BEDP ENVIRONMENT DESIGN GUIDE

# OFFICE BUILDING RETROFIT AT 55 ST ANDREWS PLACE, MELBOURNE – TURNING A SPARROW INTO A PEACOCK

**Roger Kluske and David Clark**

## 1.0 PROJECT DETAILS

**Principal, Owners' and Tenants' Representatives**
Government Services Group

**Tenant**
Department of Parliamentary Services

**Lead Consultant – Base Building, ESD and Mechanical Engineers**
Cundall

**Lead Consultant – Fit-out, Architects and Interior Design**
H2o Architects

**Project Manager**
Montlaur Project Services

**Electrical, Hydraulic and Fire Engineers**
Medland Mitropoulos

**Quantity Surveying**
W T Partnership

**Building Surveyors**
Stokes Perna

**Builder**
Schiavello

**Facility Manager**
Jones Lang LaSalle

**Net Lettable Area**
6,090m²

## 2.0 INTRODUCTION

This article describes the upgrade of an existing government building, 55 St Andrews Place in Melbourne's Treasury Reserve, utilising an unconventional design process and with a strong emphasis on integrated design from the outset.

The aim of the project was to transform a poorly performing building, from both an energy efficiency and indoor environment quality perspective, into a building that meets current best practice for greener office spaces.

The building is owned and occupied by the Victorian Government.

Two of the buildings, 1 Treasury Place and 1 Macarthur Street, commenced construction from 1963, while 3-5 Macarthur Street (later renamed 55 St Andrews Place) was constructed as a four storey building in 1967.

## 3.0 HISTORY OF THE BUILDING

No. 55 St Andrews Place has an interesting history. The following is taken from the Heritage Victoria publication *The Treasury Reserve* (2000) by Frances O'Neill.

> *During the 1960s the State Government planned to build a skyscraper office tower behind the Old Treasury Building. An architectural competition was held in 1962, in which twelve firms were invited to submit designs. The guidelines for the competition mentioned the State Government's wish for a building which would express "soaring wonderment".*

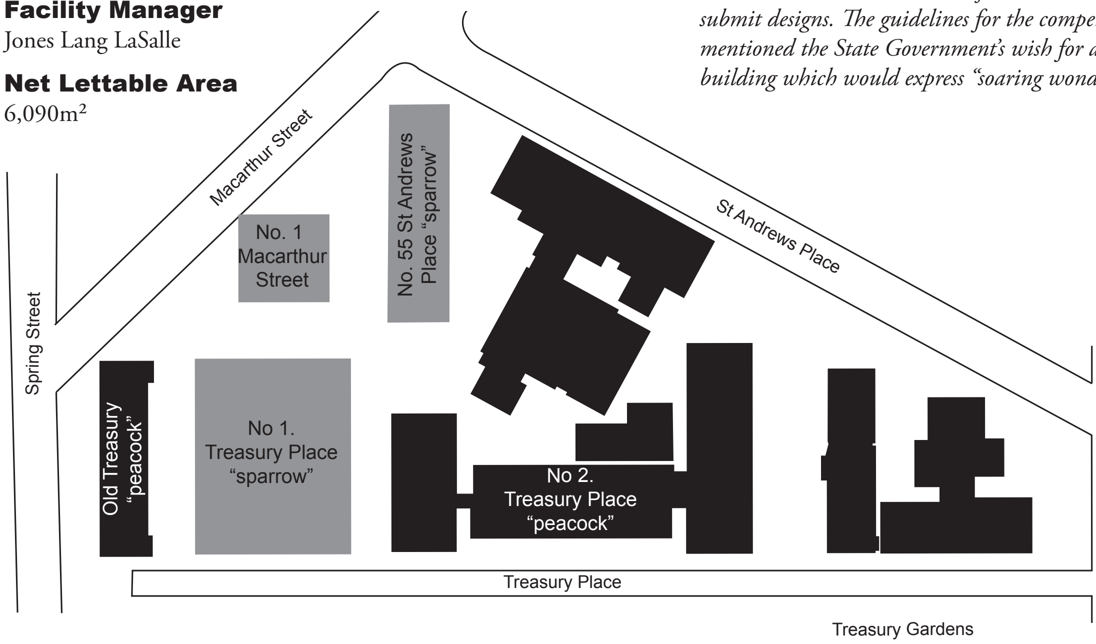


**Figure 1. Plan of Treasury precinct**
(Source: extrapolated from Google Earth)

*Eleven submitted designs conformed. The twelfth, Yuncken Freeman, put forward an entry by architect Barry Patten, who believed that a tower block "would destroy Melbourne's best vista – that is – looking eastward from the top of Collins Street to the Old Treasury Building". Patten's design was for two infill buildings of similar scale to the Old Treasury Building (constructed between 1854 and 1862) and 2 Treasury Place (constructed in 1859) which would "stand out like brown sparrows between two peacocks of Victorian architecture". A taller building was then to be placed facing Macarthur Street. At first this entry was disqualified by the judging panel, but then the decision was reconsidered.*

