Doing WELL
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When you think of the terms “re-lifing” or “adaptive reuse” as it applies to the built environment, it’s usually associated with decades-old edifices – structures whose original purpose no longer exists or has been shifted offshore. Think old clothes-manufacturing factories converted into residential lofts, power stations turned into live-music venues.

Sometimes, however, a building is designed with little foresight, and after only a few years it’s beginning to look, well, tired. Past its best, shall we say. The Brisbane’s CBD’s 175 Eagle Street was one such structure, showing its age.

Holding a prominent riverside position on the corner of Wharf, Queen and Eagle Streets, in the city’s “Golden Triangle”, the 2002-built high-rise commercial office building was suffering from poor market perception.

A string of tenant complaints and increased vacancies from the expiration of 10-year leases had resulted in the 20-storey building become an underperforming asset for its owner, the Charter Hall Group.

But the willingness of owner, Charter Hall Group, to commit to a $25 million refurbishment of all tenancies and public spaces, including substantial changes to the air conditioning system, has ensured the building fulfils its potential.

175 Eagle Street has been given a second chance.

ROADMAP TO IMPROVEMENT

Despite its youth, 175 Eagle Street was in poor shape when Aurecon was engaged by Charter Hall to undertake a major refurbishment of the building in December 2010.

Buried by the successful refurbishment of the Charter Hall-owned 570 Bourke Street in Melbourne (as featured in Ecolibrium, October 2015), Aurecon began preparation of a Building Improvement Opportunity Report. This identified all possible opportunities for refurbishment of 175 Eagle Street.

“This was the roadmap to improve the building NABERS Energy rating to at least 4.5 stars,” says Marco Hopman, M.AIRAH, an associate for Aurecon in Brisbane.

The report also established the opportunity’s capital cost, energy savings, payback period, percentage contribution to achieve the NABERS Energy rating target, cost-per-kilowatt tonne of carbon reduction, and the difficulty of implementation.

During its investigations, Aurecon found the variable-air-volume (VAV) air conditioning system serving the office floors – which had been a cause for tenant concern – to be suffering from poor temperature-control and zoning issues.
Despite the then 10-year-old mechanical plant being in relatively good condition, Hopman says it was not able to operate efficiently due to being excessively oversized.

The plant comprised of two water-cooled chiller plants. An 800kW low-rise chiller plant in the basement carpark served the basement and podium levels; a 3750kW rooftop chiller plant served the office floors and floor-by-floor air-handling plant.

The air conditioning provided to the office floors was designed for very high internal loads (20 W/m² lighting and 30 W/m² equipment loads), with a VAV turn-down to only 66 per cent of maximum flow.

“Nearly all of the time, all VAV boxes were operating at minimum flow,” says Hopman. “Temperature was controlled via electric reheat, resulting in additional chiller and electric reheat energy, and provided poor temperature control in the spaces.”

In addition, he says the power drawn by the fan-assisted VAV boxes was significant.

These issues – as well as tenant systems drawing on the base-building chilled water system and an inefficient lighting system – had contributed to the base building operating at a NABERS Energy rating of 2 stars.

Under the direction of Charter Hall’s senior manager of technical services, Alan Johncock, more than 40 opportunities were identified and selected for further analysis before 20 were selected to proceed to full document design.

“The energy metering system in the building was relatively comprehensive,” Hopman says. “And this enabled us to accurately determine where energy was being used, as well as calibrate our models and accurately predict the energy savings for each option.”

Among those opportunities selected was the adoption of a low-temperature VAV design and reconfiguration of the existing air-handling unit (AHU) layout, new high-efficiency chillers, BMS control tuning, and better particulate and gas filtration to improve indoor air quality.

But there was also plenty of low-hanging fruit to be picked. This included the replacement of existing lighting with efficient T5 lighting fixtures and controls systems, removing reheat from the HVAC design, and recommissioning the entire system.

Hopman warns, however, against confusing easily identifiable opportunities with being the cheapest to remedy.

“Whilst it was obvious once we started looking at the building that the new HVAC system had to be redesigned to eliminate reheat operation,” he says, “it was neither a simple nor cheap exercise.”
Other items selected for the “re-lifing” of 175 Eagle Street included metering upgrades, car park ventilation carbon dioxide control, and the addition of solar hot water.

According to Hopman, of the 20 initiatives undertaken, eight were of a mechanical nature. Together these contributed more than 70 per cent of the anticipated energy savings.

FLOOD OF OPPORTUNITY

But just one month into the project, disaster struck when the Brisbane River burst its banks and Brisbane suffered its worst flood event in almost 40 years.

Surrounding low-laying areas were inundated, 2,100 residential streets were evacuated and flooding reached a height of 4.46m to affect many parts of the CBD.

Among the many properties affected was 175 Eagle Street, which suffered basement-level flooding. Fortunately, the flood level peaked about 200mm below the floor of the substation.

“I recall my first site inspection after the flood waters had receded,” says Hopman. “It required walking through ankle-deep mud in the carpark levels to look at the basement chiller plant and carpark exhaust systems.”

As soon as the flooding receded, Aurecon assisted Charter Hall to get the building back to normal operation as quickly as possible. This required a significant...
amount of remediation works, and created the opportunity to implement some of the refurbishment works already identified.

