THE OFFICIAL JOURNAL OF AIRAH

SEPTEMBER 2017 · VOLUME 16.8
RRP $14.95
PRINT POST APPROVAL
NUMBER PP352532/00001

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FEATURE

Redoubtable Thomas

A redevelopment in Sydney's Macquarie Park has combined old and new mechanical services to breathe life into a 25-year-old a commercial office building. **Sean McGowan** reports on the transformation of 1 Thomas Holt Drive.

Macquarie Park in Sydney's northern suburbs has long been an important business centre and home to a large number of national and international corporate entities.

Indeed, at the turn of the millennium, Macquarie Park had the fourth largest concentration of jobs in New South Wales after the Sydney CBD, North Sydney and Parramatta.

As one of the area's most prominent commercial office buildings, the seven-storey 1 Thomas Holt Drive (1THD) had served its owners and tenants well since it was first constructed in 1989. But 25 years on, it was perceived as aging and inefficient – at least in comparison to current best-practice office accommodation.

This led its owner, AMP Capital, to investigate a refurbishment that would ultimately become an award-winning redevelopment, which has extended the life of the building for at least another 25 years.

CONDITION AUDIT

AECOM was appointed by AMP Capital in 2011 to provide a condition audit of the existing building services at 1THD. The consultants were tasked with identifying and costing a scope of works associated with potential upgrade options.

> "The new façade is a low-e, double-glazed panelised curtain wall system"

"The original development was constructed in 1989, and the mechanical services provision, while compliant with the relevant codes and standards at the time, was designed to comply with the Ordinance 70 requirement," says Ian Dixon, associate director – sustainability and applied research at AECOM.

The audit revealed an original mechanical services system comprising of a constant-air- volume system serving perimeter and centre zones.

Both zones were served by separate, common built-up chilled-water air-handling units (AHUs) supplying conditioned air on each floor via supply-air risers and ductwork distribution.

Conditioned air was returned to the AHU via a return-air intake at the riser on each floor, and returned to the plantroom on level six. Hot-water heating coils were used to provide heating to each zone.

Outside air was provided from an opening in the plantroom, which served as a plenum for mixing with the returned air from each floor.

A single, water-cooled chiller supplied chilled water for the air conditioning systems, with a lead-lag-pump arrangement for chilled water distribution. Heating water was provided by central hot water generators and duty/stand-by pumps, with both chilled and heating hot water pumps configured to constant flow.

Furthermore, AECOM's investigation found the building to be operating at a NABERS Energy rating of 2.5 stars base building, and no Green Star rating present.

"The building had served a productive 25 years," says Dixon. "But with many components reaching the end of their service life, a broader refurbishment was sought to ensure the building offered best-practice office accommodation in terms of function, form, tenant amenity and building energy and sustainability performance."

A "refurbishment" quickly became a "redevelopment", with AMP Capital deciding to pursue a design that stripped the building back to its structure, expanded the floor plate into the building's adjoining warehouse facility, and brought the building up to best-practice design.

A "refurbishment" of 1 Thomas Holt Drive quickly became a "redevelopment".

MEETING DEMAND

The original brief from AMP Capital to AECOM sought to achieve a 4 star NABERS Energy base-building rating via two potential refurbishment options.

The first was to refurbish the existing building as well as encroach into the attached warehouse distribution area to achieve 11,000m² NLA (net lettable area) of Property Council of Australia B-Grade rated office space.

The second option pushed the expansion further into the warehouse further to create additional multi-level commercial office space linked to the existing, refurbished building at 1 Thomas Holt Drive. This new building would achieve an A-Grade rating.

"One of the key triggers influencing the transition to full refurbishment was that the building needed to re-enter a highly competitive market with increasing expectations from prospective tenants," says Dixon.

AECOM undertook benchmarking exercises and worked with AMP Capital to provide details of other high-performing office and industrial facilities in the local business parks. This eventually resulted in a solid business case being presented to AMP Capital's investment team based on the second option.

Ultimately, the project team successfully gained the support to target a 5 star NABERS Energy base-building rating, as well as to pursue a 5 star Green Star Office Design v3 rating.

"Green Star was not originally pursued," Dixon says. "Rather, it was a later addition to the project to ensure the refurbished building re-entered the market with contemporary sustainability performance."

The new façade introduces more light across the floorplate.

The decision to pursue a Green Star Office Design v3 rating would prove a worthwhile one, however, as 1THD would become one of only a small number of buildings in the area to achieve a formal rating.

STRIPPED BACK

Following the review, AECOM's design team investigated various initiatives and features that could be implemented to achieve the best outcome.

This included the construction of a new façade to replace the original window wall system, which featured low-performance single glazing.

AECOM proposed a new curtain-wall façade, which not only improved the aesthetic appearance of the building, but also improved thermal performance and reduced energy consumption.

The new façade would also contribute to a small increase in the NLA.

"The new façade is a low-e, double-glazed panelised curtain wall system that allowed for efficient installation without the need for external scaffolding," says Mina Yang, associate – building services with AECOM.