*The design was finally accepted and the three pre-cast concrete panelled boxes were built with height, scale and proportioned window openings which complemented the classical forms.*

1967 Commenced life as the State Chemical Laboratories for the Department of Agriculture.

1994 State Chemical Laboratory tenant vacated the building.

1996-97 During the building refurbishment an additional level was added (level 4).

2006 The Department of Justice moved out of the building.

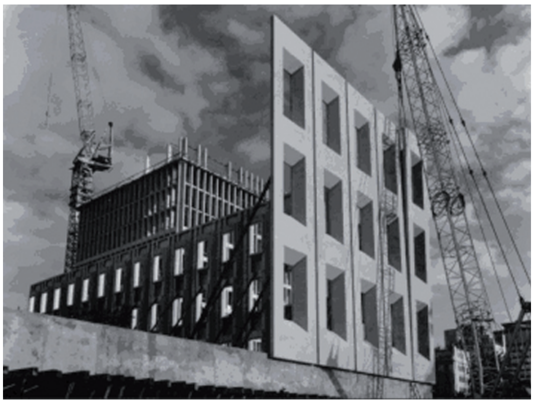

**Figure 2. Under construction in 1967**
(Source: National Gallery of Australia)

**Figure 3. 55 St Andrews Place prior to upgrade**
(Source: Cundall, 2005)

In 2004-05 the Government commenced evaluation of options for the building. The goal was to ensure its ongoing use as an effective part of the government's property portfolio. Concurrently two events occurred – the search for a new tenant and the development of a plan to improve the building.

## 4.0 VICTORIAN GOVERNMENT ACCOMMODATION STANDARDS

In 2005 the *Victorian Government Office Accommodation Guidelines* was launched, and 55 St Andrews Place was the first major government owned office building construction/refurbishment to commence under the guidelines.

The key targets prescribed for government office buildings were:

- Green Star – Office Design: 4 stars
- Green Star – Office Interiors: 4 stars
- ABGR (now NABERS Energy) Base Building: 4 Stars (existing), 4.5 stars (new)
- ABGR (now NABERS Energy) Tenancy: 5 stars.

Key requirements included:

- Engage a dedicated ESD consultant
- Involve the Government Services Group environment manager (EMS)
- Increase productivity by improving working conditions
- Provide access for people with a range of disabilities
- Water efficiency
- Select materials to minimise waste and off-gassing
- Minimise waste – kitchen design, recycling area and construction waste
- Data centre energy efficiency to be considered.

## 5.0 THE PROBLEMS WITH OL' 55

From a sustainability point of view the building was in poor condition. The energy use was high – the total electricity and gas use exceeded best practice for this type of building and it was one of the government offices' worst performers. The building rated about 1 star in an unofficial Green Star rating (one third of the building's points were due to its proximity to Parliament railway station!) and benchmarked, it is suggested it would have been around a 1 star rating using the ABGR (now NABERS Energy) Whole of Building rating tool.

### 5.1 General Issues

In summary, the building was a typical 1960s building that underwent a 1997 fitout and in adding another floor, caused additional problems. This extra floor extension used the existing air-conditioning plant without any additional capacity being added to the system. The

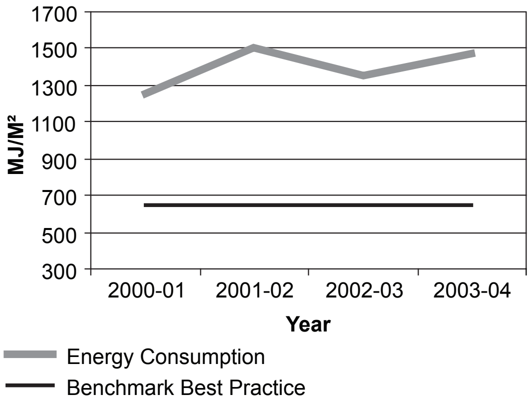


**Figure 4. Electricity and gas consumption from the past 4 years compared to benchmark**
Compared to a benchmark of 'best practice' from the Property Council of Australia Energy Guidelines 2003. (Source: Cundall, 2005)

opportunity was taken when a tenant vacated the premises to give the building a much needed makeover.

