

THE OFFICIAL JOURNAL OF AIRAH

JULY 2017 · VOLUME 16.6

RRP \$14.95

# Ecolibrium

## The Innovation issue

Eight trends shaping  
our industry's future.







# A heady brew

Having already achieved a 6 star Green Star design rating and 5 star NABERS Energy rating since its completion in 2012, the designers behind an \$80 million commercial office building in Melbourne's Docklands precinct are not resting on their laurels in their pursuit of energy and water efficiency.

**Sean McGowan** reports.

Digital Harbour is a mixed-use, inner-urban community on a large site in Melbourne's Docklands – bounded by La Trobe Street to the south, Harbour Esplanade to the west and Wurundjeri Way to the north.

Its developer describes it as “linked by a series of green landscaped recreation spaces with overlays of high-speed communications infrastructure and exemplar buildings”.

Among these is the headquarters of Melbourne Water at 990 La Trobe Street.

Completed in 2012, the seven-level A-Grade commercial office building features 12,895m<sup>2</sup> of NLA across its L-shaped floor plate, with a series of open and interconnecting atrium spaces linking the upper six levels of the building.

The ground floor offers a reception, café, facility manager's offices and carpark, while two secure levels provide carparking, bicycle parking and storage. A further level is dedicated to mechanical services plant, including air-handling units (AHUs) and other services.

## EFFICIENT DESIGN

Umow Lai first became involved in the Digital Harbour project in 2010 when the consultancy was asked to prepare a design brief for new offices to accommodate Melbourne Water.

The firm was then later approached by the developer, Digital Harbour Holdings, to further the design prior to the building's construction in 2011.

The original brief called for a design targeting a 6 star Green Star Office Design v3 rating, leading Umow Lai to respond with a design that included several energy- and water-efficient initiatives.

Among these were an under-floor air-distribution (UFAD) system, a trigeneration plant including gas-fired generator and 275kWh absorption chiller, two 700kW efficient air-cooled chillers and evaporative condensers used for heat rejection.





The mechanical services design complements a high-performance façade, which includes shading devices and double-glazing with a U-value of 1.56 W/m<sup>2</sup>K and solar heat gain coefficient (SHGC) of 0.26.

“The building has excellent indoor environment quality,” says Umow Lai’s sustainability consultant, Matthew Webb, M.AIRAH.

“Ventilation rates are above AS1688 minimums, there is excellent daylight penetration and low or zero VOC/formaldehyde in interior materials selection.”

## UNDER FLOOR

The use of a UFAD system was particularly suited to the Melbourne Water tenancy fitout at 990 La Trobe Street, given its open-plan style with partitioning kept to a minimum.

Additionally, every two floors are connected by stairs to increase openness and promote more staff activity.

“The building has excellent indoor environment quality”

Webb says the UFAD system delivered significant improvements in energy efficiency and indoor environment quality (IEQ) over a ceiling-based variable-air volume (VAV) air conditioning alternative.

As well as conditioning the occupied zone more efficiently, the air changes achieved throughout the UFAD zone are both more even and effective.

“Air supply is constantly rising up through the zone in a single pass,” he says, “rather than diffusion from the ceiling and mixing through the space.”

Though UFAD systems offer significant advantages, they do pose challenges that are not normally encountered in traditional VAV systems.



990 La Trobe St boasts a high-performance façade.

## FEATURE



This oversupply can lead to the entire height of the space being conditioned (mixed air), therefore requiring more heating or cooling leading to an excess in energy use.

“For these reasons,” Webb says, “UFAD is not quite as common as it otherwise might be.”

## TRIGENERATION EXPLORATION

Although Melbourne Water originally considered an offsite renewable energy source to achieve its energy efficiency and NABERS Energy targets, it was determined that the adoption of cogeneration/trigeneration would be more feasible.

“NABERS has some fairly strict rules about the treatment of renewables and onsite generation,” says Webb. “Essentially, rated buildings need to have any such initiatives on the user side of the authority meter.”

One of these is the design of an underfloor plenum and well-sealed subfloor zone, which needs to be accounted for both in the design, as well as during construction.

“The supply-air temperature also needs to account for temperature

increases in the floor plenum as well as the room load,” Webb says. “Air quantities need to be tuned accurately to provide sufficient conditioning but prevent oversupply, or drafts can occur.”

A 275kWh gas-fired trigeneration plant was installed at 990 La Trobe Street, and operates for 11 hours a day (8am to 7pm) on business days only by Cogent Energy (now a division of Origin Energy).

Cogent Energy has a contract to supply electricity to the base building at 990 La Trobe Street regardless of the source. Therefore, the trigeneration plant supplies energy during business hours while the after-hours supply is sourced from the grid.

“As the sole supplier of electricity, Cogent negotiates a price for electricity as a whole (trigeneration plus grid supplied),” Webb says. “As a consequence, 990 La Trobe Street has been somewhat insulated from the fluctuations in energy prices over the years.”

The ultimate effect of this arrangement is that the carbon intensity of this electricity mix is reduced from ~1.31kg CO<sub>2</sub>-e (coal-based grid) to ~0.91kg CO<sub>2</sub>-e.

## EXPERIENCE TELLS

The use of under-floor air distribution (UFAD) at 990 La Trobe Street is nothing new to Umow Lai.