As well as introducing more natural light across the floor plate, the new façade also reduces the building fabric heat gain. Internal heat gain has been reduced through the use of LED lighting fixtures, and improved lighting controls.

To achieve a high-quality indoor environment, AECOM designed a new, low- temperature variable-air-volume (VAV) air conditioning system for all office spaces.

An economy air cycle has been incorporated to take advantage of free cooling when ambient conditions are suitable. Night purge is also used to remove the heat absorbed by the building structure, thereby reducing the conditioning time during early-morning system start-up.

Demand control has been incorporated into the low-temperature VAV system, with swirl diffusers used for all air distribution.

"Designing to A-Grade specifications required additional mechanical systems to be provided," says Yang. "This included a dedicated tenant condenser water system, outside-air system, general exhaust system, and tenant kitchen exhaust system."

Spaces with high sensible cooling loads (such as meeting and training rooms) are provided with base-building and supplementary cooling from the tenant condenser water system.

"This method enables the base-building energy load to be spread across a larger floor area," says Yang, "but with much of the cooling completed by the tenant condenser water system."

MEETING NABERS

One of the major challenges in AECOM's design at 1 Thomas Holt Drive was to maintain the projected energy consumption for the base building in order to obtain the required NABERS Energy rating.

"The base building A-Grade design had only made certain cooling and heating-load allowances based on occupancy, lighting and equipment rate," AECOM's Ian Dixon says. "And tenancy fitout has pushed the boundaries of the load allowance."

The increased load allowance required more cooling and heating to be provided in some areas of the tenancy, and reductions in others.

"The increase had to be carefully managed so that the base-building energy usage would not surpass the targeted 5 star NABERS Energy rating," Dixon says. "This was achieved by adjusting the VAV terminal boxes to allow for more supply air in areas that require additional cooling, and supplementing with additional condenser-water package fan-coil units (FCUs) from the tenant condenser water system."

A 99kW solar PV array provides a renewable energy source to the base building.

Other elements of the mechanical design required the implementation of new and additional mechanical plant and equipment. These include a motorised damper, chillers, heat exchangers, pumps, heating-hot-water coils for the built-up AHUs, and a VAV terminal box on each floor.

To accommodate the new design requirements, the service riser and on-floor duct work had to be reconfigured. The plant-room area was also realigned to suit the proposed scheme.

Yang says the existing building geometry and structural elements presented the most challenges, because the core area could not be extended to accommodate new risers.

"The existing building structural beams were also not conducive to service reticulation on each floor," she says, "without making adjustment to reduce the profile of ductwork and coordination of plant to provide access for services."

The new design also required the installation of two water-cooled chillers and a series of pumps to meet the new building load.

This configuration meant extensive modification of the chilled-water and condenser water pipework system had to be completed. Spatial issues within the plantroom resulted in the layout being reconfigured and the building's structure assessed to ensure it could accommodate the two chillers that replaced the original single chiller.

"Working closely with the mechanical contractor, Oram Smith, we managed to overcome many of the issues on site," Dixon says. "We were able to complete the installation to a level that would still allow us to achieve satisfactory testing and commissioning of plant and equipment."

CLOSE CONTROL

At 1THD a new building management control system (BMCS) and new controls strategy have been programmed to optimise ongoing operational energy efficiency and occupant comfort.

All mechanical systems are continuously monitored for any abnormal operating condition such as a spike in cooling or heating demand.

CO_2 sensors connected to the BMCS are used to continually monitor and modulate outside-air flow rates according to occupant demand.

The building also features extensive energy metering and sub-metering for tenant and house load groups of 100kVA (max.) for the monitoring of electricity and water consumption. Thermal metering for chilled water and heating hot water consumption is monitored by the BMCS.

To improve visibility of energy consumption, a real-time information display screen has been installed in the building's lobby. A building intranet information system informs building users of building events and ongoing operational performance.

New T5 lighting to office areas has been designed in <100m² zones. Controls have been programmed to save energy by dimming when daylight is present, or turning off when spaces are unoccupied. Motion-sensor control has also been installed in all areas of intermittent occupancy such as lobbies, toilets and external areas.

PLANT RETAINED

As part of its report on the condition and upgrade opportunities of the existing mechanical services, AECOM identified a number of system components that required replacement, as well as some that were suitable for retainment.

Of plant requiring replacement, the major items were the original water-cooled chillers.

"Although they had been well maintained," Yang says, "the chillers had reached the end of their designed life, and were due for replacement.

"Furthermore, they did not have the sufficient capacity to meet the requirements for current outside-air quantities or redundancy for PCA A-Grade requirements."

The existing cooling towers were found to have been sized with 100 per cent redundancy, and despite their age, were assessed to be in good condition.

Having sufficient heat-rejection capacity to meet the requirements of the proposed new chilled-water plant and tenant's supplementary cooling capacity, a decision was made to retain them after being refurbished and thoroughly cleaned.

The overarching aim was to meet Property Council of Australia A-Grade and a NABERS Energy rating of 5 stars. This meant each tower was provided with a new evaporator fan complete with variable-speed motors to reduce energy consumption at partial loads.