On the plus side the workstations left behind by the previous tenant were in good condition, with a number of spare parts. The walls and floors were in good condition and the solar hot water system on the roof was working well. Other issues which needed to be addressed included:

- **Lighting** – the building was very dark due to the heavily tinted windows, and the artificial lighting system didn't meet modern lighting practices
- **Water** – there were no water conservation features in the building
- **Fire Services** – required upgrade
- **Floor Coverings** – the carpets were nearing the end of their life

## 5.2 Indoor Environment Quality

While the required temperature set points were usually maintained within the building, from an occupant's point of view the comfort levels were poor. This was due to a combination of the poorly insulated nature of the building facades and building services issues, including:

- cold air draughts and perceived lack of fresh air
- the outside air intake location resulted in it collecting exhaust fumes from vehicles in the adjacent driveway (causing more than one building evacuation in the past!)
- the heavily tinted glazing became very hot in summer causing localised discomfort due to radiant heat, and cracking of the glazing in a number of windows
- the roof added in 1997 was not well insulated and thus air returning to the plant via the ceiling plenum from the level 4 office space reached 40 to 50ºC on extreme days, when ideally this would be around 24ºC!
- the addition of a VAV boxes to air-condition the added level 4 drew additional air from the main air-conditioning system, starving the main air-conditioning system of supply air. (Variable Air Volume boxes use localised fans that variably blow conditioned air from ductwork into the building interior – as determined by thermostats)
- problems with the air-conditioning control system with temperature sensors being incorrectly positioned, or not relocated during tenancy fitouts

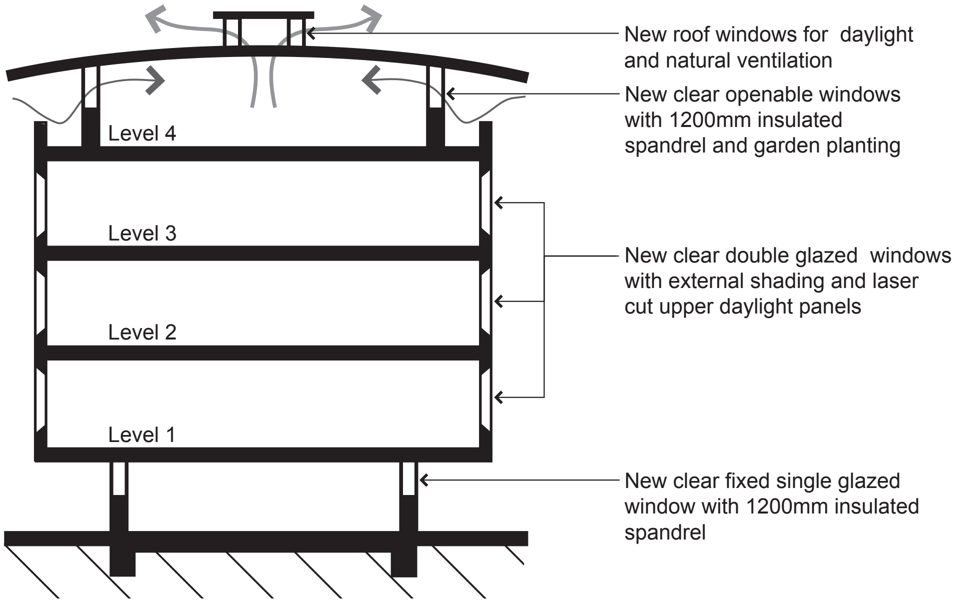


**Figure 5. Original improvement concept used in business case**
(Source: Adapted from Cundall ESD Improvement Plan, 2005)

## 6.0 DEVELOPING A BUILDING IMPROVEMENT PLAN

In mid 2005 the Government sought consultants to develop and implement a building improvement plan to achieve the following for a base building upgrade and interior fitout:

- 4 star Green Star – Office Design
- 4.5 star ABGR (NABERS Energy) Base Building
- 4 star Green Star – Office Interiors
- 4.5 star ABGR (NABERS energy) Tenancy rating

