1200 Buildings

CASE STUDIES

406 Collins Street

406 Collins Street provides an excellent demonstration of how to completely replace the HVAC system in a 1960s mid-size commercial building whilst maintaining tenancy.

Built

1958 - 1961

NLA

4000 m²

Tenancy

Offices, Telstra retail store.

Building owner

Dr Dorian Ribush

Property manager

Colliers International

Refurbishment project timelines

2008 - 2011

Project team

Project manager: Dr Ribush
Consulting engineer: RC Lister Engineering Pty Ltd.
Contractor: Blue Planet Electrics

NABERS Energy

Current: 1.0 NABERS
Target: 4.5 – 5.0 NABERS

NABERS Water

Current NABERS Water: 5.0

Key refurbishment features

- MITSUBISHI Variable Refrigerant Volume (VRV) air conditioning system
- Zoned floors
- Economy cycle dampers
- Automated night-flushing
- Roof sunshade
- Internal and external shading in courtyard
- Motion light sensors in stairwells and lifts
- High efficiency lighting in common areas
- Sub-metering system
- Web enabled building management control system (BMCS).

Energy saving

Expect considerable savings in consumption: 50 – 70%.

Water saving

Already highly efficient

Greenhouse saving

Yet to be determined

Project costs

$1.5 million

Annual saving

Yet to be determined

1200 BUILDINGS

History

This site has been built upon since the 1840s. In 1897, a grand building was constructed in typical Victorian style, as the headquarters of the Mutual Assurance Society of Victoria.

In 1958, the old building was demolished and in its place, a new modernist six-storey building was constructed. This was typical of a late 1950s 'skyscraper' design – built from a steel and concrete structure, plain (non-ornamented) façade, with a strip of windows on each floor facing Collins Street.

The building was enlarged in 1961, when four more storeys were added.

The only original feature remaining from 1897 is the 'Atlas' statue, which was originally featured in the decorative pediment at the top of the old building. It is now located at the street level adorning the building entrance.

The building's heating, ventilation and cooling (HVAC) system was typical of the 1960s: the aim was to minimise capital cost while providing relatively good working conditions, but there was no concern for energy efficiency – at the time, energy was cheap.

Background

Dr Dorian Ribush purchased the building, Praemium Housein 2006.

At the time, Dr Ribush realised that the building was functioning poorly, and decided it would need substantial retrofit.

The building has 4000 m^2 net lettable area (NLA), including a Telstra retail store on the ground floor, and eight tenants that occupy at least one floor each. The floor plate is rectangular, measuring about 350 m^2 on each floor.

The HVAC system had clearly reached its use-by date. Modification of the existing system was not considered to be a viable option to achieve a significant improvement on energy efficiency.

A large central boiler provided the heating, and a central chiller located on the roof provided the air conditioning. Due to a quirk of history in 1961 when four additional floors were added to the original six, the air handling provided to the first six floors was from the basement, and the top four floors from the roof. So while the boiler and chiller supplied the whole building, the air circulation and fresh air intakes operated as though the building was in two separate parts.

Even on a very hot or very cold day, both the boiler and chiller operated - which is a very inefficient way to operate an HVAC system.

At about the same time as Dr Ribush started to investigate ways to improve the energy efficiency of the building, the City of Melbourne launched the Building Improvement Partnership Program (BIPP). Under this scheme, a large consultancy was engaged to conduct an audit of the building, and a set of recommendations was made, which included completely replacing the HVAC system. Dr Ribush was critical of the quotes that were provided and obtained a second opinion. .

In 2009, Dr Ribush applied to the Australian Government's Green Building Fund, which provided matching grants of up to half a million dollars for energy refurbishment projects. For the purposes of the application, the building was then rated 2.0 stars National Australian Built Environment Rating System (NABERS) Energy.

The application was successful and with the total cost of the works of about $1.5 million, the retrofit went ahead.

Objectives

The main objectives of the retrofit project were to:

- improve the energy efficiency of the building
- achieve at least a 4.0 star NABERS Energy rating
- reduce the carbon footprint and once the energy consumption was reduced, use green power sources.

Planning

On receiving the Green Building Fund grant, the first task was to investigate the best way to implement the HVAC refurbishment.

The City of Melbourne referred Dr Ribush to the Australian Institute of Refrigeration, Air conditioning and Heating (AIRAH) to appoint the consulting engineer, Mr Dick Lister. Together they worked on the Green Building Fund application.

