



The Generatori Building

Innovative engineering preserves Venice Arsenale

An innovative climate control system that taps into the natural energy of the Venetian Lagoon is delivering high levels of comfort and energy efficiencies while preserving an historic industrial building in the heart of Venice.

The Venetian Arsenale was once the lifeblood of Venice's naval power. The Byzantine style complex dates back to 1104 AD and spans an area of 45ha, or about 15% of the city. While it is still home to a working naval base, this complex of shipyards and armouries has, in recent years, been undergoing a transformation.

Many of the buildings have been refurbished and put to new use as offices, homes and cultural facilities, as part of a programme being carried out by the Ministry of Infrastructure and Transport – The Venice Water Authority working to save the city from sinking into the lagoon.

The objective is to provide functioning buildings, while preserving the Arsenal's historic architecture. This required seismic retrofitting of structures and new infrastructure, including power, water, sewage and fibre optic cables.

Tapping into the heat of Venice's Lagoon

The underground utility network takes advantage of the natural resource on the city's doorstep, with the inclusion of a water loop heat pump system. The innovative system extracts thermal energy in the water pumped from the Venetian Lagoon, to provide heating for buildings.

Each building on the network has its own heat pump system, which draws heat from the water loop to control the internal climate. In essence, the water loop acts as a district heat recovery system, taking excess heat energy from buildings and transferring it to others, where it can generate heating and hot water.

For most of the year, the lagoon water is between 10°C and 26°C, which allows building heating systems to operate most efficiently. However, for a few weeks a year, typically between December and February, the water temperature can fall below 5°C. At these times, glycol will be added to the system and an additional heat pump will raise the water temperature to ensure efficiency of the system is maintained.

Restoring the Generatori Building

One of the most recent buildings to benefit from this ingenious system is the recently restored Generatori Building. Built in the early 1900s on the northern edge of the Arsenal, this building once housed diesel-electric generators that supplied electricity to the shipyards.

The three year restoration project, which began in May 2010, involved repairing the building’s outer masonry walls and roof, removal of internal structures and glazing of arches running down its long sides. Inside, a steel and glass office building was constructed. This ‘building within a building’ is structurally independent of the outer shell. Construction was carried out by Thetis SpA, with design by architect Cecchetto and Associates.

The new three storey building contains offices, meeting rooms and archives. It was designed with a cooling demand of 80kW (at Te of 35°C) in summer and heating demand of 87kW (at Te -5°C) in winter. These are met by a Daikin water-cooled VRV geothermal system with heat recovery, which uses the water loop as its energy source.

The Daikin VRV climate control solution

The VRV system comprises water cooled heat pumps supplying underfloor heating in the new ground floor reception, meeting rooms and basement and fan coil units on the upper two floors of offices. There are also ventilation units throughout the building to provide fresh air.

The comfort of individual zones can be controlled by occupants (eg fan speed, temperature and timers) and everything is linked to the building management system.

The VRV-W system continually adjusts to meet the heating or cooling demand, so energy consumption is low. In fact, the geothermal version of VRV-W has an operation range down to -10°C inlet water temperature in heating.

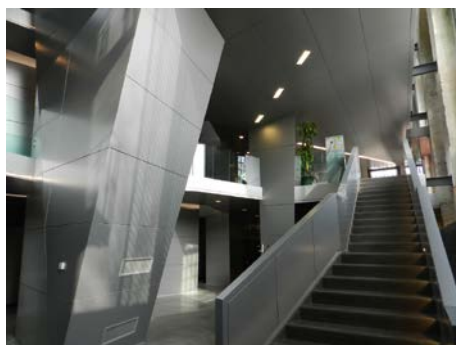
Unlike conventional air-to-air systems, performance is unaffected by outside air temperatures, so high levels of efficiency are maintained all year round and comfort is assured. Additionally, water cooling means no defrost operation is required and the resultant rapid start-up time assures quick and comfortable heating, even on the coldest days.

The Generatori Building’s efficiency is further improved by use of heat recovery – not only via the water loop but within the building itself. The system recovers “free” heat from areas requiring cooling – typically the upper two floors – and uses it to heat other areas and provide hot water for washrooms. Any excess heat energy is drawn off by the water loop and used in other buildings as necessary.

Overall, heat recovery accounts for about 12% of the total energy consumption, with a resultant lowering of operating costs and reducing CO₂ emissions.

Daikin’s VRV-W geothermal system was the ideal choice for this project, as it could easily be connected to the Arsenal’s water loop system to deliver a highly efficient and sustainable solution to climate control.

Moreover, because VRV is a modular system, the quiet, compact and lightweight heat pump units are located discretely throughout the building. This allowed the best use of available space and demonstrates VRV’s suitability for sensitive restoration projects.



Daikin fan coil units and radiant heaters control the climate within the new offices.



Heat extracted from Venetian Lagoon water is used to heat and cool buildings in the Venice Arsenal.