The ESD and engineering consultants, Cundall were engaged to develop the improvement plan for the building, and they, in turn, engaged H2o Architects and Medland Metropolis (electrical, hydraulics and fire services) to assist in developing the concepts and budgets. Three strategies were developed with budget costs for each:

- Option 1: Measures to achieve at least 4 Star Green Star and ABGR (NABERS Energy) ratings
- Option 2: Other measures that achieve 4 Star rating and improve the health, well-being, spatial efficiency and productivity of the building.
- Option 3: Measures that achieve a benchmark building in fulfilling the triple bottom line (TBL) objectives of the Office Accommodation Guidelines

## 7.0 IMPLEMENTING THE IMPROVEMENTS

In 2006 the client gave approval to proceed with Option 3 with a budget of $4.3 million allocated, and Cundall was appointed as principal consultant to manage and prepare the design and documentation for the base building. While it might be considered unusual for the ESD consultant to engage architects, engineers, quantity surveyors and building surveyors as sub-consultants, this was consistent with the Government Services Group's desire to challenge conventional design processes as well as conventional design solutions.

H2o Architects and Cundall were appointed to provide architectural and engineering services respectively for the fit-out works, while another firm, Montlaur Project Services, was engaged around the same time to project manage the tenant fit-out and provide construction administration services for the combined base building and fit-out works. The design of the tenant fit-out and base building upgrade proceeded in parallel. The design documentation and drawings were truly integrated with only one set of documents produced and tendered for the whole project.

## 8.0 DESIGN PROCESS

Very early in the design process the team realised that an innovative and consultative approach was required. Throughout the design phase the whole project team met on a weekly basis for approximately two hours to review the progress made over the last week. Cundall developed an Action Plan spreadsheet (a double-sided A3 sheet) which was updated at each meeting and which acted as the design brief, meeting minutes, cost plan, program and a 'green plan' all rolled into one. The benefits of the design approach were many:

- all team members had a clear understanding of the ESD elements of the building
- the team was asked to contribute their own thoughts
- the team members added value to the design from their own professional perspective
- the client team knew, first hand, the issues, the cost and the resolution proposed

This process meant the whole team 'owned' the design. The team also asked the engineering services manager from Jones Lang LaSalle (facility manager of the building) to attend, which proved to be a huge advantage, as the design has a maintenance culture embedded throughout.

The base building design outlined in the *ESD Improvement Plan* was further tested and refined. New features were added and other initiatives were deleted or adapted to either keep the project on budget or to reflect the fit-out requirements of the new tenant. Major changes included converting the ground floor from an office layout into eight larger Parliamentary committee rooms and a multi-purpose room, and relocating the building entry.

The typical approach to refurbishing poorly performing existing buildings is often to simply replace existing services, internal materials and fittings. The approach to 55 St Andrews Place was to go back to first principles and consider the same key issues as when designing a new building. The core design philosophy was to:

- improve daylight
- improve comfort and air quality
- reduce solar heat load entering the building through the roof and windows
- retain existing materials, systems, appliances and other equipment where possible

## 9.0 OVERVIEW OF GREEN BUILDING INITIATIVES

The following summarises the key ESD initiatives introduced into the project.

### 9.1 Indoor Environment Quality

#### Daylight and Solar Control

- To increase the daylight potential, glazing to windows was replaced with clear glass, and external automated blinds were installed to levels 1 to 3 to improve thermal comfort. Most of the building's windows face east and west and receive large solar heat loads. As they were not shaded, the resultant internal heat gain required a lot of energy to air-condition. To manage the solar heat loads through the windows, the glass had been tinted and a reflective film had been applied. The windows were very dark and, consequently, very little daylight entered the building. Because the windows were dark they also got hot, which meant it was uncomfortable sitting next to the windows when the sun was on them. External blinds were installed to control the solar load before it enters the building, allowing clear glazing to be used instead, significantly increasing daylight into the building.

- On Level 4 the large expanse of glazing was reduced by replacing full height glass with an insulated 1.2m high spandrel panel and installing new low-e glass. This reduces heat losses/gains through the façade, improves comfort and increases daylight levels.

## Artificial Lighting

The lighting within the office areas was re-configured to allow for greater comfort and energy efficiency:

- The previous lighting was designed to provide light levels of 400 Lux and sometimes provided higher levels. The new overhead lighting provides a background lighting level of around 180 Lux, which is generally better for computer screen based activities.

