

All in one system solves Korean HVAC Challenges



Jackie Blanden of Protek,
with Boris Johnson, Mayor of London

The large floor plates include open plan, partitioned and cellular offices.

The designers of Mando Lab's new office building in South Korea were clearly influenced by its location in Pangyo when they drew up their plans. Pangyo is a newly developed eco-friendly city south of Seoul, which was designed with parks and large green spaces. Additionally, green technologies were incorporated in energy plants, waste facilities, etc., in order to maximize energy efficiency.

The design called for an energy efficient HVAC system. In line with South Korea's energy legislation, only free cooling from outdoor air is allowed during the Spring and Autumn. The 10 storey building has large floor plates with machine rooms that service each floor.

At Protek, they simply decided to design a new unit for this project to enhance the energy efficient requirements. Protek's concept for Mando Lab soon crystallized into the Combi Unit, and 24 units were delivered for this project.

Mando Lab building in Pangyo

Overall, Protek together with its Korean agent,

Kprotek, delivered a turnkey underfloor air conditioning system, complete with Combi Units, RAG (FTU) units, BMS for the HVAC system, attenuators, and including installation of the system, start up and commissioning.

The recently completed commissioning of the system confirms the efficiency of the design.

Protek's Tim Edwards, who was key in the design of this unit said, "Our strategy of combining energy efficient components with energy saving management strategies has delivered a superb result. The SFP (Specific Fan Power) measurements of between 0.35 kW/m³/s and 0.91 kW/m³/s at full speed are very good."

"Further, we are all delighted at the acoustic readings which are all below 40 dBA. The attention to detail and cooperation between Kprotek and the Halla Construction team on site have all contributed to this result."

Protek is a Swedish company which specializes in underfloor air conditioning systems and its experience goes back many

years to the inception of these systems in the 1980s. Swedish concepts of energy saving and innovation have played a large part in the design of its units and Protek was the first underfloor manufacturer to use energy efficient EC fans as standard in its Zone Units. EC fans are also used in its RAG units.

Control System Development

Possibly Protek's most important innovation was to develop a control system for its units which is based on temperature control and not pressure control; a major differentiation from other UFAD systems.

In UFAD systems, it is important to understand the two significant impacts on the system which are caused by:

- First, the thermal properties of the floor slab and
- Second, the leakage of the supply air in the floor void.

As the Supply Air is in direct contact with the floor slab, the Supply Air gradient can vary significantly depending on the temperature of the floor slab at, say, the perimeter of the

The new Mando building consists of separate twin blocks connected by bridges.



building compared to the slab temperature in an internal zone. This temperature difference can be between +3oC to + 5oC at the perimeter zone compared to an internal zone. Tests have shown that air velocity of 2 m/s in a concrete plenum allows airflow of up to 30m without significant heat pickup, whereas the heat pickup at 0.3 m/s is dramatic. In a pressurized system, it is difficult to control this temperature gradient because of the stagnant air in the floor void, an inherent problem with pressurized systems.

That is why Protek designed a temperature based system which relies on temperature sensors in the room, in the floor void (in the RAG units), Return and Supply Air temperature sensors as well as a slab temperature sensor; and uses bypass grilles in the perimeter areas to ensure constant air movement in the floor void. Due to the temperature control, there is no need to pressurize the floor void. The bypass grilles ensure that the supply air in the floor void is never stagnant and so eliminates the risk of heat pick up or thermal decay.

The Supply Air from the floor void is introduced into the office areas by local fan terminal units (RAG units) which control the micro climate in each zone. These RAG units have EC fans and dampers and, with Protek's temperature control, are particularly well suited to applications involving high and varied heat loads.

Protek's control strategy also uses the floor slab to store energy by managing the temperature of the floor slab to minimize



peak cooling demand or, where climatic conditions allow, for cooling the floor slab by ventilation from outdoor air at night so as to reduce demand at start up in the mornings.

The Protek temperature control also eliminates the problem of Supply Air leakage from the raised floor plenum. Leakage of supply air from the floor void happens in a number of ways:

- in the base building core and shell areas for example in expansion joints in

the concrete slab, at dry wall partitions in the concrete slab, at elevator shafts below the raised floor, etc.

- in the plumbing system where pipe penetrations through concrete slabs and plenum walls are a major problem
- in the electrical system where cables in the underfloor baffles need to be sealed.
- In the communication cable system. Underfloor baffles need to be carefully sealed to prevent leakage where Cable trays penetrate the baffles.

- In the access floor where leakage occurs between the floor tiles.

UFAD systems which use Pressure Control demand stringent tests and procedures to eliminate leakage; while Protek's temperature based system has no such requirements for leakage control or air balancing for the system to work.

Combi Units and Protek BMS

Jackie Blanden of Protek, is keen to tell us more about the Protek Combi Units and to emphasize the benefits of their BMS system.

These units can supply 100% outdoor air when the climatic conditions allow for ventilation to provide the cooling; or supply a minimum of outdoor air (based on CO2 control demand) with cooling supplied by cooling media.

Designed especially for this project, the Combi Units combine the functions of outdoor air AHUs and Zone units for cooling and heating demand, together with heat exchangers for energy saving and humidifiers for the dry Korean winter condition. These units can supply 100% outdoor air when the climatic conditions allow for ventilation to provide the cooling; or supply a minimum of outdoor air (based on CO2 control demand) with cooling supplied by cooling media. In addition, the heat exchangers provide savings in the cooling and heating demand due to the energy exchange which has an efficiency of approximately 75%.

To date, the interest in these Combi Units has been outstanding.

The energy efficient and highly specified components used in the Combi units include some of the best names in European HVAC components, including Ziehl fans, Danfoss valves, Vacon inverters and WAGO controllers.



Protek's Combi unit combines functions of Outdoor Air AHUs, Zone units for cooling and heating, together with heat exchangers and humidifiers.



The acoustic readings are all below 40 dBA

Protek also provided a comprehensive BMS for the HVAC system in open standard which is compatible with Protocols such as Bacnet, ModBus and LonWorks. The BMS features

- Controllers in the Zone Units, Combi Units, OA AHUs and RAG units with Open Protocol and compatible with any modern BMS systems.
- Nethub Web Server providing information exchange with main BMS system
- The Nethub Web Server also provides Alarm Lists and Administration control and pages featuring time control, plant overview, floor plans, building energy management and much more in the way of reports to management.
- Korean language option is also available due to demand from clients.

When the system is connected to the internet, Protek can overview operations from their factory and remotely fine tune and optimize the entire system.

New Product Developments

New products for Protek's Office underfloor system are constantly being developed and existing products upgraded with new technologies, with a view to streamline installation and control and provide the best energy efficiency.