The 800kW basement chiller plant would also be removed and the lower floors connected to the larger, rooftop chiller plant.

“Removing the 800kW chiller plant reduced the load on the cooling towers, enabling the condenser water leaving temperature to be reduced from the original design of 38°C to 35°C,” Hopman says. “This then allowed the existing chillers to operate more efficiently.”

**FLOOR-BY-FLOOR**

Over a two-year period, construction works were carried out on a floor-by-floor basis as tenants vacated, making scheduling and staging of most floors relatively simple.

In some cases, however, significant works were carried out whilst half the floor was tenanted. This required the team to develop detailed methodologies to minimise tenant disruption.

Among these was the replacement of all carpark lighting and controls. Carpark ventilation fans were also replaced with energy-efficient alternatives.

Carpark ventilation fans. Old fans were replaced with new larger diameter and more energy-efficient fans.
To this end, Aurecon collaborated closely with Charter Hall, the managing contractor Shape (formerly ISIS Constructions), and the mechanical contractor, Professional Air, to provide a solution to each challenge as it arose.

"And as many tenants were new to the building, most floors were designed and constructed as integrated fitouts," says Hopman.

One of the major projects carried out was the reconfiguration of the existing AHU system from an east/west layout with fan-assisted VAV boxes, to an internal/external type system with low-temperature VAV air distribution.

In implementing the new system, airflow rates per floor were reduced from 10,180L/s to 5,890L/s. Existing AHUs were retained, and the chilled water coils replaced to enable low supply-air temperatures to be achieved.

"We did look at retaining the existing chilled-water cooling coils," says Hopman. "While they could achieve the lower supply-air temperatures, it would have been at the expense of unacceptably low-return chilled-water temperatures."

Coordination with the existing structure and work saw Aurecon use BIM 3D software. The software was particularly useful in modelling the mechanical ductwork coordination in the tight ceiling voids.

"The challenge with changing the air-handling zoning in this way was the reconfiguration of ductwork," Hopman says.

Aurecon managed to reuse most of the major duct runs, and increased the thermal insulation on existing ductwork from the existing 25mm to 50mm by wrapping an additional 25mm layer over the existing insulation.

All VAV boxes were removed, and new, Property Council of Australia A-grade compliant zoning was provided, with new VAV boxes. Aurecon worked closely with the supplier to maximise the turn-down ability of the VAV boxes without creating acoustic issues in the space.

Similarly, all grilles were replaced.
TOP DOWN

With the resulting reduction in building load, the original low-level chiller plant was able to be removed, and the rooftop chiller plant used to service the whole building.

“The result of this is that the rooftop centrifugal chillers are more energy-efficient than the small reciprocating chillers that were installed in the basement chiller plantroom,” says Hopman.

Another benefit to the building owner is a reduction in required maintenance. The removal of the basement chiller also created space in the basement for other uses, including the addition of a high-quality, end-of-trip facility.

To allow for current and future demand, the existing tenant condenser water system was generously sized at 35W/m². This also provided greater flexibility in the tenant fitout design of various server rooms and other areas with high heat loads or out-of-hours operational requirements.

To improve the internal environment and indoor air quality for building occupants, the original plant’s basic F5-grade deep-bed filters were replaced with 50mm pre-filter and F7-grade deep-bed filters to provide good particulate filtration.

Volatile organic compound (VOC) gases are controlled with gaseous filters. Demand-control ventilation of outside air using CO₂ sensors was also installed. The original BCA-compliant outside air levels, based on 7.5L/s/person, have been retained.

Despite Brisbane’s climate being conducive to the operation of economy cycle (which has been shown to reduce building energy consumption by approximately 5 per cent), it proved difficult to retrofit at 175 Eagle Street.

“The original building did not include economy cycle operation to provide free cooling when ambient conditions are suitable,” says Hopman. “Due to the inboard location of the AHU plantroom and core constraints, it was not practical to provide economy cycle to the building.”

All existing and reused ductwork and air-handling plant was also cleaned.

Hopman says all these actions are as recommended in the new WELL building standard ratings (see this month’s cover story on p.36).

Other refurbishment works at 175 Eagle Street have included the addition of a new restaurant, including full commercial kitchen, located in the building’s entry lobby. This required a new makeup air system and UV-type kitchen hoods for low-level exhaust discharge.

SECOND CHANCES

Despite works only just beginning on level 18 at the time of publication, and the chillers still to be replaced (scheduled for 2018), 175 Eagle Street is almost operating at a 4 star NABERS Energy rating.

When the remaining works are complete, the building is expected to comfortably achieve its targeted 4.5 star NABERS Energy rating, and perhaps push towards 5 stars.
The new, energy-efficient air conditioning system is also said to operate extremely well, and has resulted in a marked reduction in tenant complaints. It has also contributed significantly to a 50 per cent reduction in base-building energy consumption.

The re-lifing of 175 Eagle Street says as much about the design and construction of new buildings as it does about the second chance that refurbishment can give to existing building stock.

“When we design and construct a new building, our decisions at that time will have a long and lasting impact on the building for the life of the building,” Hopman says.

“As designers, we should clearly understand the client’s aspirations, challenge requests that we know are not in the building’s best interests, and ensure the design is technically sound.”