**Figure 6. Refitted windows**
Windows were clear glazed and external automated daylight guidance blinds were fitted.
(Source: Cundall, 2007)

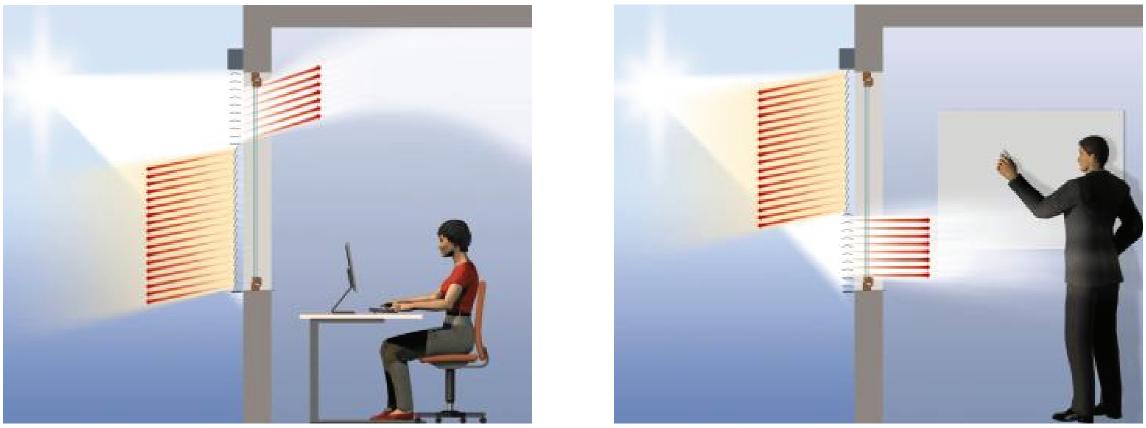

**Figure 7. External automated daylight guidance blinds**
These blinds allow for adjustment in 2 panels – allowing for glare to be avoided at desk level, and light to be reflected up to the ceiling at the same time.
(Source: Warema GmbH, courtesy of Shade Factor)

**Figure 8. Task lighting to workstations**
The task lighting is connected to the lighting control system which allows all lighting to be shut down via time clocks.
(Source: Cundall, 2007)

- Local task lighting provides lighting levels of at least 400 Lux on the desktop, and is controlled by each building occupant at individual work stations, for paper based activities
- Roof skylights were provided to level 4 to increase daylight
- Electronic (HF) ballasts were provided to fluorescent lighting to reduce flicker

## Air Quality

The following improvements were made to the building to improve the indoor air quality and temperature:

- The air-conditioning fresh air inlet was relocated to improve indoor air quality. This was previously located at the rear of the building in a position that sometimes brought vehicle exhaust fumes into the building from trucks using the service road.

- Outside air brought into the building by the air-conditioning system has been increased to 50 per cent above the minimum code requirement, to improve indoor air quality.
- The return air from the committee rooms is not recirculated to other spaces, thus significantly improving indoor air quality.
- Air-conditioning ductwork was cleaned to remove dust accumulation from years of building use.
- High performance swirl air outlets were installed to reduce draughts and improve air distribution, and give more even temperature.
- The new air-conditioning swirl diffusers fitted mix air better than the previous air outlets. This provides more accurate temperature control and eliminates draughts within the space. This improvement is particularly important because of the variable air volumes (VAV) tends to create fluctuations in the air-conditioning system.
- The more people and the less outside air there is in the building, the higher the Carbon Dioxide ($CO_2$) levels will be. $CO_2$ sensors were installed to monitor air quality in the building, and these can trigger a greater fresh air intake by the air-conditioning system.
- Low Volatile Organic Compound (VOC) carpets, carpet adhesives and paints, and low formaldehyde MDF and particle board were used to reduce air pollutants inside the building.
- A new separate exhaust system for printer/photocopier rooms has been provided to remove air pollutants. This system removes the toxic emissions from printers and photocopy equipment, such as ozone, directly from the building, rather than mixing and recirculating them with the conditioned air.
- A naturally ventilated winter garden (used as a meeting resource room), accessible to all building occupants has been provided at the northern end of level 4. This space is not air-conditioned.


**Figure 10. New window and air plenum**
The existing air grille was removed and the aperture glazed, with an additional glazed panel added to the internal partition. This allowed daylight to enter the room beyond, and the space between the walls to act as a plenum.

- The design solution allowed for a naturally ventilated winter garden to be created at the northern end of level 4. This area is used as a meeting resource room, accessible to all building occupants.

