Finglas Swimming Pool

Introduction

Dublin City Council has a state of the art 25m swimming pool as part of its new complex in Finglas, Dublin. A childcare centre, a four storey regional civic office, a youth centre and 6 outdoor floodlit pitches make up the entire development.

A swimming pool building by nature is a highly serviced building with potentially high energy consumption due to constant thermal and electrical loads throughout the year. On the other hand, there is often substantial economic scope to incorporate technologies to improve the building energy performance. This case study demonstrates how a swimming pool can successfully integrate sustainable design techniques and provide a low energy, user-friendly, easily maintainable building without any compromises on the comfort of the occupants.

Building Description

The building is a two storey lightweight steel framed structure with metal decking roof and side walls, with a total floor area of 2880m^2. The ground floor is made up by the double height main swimming pool hall, aerobics studio, offices and changing areas. A gym, associated toilets and changing areas and offices are located at first floor level.

Energy Efficiency Specification

Building Fabric

The high internal temperatures required in pool buildings justify the use of higher insulation levels to reduce the rate of heat loss through the building fabric. Sufficient insulation has been installed to ensure a 30% reduction from standard U-value requirements in the prevailing Building Regulations, thus reducing both heat losses and gains through the building fabric. Details are given in the following table:

Structure	*Building Regulation U-Value (W/m²K)*	*Finglas Pool U-Value (W/m²K)*
Wall	*0.45*	*0.30*
Roof	*0.35*	*0.18*
Floor	*0.45*	*0.30*

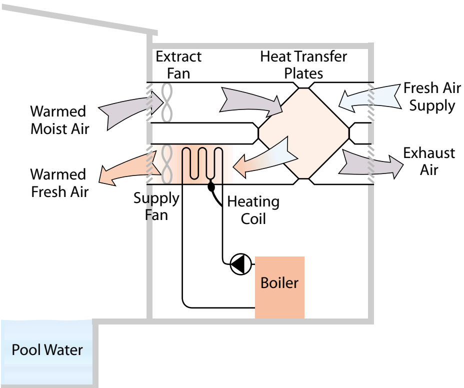
Design calculations indicate that the payback period on the additional investment will be approximately four years with an energy saving of 7,140 kWh and 5850 kg CO_2 per year.

Careful consideration was given to the specification of the services, controls and construction to provide a comfortable environment with reduced running costs.

Ventilation Strategy
The building is split into three ventilation zones determined by expected occupancy and by plant space restrictions.

A mechanical ventilation system is essential for a swimming pool in order to control the humidity level. Two main Air Handling Units (AHUs) serve the pool hall and the changing village. The units are equipped with supply and extract variable speed drives which continually vary the speed of the fans according to the humidity of the pool hall ensuring that they only run at the required capacity. At night, when the pool is unoccupied, less ventilation is required. Therefore, a night set back mode is incorporated into the control strategy for the pool hall AHU with the supply and extract fans running at approximately half speed. This maintains sufficient heat levels to keep the pool water and hall at a desired temperature.

Typical Ventilation System with a Plate Heat Exchanger



In the case of Finglas Swimming Pool there is a low level warm air supply via a concrete plenum on one side of the wall, with a mid height warm air supply via concealed ductwork on the other side of the wall. The hall extract is via two high level ducts on both sides of the walls.

Minimising Evaporation-Pool Cover
A high evaporation rate results in a high heat loss from a typical swimming pool surface and the consequent requirement of higher ventilation rates in order to control humidity levels. It therefore has the capacity to be a significant energy expenditure factor. A pool cover is the most effective means of reducing evaporation from the pool surface and will be in place when the pool is not in use. As well as minimising heat loss from the pool it will reduce the need for pool hall ventilation at these times and allow for the ventilation system to work in night set-back mode.

Design calculations indicate that the payback period on the additional investment entailed by the combined measures of the ventilation strategy and the pool cover will be approximately 3.5 years with an energy saving of 35000 kWh and emissions abatement of 6300 kg CO_2 per year.

