CHURCHES OF CHRIST NEW QUEENSLAND HEAD OFFICE

CASE STUDY

Churches of Christ
Kenmore Queensland

Head Contractor
National Construction Management

Consulting Engineer
Ashburner Francis

GEO AIR
HEATING COOLING

Overview

Churches of Christ is an established not for profit organization operating a broad range of community based services. With a long established base in Brisbane suburb of Kenmore, the organization is embarking on a staged redevelopment of this site which will see a community living, short stay accommodation and aged care facility eventually developed. Stage one of the renewal is the building of their new head office.

Churches of Christ in Queensland has the environment and sustainability at top of mind and is aiming for the highest possible energy efficiency rating with the development. The new head office building will feature a large solar panel array, geothermal air conditioning, photovoltaic energy generation and even provision for electric vehicles.

Geothermal Air Conditioning

To accommodate project requirement, QPS Geothermal delivered a 500kW central plant system, offering both heating and cooling as well as heat recovery for potable hot water. A high level interface was required for integration into building management system.

Works undertake were to Ashburner Francis specification as summarized below.

A. Installation of fully operational central geothermal plant for chilled and hot water.

B. Installation of heat recovery for potable hot water. Including provisioning of water circulatory lines to future build location. Single point chilled and hot water connections provided for mechanical contractor.

C. Provision of sub mechanical switch board for single point connection by mechanical contractor.

D. Provision of controls interface for Building Management System with single point connection for controls contractor.

Installation Overview

Unit	Capacity Cooling	Capacity Heating	Geothermal Loops	Heat Pumps
AC1	500kW	160kW	50 at 80m	25 at 20kW

1. Geothermal Loops

Works commenced in March 2015, with a total of 50 geothermal loops installed, 32 of which were located beneath the building, QPS Geothermal deployed two specialist drilling rigs for work to accommodate program requirements. Ground conditions encountered were basalt with layers of quartz requiring down the hole hammer drilling methodology to be deployed

All GeoAir loops were installed with 8m separation. QPS Geothermal worked closely with the head contractor prior to commencement developing a coordinated services drawing to remove any in ground services conflict. All in ground works were programmed to maximize on site efficiency given works were on critical path.

Horizontal Line Runs

Geothermal loops were connected to plant location by way of excavated trenches at one meter below surface. All lines were installed within protective insulation and warning tape above lines. All excavated tranches were backfilled with sand.

All installation works were undertaken under controlled quality management, with installed lines vacuum and pressure tested prior to backfill. Lines were terminated within plant room for future connection to geothermal plant.

2. Geothermal Plant

Central plant was installed with a total cooling capacity of 500kW and heating capacity at 160kW. Located within designated plant area in basement, GeoAir

plant replaced conventional chiller and boiler configuration. Total plant area is at 8200 x 3300 inclusive of service space. With each heat pump operating at 51db and requiring no ventilation, the installation did not require external plant, roof top platforms or cooling towers.

3. Electrical

QPS Geothermal provided a mechanical sub board for single point connection by mechanical contractor. Sub board was located adjacent to geothermal plant.

4. Controls

High level interface was required for installation with interface into building management system. Using a centralized PLC, the GeoAir controls interface directly into building management system through BacNet protocol. Providing full automation and integration, controls system also provide real time data on all aspects of system operation.

Single point connection was provided for controls contractor with touch screen display.

Potable Hot Water

Geothermal plant connected to potable hot water to building via heat recovery exchangers installed in series. Provision for future supply to residential buildings is via circulatory lines installed to location as per drawings.

Passive hot water production will provide significant future operating benefits for facility.

System Efficiencies

GeoAir system as installed is operating at a total plant co-efficient of performance of 7.0. With 25 heat pumps at 20kW each installed, the plant has the ability to operate with only 4% of the total plant operating. This modular nature of the installation provides significant part load efficiencies of the plant contributing significantly to the total operating efficiencies.

GeoAIr Installation Design Parameters

Ground Source Heat Pump	
Temperature Entering GHE	65C (cooling mode)
Fluid Type	R410a (Refrigerant)
Fluid Mass Density	1040 Kg/m3 (30C)
Fluid Specific Heat Capacity	0.84 kj/kg-K
Fluid Dynamic Viscosity	Subject to operating temperatures
Ground Conditions	
Ground Type	Granite / Basalt
Thermal Conductivity	4.673 W/MC (+/- 0.045)
Ground Heat Exchangers	
GHE Spacing / Arrangement	8m linear
GHE Depth / Diameter	80m / 125mm
GHE Grout	Grout 111
Grout Thermal Conductivity	2.343 W/MK (+/- 0.045)
Grout Density	1.841 kg/m3
System	
Field Sizing Capacity	500kW
Full Load Cooling	500kW
Piping	
Pipe Type	Copper (R410A Grade)
Wall Thickness	0.91mm
Pipe Thermal Conductivity	392.869 W/MC
Pipe Configuration	Vertical. Liquid line fully insulated

Equipment Selection

GHP – 1-25	Heat Pump	Geothermal Loop	Heat Exchanger (Cooling)	Heat Exchanger (Heating)	Heat Exchanger (Heat Recovery)
Manufacturer	GeoAir	GeoAir	Fluid Dynamics	Fluid Dynamics	Fluid Dynamics
Model Number	GEA61AT	QPS_80GL	FDR096H	FDR096H	FDK050
Size	20kW (per unit)	80m (per loop)	20kW	20kW	10kW
Qty	25 off	50 off	25 off	8 off	25 off
Unit Reference	GHP_1-25	GEO80GL	CWHX_1-25	HWHX_1-8	HRHX_1-25
Compressor	Copeland Scroll	N/A	N/A	N/A	N/A
Electrical (each) Volts Phase FLA OA	 415 three 13 9.1	N/A	N/A	N/A	N/A
Refrigerant	R410a	N/A	R410a	R410a	R410a
Dimensions	600 x 600 x 800	8m Centers	522 x 106 x 121	522 x 106 x 121	306 x 106 x 82.3
Weight	105Kg	N/A	12.31Kg	12.31Kg	5.96kg
Refrigerant Line	V – 22mm L – 12mm	V – 20mm L – 12mm	V -28.8 L – 22.36	V -28.8 L – 22.36	V -16.15 L – 16.15
Water Connection	N/A	N/A	25mm (1”)	25mm (1”)	25mm (1”)
Grout	N/A	Grout 111	N/A	N/A	N/A

Installation Benefits

1. Reduced electrical infrastructure was required for project significantly reducing associated costs
2. Significantly reduced operating costs of air conditioning plant will provide benefit for organization over the life of occupancy
3. No external plant removed need for rooftop plant and external plant enclosure removing associated build costs
4. System offering both heating and cooling removes total plant on site offering ongoing maintenance costs
5. Compact nature of plant reduces spacial requirements within building allowing usage for other purposes
6. Waste heat from system provides potable hot water passively for building. Provisioning for future aged care accommodation to be built on site will provide passive potable hot water for this facility

QPS GEOTHERMAL

69 Fredrick St Northgate QLD 4013

Phone: [07] 3256 7092
Fax: [07] 3256 8251
Email: info@qpsgeothermal.com.au
Web: qpsgeothermal.com.au