Mr Lister shared the same 'hands-on' approach as Dr Ribush and was willing to find solutions along the way. This was considered preferable to employing a large contractor that would come in and do the whole job under time pressure. In a fully tenanted building, significant tenant engagement and consultation, and a lot of timetabling and flexibility was necessary while the works were underway Consequently, a floor-by-floor approach was chosen to minimise disruption to tenants.

This decision also meant adopting a HVAC system that could be introduced floor-by-floor. Instead of a centralised system, a split unit system servicing each floor was chosen, so that each floor was effectively self-contained. Each unit was located on the roof, with copper pipe running down the riser or stairwell to that floor, and supplying the indoor air-handling units at that level.

This solution simplified the installation process: craning a chiller and boiler on the roof was not required. Instead they were able to bring the units up in a lift and the front stairwell.

Other options such as variable air volume (VAV) were incompatible with the ducting infrastructure of the building, or would have taken up valuable floor space for the installation of air handling units.

The consulting engineer provided a comprehensive design plan for the system prior to engaging the installation contractors.

Implementation

Mr Lister had previously worked with a small refrigeration service company, Blue Planet, who were engaged as the HVAC contractors. Blue Planet has a team of five or six men who understood the approach Dr Ribush and Mr Lister were taking; to trouble shoot as they proceeded on a floor-by-floor basis.

It was very apparent as they started work that each floor had a different problem, typical of buildings of this age. The location of the kitchen, the plumbing, the duct-work and so on, was different for each floor, so having a rigid installation plan was not possible or practical.

The contractors undertook special training with Mitsubishi, the vendors of the HVAC variable refrigerant volume (VRV) units that were subsequently installed. Mitsubishi Heavy Industries was also contracted to commission the units once they were installed.

Dr Ribush became the project manager and oversaw the project scheduling, rubbish removal, fire services arrangements, tenant liaison and made decisions on the placement of equipment.

To minimise tenant disruption, the work commenced at 6am and finished at 2pm, with any noisy or dusty work finished by 9am.

Features

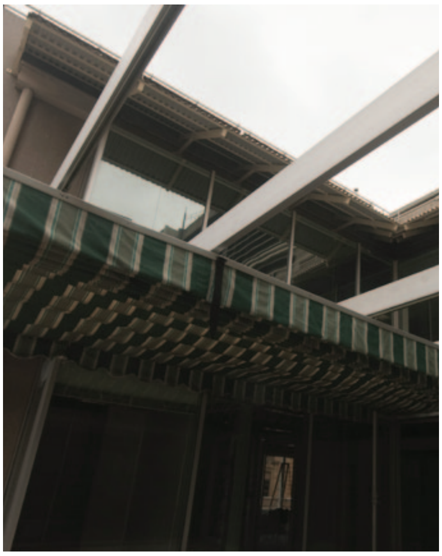
Building

The building structure and façade was left intact, other than removing and replacing ceilings to expose the ductwork and to install new air handling systems.

In the case of the ceilings, it was found that the original ceiling tiles were poorly installed and these were replaced by more modern methods where individual tiles can be removed without affecting the whole ceiling structure.

HVAC

- The decision was made to install a zoned Mitsubishi VRV air conditioning system. Each floor is divided into four or five zones that can be controlled independently.
- There are a total of 10 outdoor condensing units, with an average of four or five indoor fan coil units (FCU) per floor.
- In addition to the new VRV system, extra economy cycle dampers on each floor are installed to allow for the relief of warm return air to atmosphere, thus alleviating load on the FCU.
- Each floor has an isolating damper installed on the supply air to ensure that the outside air fan only runs fast enough to supply the required air volume.
- Mr Lister views the system solution that was installed as being the most cost-effective for a building of this size, and one of the objectives of implementing this is to provide an example for other buildings of this type.
- The building will be 'night flushed' in summer and winter as part of the current project. This will use an automated system to measure the relative inside and outside air temperatures, and between 5am and 7am will draw air in from outside to flush the whole building and rid it of stale air.
- The chiller and boiler will both be removed. It was necessary to retain them during the refurbishment so that unrenovated floors could be cooled or heated using the old system. In other words, a dual system was operated throughout the project.



Energy load

The building is hemmed on the east and west sides by other buildings, so the thermal loading from these directions is minimal. Other buildings provide shade on the northern aspect to level six, which prevents solar gain on most levels below. Above this height, there is direct sunlight.

The southerly windows, where there is negligible direct sunlight, are small in comparison to modern 'glass block' high-rise buildings and are double-glazed for noise insulation rather than thermal comfort.

On floors nine and ten, there is a small eastern facing courtyard indented in the building, and both external and internal shades have been introduced on all windows to deflect direct sunlight.