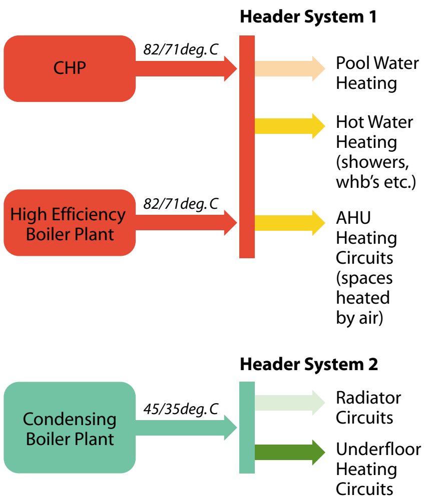
Heat Recovery
Plate heat exchangers have been incorporated into the two AHUs. These are more efficient than the typical run around coil exchangers. The extract air warms metal plates and transfers this to heat the supply air. Less energy is then needed to achieve the high supply air temperatures required to maintain these areas at design conditions.

It is expected that the additional cost for the installation of plate heat exchangers will pay back within one year with energy savings of 540,000kWh and 97,200 kg CO_2 per year.

Heating Strategy
The choice of heating systems throughout the building was determined by practicality and efficiency.

Heating is fuelled by three sources, and split into two separate systems as shown in the schematic below.

Heating Schematic



The first header system consists of a high efficiency low temperature hot water system running at 82°C flow/71°C return temperatures and serves constant temperature circuits such as pool water heating, domestic hot water and air heating. A combined heat and power (CHP) plant was incorporated due to the simultaneous demand for heat and electricity throughout the year. This provides a 180kW thermal load and acts as the lead boiler for this system. The unit has been sized to meet a constant electrical demand of 110kW for the building for the minimum of 5000 hours a year, which ensures a payback period for the CHP of 9.75 years. The CHP system does not feed back to the public electricity grid. The heat generated by the CHP is topped up by two high efficiency boilers.

The second system is fuelled by two condensing boilers running at 45°C flow/35°C return temperatures and serving variable temperature circuits such as underfloor heating and radiators. The underfloor heating is installed in the changing village, foyer and aerobics studio while radiators heat the gym and outdoor changing areas. The radiators are sized to allow the system to constantly run at a low return temperature which in turn allows the condensing boiler plant to run in condensing mode and achieve extremely high efficiencies. Condensing boiler plant will typically achieve a peak efficiency of 93% (gross calorific value) as opposed to a standard conventional boiler which will typically achieve peak efficiencies in the region of 83%.

All pumps are duty standby and where possible infinitely variable speed drive pumps have been incorporated to ensure minimum running costs and maximum energy savings.

Water Services
A 56,000 litre cold water storage tank is located in the main plantroom providing a boosted cold and hot water supply throughout the complex. Hot water is provided via two 2,500 litre quick recovery storage cylinders complete with manufacturers plate heat exchangers.

The following pay back periods and energy savings are expected from the heating plant:

Plant	Pay back (years)	Energy Savings (kWh per year)	CO_2 Emission Savings (kg CO_2 per year)
High efficiency boilers compared to a conventional boiler installation with 85% efficiency	*2.3*	*360,000*	*65,000*
Condensing boilers compared to a conventional boiler installation with 85% efficiency	*3.4*	*70,000*	*12,600*
Variable speed drive pumps	*10.6*	*17,500*	*11,600*

Approximately 30m^3 per week is used to backwash the pool water filters alone and in addition to this there is a large demand for domestic hot and cold water serving showers and changing areas. Buro Happold worked in conjunction with The City of Dublin Energy Management Agency (CODEMA) to determine a strategy to minimise water consumption within the complex. Rain water recycling was considered to provide back wash water for the pool filters or to provide water for WC flushing but was ruled out due to cost constraints.

