps is by way of refrigerant lines installed horizontally. Depth of lines is subject to site requirements and in-ground service coordination.



GeoAir heat pump

The heat pumps are Australian designed and manufactured.

GeoAir ground loops

All loops are manufactured to ISO9001 standards and are delivered to site pre-assembled and to strict quality controls. Each loop is installed to specified depth and encased in a special geothermal grout. Where multiple loops are installed an 8m separation is required. Total number of loops is determined by the building's air conditioning load.

The layout and function of the heat-pump unit has been designed to be similar to a conventional system, so that any air conditioning contractor (no matter their experience in working on ground-source heat pumps) can inspect and service them in the future.

In cooling mode, the heat pump circulates a hot refrigerant vapour into the ground via the installed geothermal loop where it absorbs the naturally cooler and stable sub-surface temperature.

With excess heat removed, this cooled refrigerant condenses into a liquid before being expanded through an expansion device at the heat pump.

At this point, the pressure is lowered causing the temperature to reduce further.

This refrigerant is then circulated through the fan-coil unit installed in the home, absorbing excess heat from the air. This causes the refrigerant to heat and expand back into a vapour, and the cycle is repeated.

In heating mode, cold refrigerant is circulated within the geothermal loop, where it absorbs the sub-surface heat. This heated refrigerant vapour is compressed and circulated through the fan-coil unit to provide heating to the building.

CLEAN AND GREEN

Construction of dwellings at Fairwater commenced in late 2014, and the first residents moved into their homes late last year.

"To date, we have installed just under 300 geothermal loops and commissioned and handed over 140 homes," says Costello.

Construction will continue in stages until May 2020.

When completed, almost 1,000 homes will have their own GeoAir system. The total system will deliver 10,000kW of thermal energy across the development.

Frasers Property Australia has forecast that the average homeowner at Fairwater will save approximately \$600 per annum – a reduction of more than 60 per cent in their heating and cooling costs compared to conventional air conditioning units.

Greenhouse gas emissions will also be reduced by over 13 per cent compared to conventional air conditioning units.

Additionally, a reduction in peak energy demand in excess of 40 per cent is expected across the community – providing significant downstream benefits to the electricity network.

"It is our hope that the use of geothermal at such a scale as at Fairwater will contribute significantly to the industry as a whole," says Costello.

"And as is the case in other parts of the world, that geothermal is recognised as a suitable and viable solution for cooling and heating." ■



The layout and function of the heat-pump unit has been designed to be similar to a conventional AC system.