A sunshade has been installed over part of an exposed roof (about 65 m^2) and this has substantially reduced the heat transfer through the roof to the tenancy directly below. The sunshade is constructed from a layer of 90 per cent shade-cloth stretched about a metre above the roof, allowing both shade and ventilation. It's a cheap and effective solution.

Motion sensors have been integrated into the stairwell lighting, as well as in the lifts. All use low voltage lamps. These lights were previously on 24 hours a day and are now off most of the time. This contributes both to lowering electricity consumption and heat load.

The lights in the high ceiling foyer have been hung lower which enables services from a ladder rather than a cherry picker. This also means that the lights need to be less bright.

Mirrorlux reflector lighting has been introduced into several tenancies. These employ a highly polished aluminium reflector behind a higher output fluorescent tube. The result means that one or two tubes can be removed from the fluoro set.

Water

Conventional flushers have been set to ensure the minimum amount water is used to suit the function.

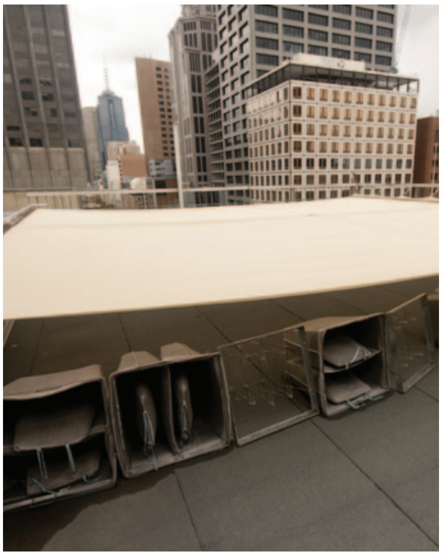
Aerators have been introduced in the hand basins to reduce high water consumption.

Waste

The tenants are cooperating with the waste separation system sorting into recyclable and landfill containers. The cleaning providers have been trained to manage this system.

Occupants are provided with a cardboard box by each work station, which only permits the disposal of recyclable waste. Other waste, such as food scraps are deposited in separate containers in the kitchen areas.

Paper towels are used in bathrooms, and recyclable paper is used for hand drying in toilets and hand basins.



Environment

Where possible, green cleaning products are used.

The building management allows tenants to take bikes in the lift into their tenancy. This encourages the use of bicycles as a mode of transport.

They are now investigating the practicalities of installing bike racks in the basement.

Building management and controls

Prior to the refurbishment project, the building had essentially no HVAC controls. It was an analogue control system that lacked calibration, with about 20 per cent of the controllers faulty, and many wiring errors from years of poor maintenance. The time clocks were not optimised to accommodate holidays or weekends. There was simultaneous heating and cooling, both during winter and summer.

This inefficient system has been replaced by an up-to-date building management and control system (BMCS) with building automation and control networks internet protocol (BACnet IP) controllers, open architecture, ethernet based, internet enabled and integrated with the new metering system for real time feedback about how the building is performing.

Not satisfied with data from existing utility meters, a complete sub-metering system was installed that collects comprehensive data every half hour and is stored on a remote structured query language (SQL) database which allows around the clock access from any location.

At present, each floor operates independently, but when the whole building is completed, there will be an interface which sets all the units on timers – business hours (8am - 6pm), public holidays and so on- and a key switch that tenants can activate after-hours if they need to use the space air conditioned (operating at 2 hour periods). This will be metered and the tenants will be charged separately for after hours use. The BMCS will track power consumption and cost for the tenant.

The BMCS has a web interface, making it possible to see what the temperature and other conditions are, floor by floor, zone by zone, and to make adjustments off-site. Faults can be detected and diagnosed, and this information can be passed on to the service contractors to fix problems. This will mean substantial improvements in maintenance speed and economy.

Challenges

The main challenges for the project team were dealing with the difficulties typically encountered in old buildings, and the need to maintain the existing services in a fully tenanted building during refurbishment work.

According to Dr Ribush, another major challenge is managing cash flow during the project. Initially he tried to fund the project from cash generated from the ongoing rent, but found that this did not meet the expenses. The Green Building Fund grant that he received provided $500,000 for the whole project, but just $100,000 up front. The rest is given on project completion. In order to make up the shortfall, he secured a loan from Sustainable Melbourne Fund (SMF).

In order to meet the costs, this project could not have proceeded without the building being occupied: otherwise the process is just too costly. So the challenge was to minimise the impact of the works on tenants.

The floor-by-floor implementation of the VRV system is compatible with this objective. But it was still necessary to provide air conditioning to those in the remaining floors that were not yet refurbished, which meant operating a dual system across the whole project.