The firm has designed a number of high-performing buildings that feature UFAD systems, including 150 Collins Street, 171 Collins Street and the Pixel Building.

“Importantly, none of these buildings rely on the purchase of accredited Green Power to reach their certified ratings,” says Umow Lai’s sustainability consultant, Matthew Webb, M.AIRAH.

Umow Lai has developed what it says is a consistent, effective methodology for the design and implementation of UFAD systems, based on extensive research and development in the theory and practical aspects of how UFAD can work.

“We’ve developed detailed simulation methods that can accurately simulate energy consumption,” Webb says.

“These are complemented by computational fluid dynamics (CFD) results that accurately provide feedback on the implications for occupant thermal comfort in terms of PMV (predicted mean vote), temperature, air velocity, and the like.

“There is close agreement between our energy simulation and CFD results, and these have been further validated through physical prototype testing completed for 150 Collins Street in 2013. The agreement between the physical prototype, simulation and CFD was very close, and provides further confidence in the design and development of future UFAD buildings.”



‘ The building has the potential to reach a 6 star NABERS Energy rating ’

## A VACUUM FIRST

With Melbourne Water as its major tenant, it is not surprising to find that 990 La Trobe Street was designed with water efficiency at the forefront.

As well as helping the project achieve a 6 star Green Star Office Design v3 rating, a water-efficient design has also led to the building achieving a 6 star NABERS Water rating in 2015 and 2016. The building is on track to achieve same in 2017.

“This building is relatively rare in achieving a 6 star rating without using an external source of recycled water,” Webb says.

The building features 50,000L of rainwater storage, which is filtered for use in hand basins and showers. Yet the use of a vacuum-flush toilet system similar to those used on aircraft and cruise ships has been utilised to significantly reduce water consumption.

Each toilet uses just 1.0L of water per flush.

The installation of this system required Umow Lai to challenge current Australian standards relating to water flush volumes.

“Having Melbourne Water as a client in this building,” Webb says, “greatly assisted us with the accreditation of the system.”

Some teething problems were initially encountered; however, minor modifications to improve reliability have been undertaken and should form the blueprint for any future installations of this type.

“The building is recognised as one of the best examples in the use of this technology in commercial buildings,” Webb says. “And it continues to operate without the frequent blockage and pressure problems that can occur in these types of systems.”

Separate stormwater storage of 68,000l has been installed to collect water used by the evaporative pad condensers to provide heat rejection for the trigeneration system, as well as for irrigation.

“It should be noted that originally the client, Digital Harbour Holdings, was interested in installing black-water treatment in this building,” adds Webb.

“However, through analysis we were able to demonstrate the advantages of reducing water consumption at the source using the vacuum toilet approach, thus avoiding the need for an energy-intensive and high-maintenance-cost black-water treatment plant.”

## FIVE YEARS ON

Following the building’s completion and occupation by Melbourne Water in 2012, Umow Lai has remained involved in building tuning since practical completion.

During this time, a number of energy-efficiency improvements have been delivered.

Among them is the minimisation of outside air conditioning through the use of carbon dioxide monitoring to provide ventilation where and when it is needed. This has been tuned in detail.

The control of the return and exhaust-air fans has also been adjusted in the past two years to minimise their use in line with a reduction in outside-air quantities.

LED and controls upgrades to lighting have also improved building energy efficiency. Yet despite its current standing, Webb believes there are further opportunities.

“The building has the potential to reach a 6 star NABERS Energy rating,” he says.

Umow Lai currently reports on the building’s performance on a monthly basis. At the time of publication, the NABERS Energy rating sits comfortably above 5.5 stars.

“In order to improve the rating, there are adjustments to the mechanical services that can be made.”

These include reducing fan energy consumption further via the introduction of variable pressure control. Additionally, the electric chillers can be operationally optimised with the chilled water system and building demand.

“Beyond that, there are upgrades to the HVAC plant in terms of equipment (such

as fans and VSD) and configurations that can assist in further energy reductions,” says Webb.

Umow Lai has also scoped the potential for an onsite PV array to push the building to reach a 6 star NABERS Energy rating. This has been assessed while noting the sensitivities relating to the electrical demand curve analysis when a trigeneration plant is already installed.

“The selection of a trigeneration system was logical in the development of 990 La Trobe Street, and the building continues to demonstrate a very low emissions intensity,” says Webb.

“However, in today’s design environment, the use of emissions-free technology such as PV is a realistic option that was not feasible during development in 2010.” ■

## PROJECT AT A GLANCE

### The personnel

- **Architect:** Woods Bagot
- **Builder:** Equiset
- **Client/developer:** Digital Harbour Holdings P/L
- **ESD:** Umow Lai
- **Mechanical Services Design:** Umow Lai
- **Mechanical Services Contractor:** JL Williams
- **Performance reporting and tuning:** Umow Lai
- **Tenant:** Melbourne Water

### HVAC equipment

- **AHUs:** GJ Walker
- **BMS:** Johnson Controls
- **Boilers:** Hunt
- **Chillers:** York Air-Cooled
- **Evaporative coolers:** 3C
- **FCUs:** Temperzone/GJ Walker
- **Pumps:** KSB Ajax
- **CRAC units:** Schneider Electric Uniflair
- **Exhaust, return and other fans:** Fantech
- **Filters:** Airepure

(Source: Umow Lai)