A new tenancy condenser water loop was also provided through heat exchangers and duty/stand-by condenser water pumps.

The building's AHUs were also found to be in adequate condition; however, the existing cooling and heating coils did not have sufficient capacity to accommodate an increase in outdoor air rates and were replaced. Supply-air fans only required a motor and pulley change.

"The air distribution ductwork was also in good condition; however, the single perimeter zone meant more energy would be required due to zone reheat in the duct," says Yang.

"Options were explored to split the perimeter zone into two zones, but this wasn't possible due to spatial constraints preventing additional ductwork being added to the existing riser."

THE LESSONS LEARNED

Ian Dixon, associate director – sustainability and applied research for AECOM, shares some key lessons to have come out of the redevelopment of 1THD.

1. **Early involvement of the ESD team was integral to the delivery.**

   "All too often, ESD can be engaged once major services and other design decisions are already taken," says Dixon. "However, the ESD consultant has a strong role to play in driving and coordinating design of high performance buildings to make sure integrated decisions are Implemented."

   While Green Star was targeted mid-way through the project, an AECOM ESD specialist was part of the project team from inception, and helped shape the strategies for targeting the NABERS energy performance and later in pursuing the Green Star rating.

2. **Completing a major retrofit of an existing building poses several additional challenges.**

   "Close collaboration and a good working relationship with the client is vital. A good working relationship allows the design team and contractor to be more flexible when preparing design options. Additionally, it also allows any issues developed during the project to be resolved quickly before it can impact on other areas, resulting in time and cost repercussions."

3. **The integrated fitout helped to avoid unnecessary material use and waste, and enabled flexibility for the base building and fit out services design.**

   "With regard to the HVAC system, the integrated fit out encouraged careful planning and distribution of base build variable air volume system and diffusers to match load concentrated areas. Continued monitoring of base build systems after handover allowed further adjustment of the sequent of operation of the air conditioning systems to minimise over consumption of energy during peak time."

4. **"This project was a strategic challenge and required our entire team to collaborate in new ways," says Dixon.**

   "We were successful and delivered on our objectives because the client, AMP Capital, had a vested interest in delivering, owning and operating a high-performance asset. We were also working with a highly experienced head contractor team in Buildcorp.

5. **Inspiring the achievement of any good project is often the result of well-thought- out planning, and Dixon says 1THD was no exception.**

   "It was a requirement that the project team met consistently onsite to discuss the progress of work and to capture any issues or potential obstacles," he says. "This allowed the project team to develop an achievable action plan and to proceed with the design as programmed."

A 99kW solar photovoltaic (PV) array has also been installed on the building's rooftop to provide a renewable electricity source to the base building. A 500kVA stand-by generator will maintain essential base-building services in the event of an electricity outage.

A 25,000L rain water harvesting tank provides clean water for toilet flushing and garden irrigation, while water efficient fixtures and fittings contribute to a reduction in potable water use.

PERFORMANCE

A building energy simulation conducted during the design stage demonstrated that the redevelopment of 1 Thomas Holt Drive would achieve a predicted 5 star + 22.5 per cent CO_2 reduction NABERS Energy base-building rating.

When compared to the original building's 2.5 star performance, electricity consumption is expected to fall by over 640,000kWh per annum – down from 1,340,913kWh per annum.

A reduction in gas consumption of almost 280,000MJ per annum was also modelled.

Combined with a small reduction in diesel use, these reductions are expected to deliver an estimated energy saving of more than $120,000 annually, and an accompanying CO_2 reduction of 1,093 tonnes.

The redevelopment of 1 Thomas Holt Drive reached completion in August 2015, followed by a 12-month period of system tuning and air balancing. Post-occupancy monitoring has since been conducted, and the building has performed as expected, achieving the targeted 5 star NABERS Energy rating.

And as the winner of Best Business or Industrial Park NSW Award at the recent Property Council of Australia Innovation and Excellence Awards 2017, 1 Thomas Holt Drive has re-established itself as one of Macquarie Park's most sought-after addresses. ▮

1THD AT A GLANCE

The personnel

- **Architect** Architectus
- **Builder:** Buildcorp
- **Client:** AMP Capital
- **Mechanical services design:** AECOM
- **Mechanical services contractor:** Oram Smith
- **Post-occupancy monitoring:** Team Catalyst

The equipment

- **BMS:** Alerton
- **Boilers:** Simons
- **Chillers:** Smardt (formerly Smardt-Powerpax)
- **Diffusers:** Air Grilles/Krantz
- **Duct:** Oram Smith
- **Duct-mounted heating coils:** Kirby
- **EC fans:** Fantech
- **FCUs:** Temperzone
- **Grilles:** Air Grilles
- **Heat exchangers:** Tranter
- **Pumps:** Masterflow Solutions
- **Thermal insulation:** Kingspan
- **Water-cooled packaged units:** Temperzone
- **VAVs** Celmec
- **Filters:** Airepure

(Source: AECOM)