The following methods were, however, implemented:

- 15 second push button control on all sinks and wash hand basins were installed to prevent water being left on unnecessarily
- Flow restrictors were set on taps to allow a water flow of 3.5 l/min for wash hand basins and 6.0 l/min on sinks
- PIR (personal infra-red) shower controls in the main communal shower area ensure showers only run when they are actually being used
- Flow restrictors set on showers to 8.0 l/min
- Wall mounted 'Cisternmiser' controls for automatic urinal flushing over each urinal bowl ensure that urinals do not incessantly flush all day and only do so when needed

Expected water savings for these measures are in the region of 8,000 litres per 24 hours.

Internal Lighting
Low energy lighting controls have been selected where possible throughout the building.

Occupancy detectors (PIRs) are located in all WC, changing areas and offices. These rely upon infrared methods of detection and a time lag is built into the system to prevent premature switch-offs or excessive switching.

A switching system is implemented in the main foyer/entrance area, pool hall, gymnasium and aerobics studio. There are a large number of switches per zone and light fittings are arranged to allow for optimisation of natural daylight.

The entrance foyer, illustrating lighting arrangements

The use of natural lighting is maximised by introducing roof lights in the pool area

In addition to standard glazing, daylighting has been maximised by the addition of roof lights in the pool hall, gym, reception and changing village. These roof lights provide a good glare-free source of natural lighting.

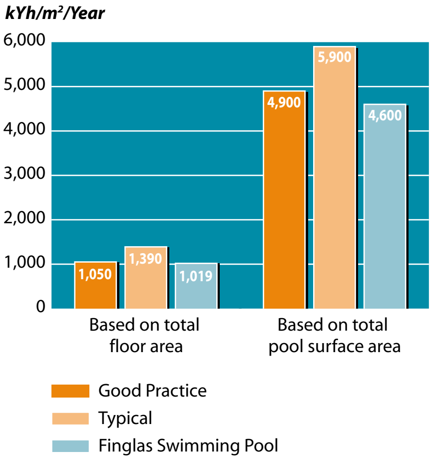
It is expected that the daylighting measures shall save 27,000 kWh and 22,000 kg CO_2 per annum.

Building Energy Management System
A building management system (BMS) with energy monitoring capabilities was installed to carry out the following functions:

- Monitor external and internal conditions and control heating and ventilation systems to achieve desired internal environment within the building. Thus plant is not running at full load when not required
- Control operation of mechanical plant
- Control duty standby switching for all pumps, twin fans and boiler plant to maximise plant life
- Monitor the building's electricity, gas and water consumption

The BMS control will help contribute to the savings attributable by the heating and ventilation systems.

Building Energy Performance Indicators for Sports Facilities with Swimming Pools



Source: *CIBSE AM5, Energy Audits and Surveys*

Based on these CIBSE guidelines, Finglas swimming pool is expected to perform well and have an overall energy efficiency rating of "good".

The energy efficiency specification will help the building achieve the following savings:

- Energy savings of 1,056,640 kWh
- CO_2 savings of 162 tonnes
- Cost savings of €51,000

These savings are largely attributable to the careful selection of the heating plant and a control strategy which allows the building to run intelligently.

Payback Analysis

Total project Investment	**€17.8M**
Cost of additional energy saving features over standard costs	**€470,000**
Estimated annual savings	**€51,000**
Simple payback on cost of additional energy saving features	**9.2 years**

Conclusions

In this project, Dublin City Council has demonstrated a realistic and practical approach to the design, specification and construction of a new low-energy swimming pool building. This proactive approach to energy efficiency will result in reductions in levels of CO_2 and in energy costs, yielding significant economic and environmental benefits over the life of the building. In this way, Finglas Swimming Pool acts as a model for other swimming pool centres in both the public sector and wider commercial sector.

Design Team

Architects:
Donnelly Turpin Architects

Building Services Engineers:
Buro Happold

Structural Engineers:
Michael Punch and Partners

Quantity Surveyors:
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