Liaising with tenants was crucial. There is always noise, dust and disruption in any building undergoing major retrofit, particularly for tenants when their floor is being worked on. This requires a good deal of goodwill and cooperation, which is not always easy to achieve.

There were many difficulties with the building itself, which was not unexpected given it was constructed 50 years ago, and where four floors were added to the original six.

A lot of the insulation on the hard metal ductwork that ran from the units into the tenancies to outlets in the ceiling had disintegrated. Fixing this entailed many additional hours of work, re-insulating or tying it back up to reinstate the insulation, otherwise heating and cooling would have been lost in the ceiling. A lot of the ceiling tiles also had to be replaced as the old ones were not installed well; when one was removed, a number of others were dislodged.

There are limitations on the ratings that can be achieved in older fully occupied buildings. Dr Ribush hopes to obtain a 5.0 NABERS Energy rating, but the difficulties may limit this to 4.5. However, 4.5 NABERS Energy is an outstanding achievment in a building of this age.

Outcomes

Energy

Performance measures have not yet been conducted as the new system has only just been installed. However, based on measurements made on floors that have the new system installed, Mr Lister is confident that energy consumption will be halved or even as low as 25 per cent prior to the retrofit.

Water

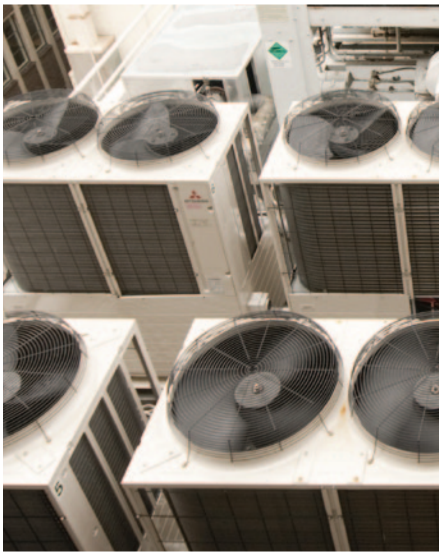
The building has low water use and achieved a 5.0 NABERS Water rating.

Social

Mr Lister believes a significant challenge in the project is tenant comfort. With the new system, there will be perceptible variations in the internal temperature range, in both summer and winter. Educating tenants to accept slightly warmer ambient temperatures in summer and cooler in winter will allow significant energy savings.

Maintenance

This is yet to be determined, but with the HVAC improvements made and the installation of the BMCS, the engineers and building management is confident that the maintenance will be speedier and less costly.



Commercial

Although it is highly likely there will be significant energy improvements, Dr Ribush is not certain that there will be direct financial returns on his investment. The viability of the project hinged on the Green Building Fund grant. Without it, he doubts that the project would have been as extensive, and it would have meant an even lower return on investment.

Overall

It is still too early to tell, but the signs are very promising that the building will achieve a 5.0 NABERS energy performance level.

Lessons

Dr Ribush believes it is inherently difficult to improve energy efficiency in tenanted, older small buildings in Melbourne. He believes this can be best accomplished by paying special attention to good communication with tenants, and providing a sensitive implementation of upgrade works.

In small, older buildings, a significant refurbishment can only be done while the building is occupied in order to maintain a cash flow. This requires a lot of planning to complete the project within a reasonable timeframe.

The other option of refurbishing around a tenant vacancy strategy is not practical for this type of building, as tenants may not move for years and this would extend the project unacceptably. Indeed, the Green Building Fund, which enabled this and many other projects, requires the building project be complete within two years.

Knocking a building down completely and starting again ignores its embedded energy and the usefulness of the original structures, and many older buildings can not be demolished because of their heritage listed.

Dr Ribush believes the best prospect in encouraging buildings of this age, size and standard is for the City of Melbourne to facilitate cooperative ventures involving adjacent buildings in a precinct, sharing expertise and technology.

Mr Lister agrees that it is crucial to have tenant buy-in to the project from the outset. The HVAC performance history of this building was very poor; the tenants were therefore antagonistic and somewhat sceptical of improvements, and it was vital to overcome this. It was important to convey to tenants that as a result of the refurbishment, there will be better air quality, reliable conditioning of air and lower energy costs.

The future

As of April 2011, one floor is yet to be completed. The commissioning is ongoing.

It is anticipated that the project will be finished in 2011.

The building owner will switch to green electricity on project completion. However, he wants to make sure that the electricity savings are significant for the tenants before making this switch, given the extra expense of green electricity.