## 9.2 Energy and Greenhouse

### Air-conditioning

- The addition of external blinds and the replacement of glazed panels as described above, help to maximise natural light while minimising undesirable heat loads on air-conditioning.
- Additional insulation was provided to the underside of the roof to reduce air-conditioning loads on level 4.
- Area of air-conditioned space reduced by making resource room naturally ventilated.

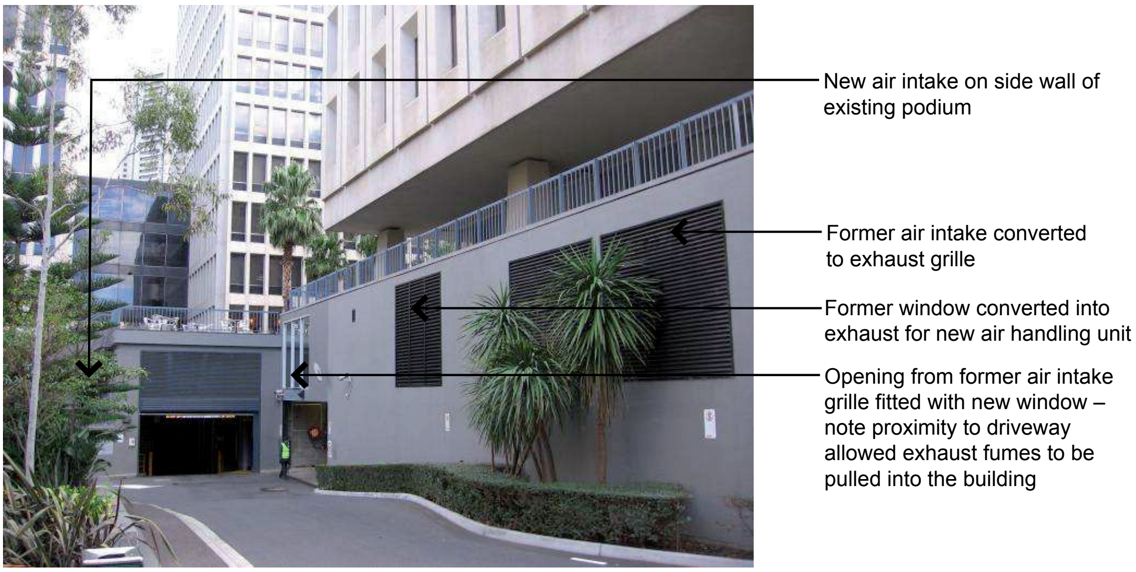


**Figure 9. Former intake air grille location next to service road**

- Heat recovery and indirect evaporative cooling provided for 100 per cent outside air to the committee room air-conditioning system to reduce air-conditioning loads.
- Ducted return air installed to level 4 fan assisted VAV boxes to reduce heat in ceiling void losses/gains.
- Lighting upgraded with background lighting automatic controls, motion sensors, and task lighting.
- Improved air-conditioning control strategies including an outside temperature adjusted thermostat set point.

### Hot Water

The existing solar hot water system on the roof was retained, because it was relatively new and working well.

### Metering

Additional energy metering was incorporated into the building and connects to the Building Management System (BMS) to assist understanding of energy use and thus allow for better energy management.

### Data Room

The building's data centre serves not only 55 St Andrews Place, but the whole of Parliamentary Services' IT system throughout Victoria. Even though it utilises more energy efficient blade servers, when all these servers were placed into level 4, they accounted for over 60 per cent of the tenant's total energy consumption.

### Shared Air-conditioning Plant

All the chilled water to the building is provided by a central chiller plant that also serves the adjacent 1 Treasury Place, and 1 Macarthur Street office buildings as well as the Old Treasury Building. As a separate project to the building upgrade, an existing unused

**Figure 11. Naturally ventilated resource room**
The concrete spandrel around the perimeter of the top floor raises the question – why was full height glass originally installed?
(Source: Cundall, 2007)

chiller in the adjacent Old Treasury Building was connected to the central chilled water system to enable the data centre to be cooled. This enabled the data room to be cooled without requiring the main chiller plant and pumps of 55 St Andrews Place to operate at night and on weekends; thus avoiding operating the large central plant at inefficient low loads.

## 9.3 Water

A number of new water harvesting and conservation methods were installed as part of the building renovation including:

- Rain water harvesting: Rainwater is collected from the roof of the building and stored in tanks located in the basement. It is then pumped to the floors for toilet flushing and future level 4 planter boxes.

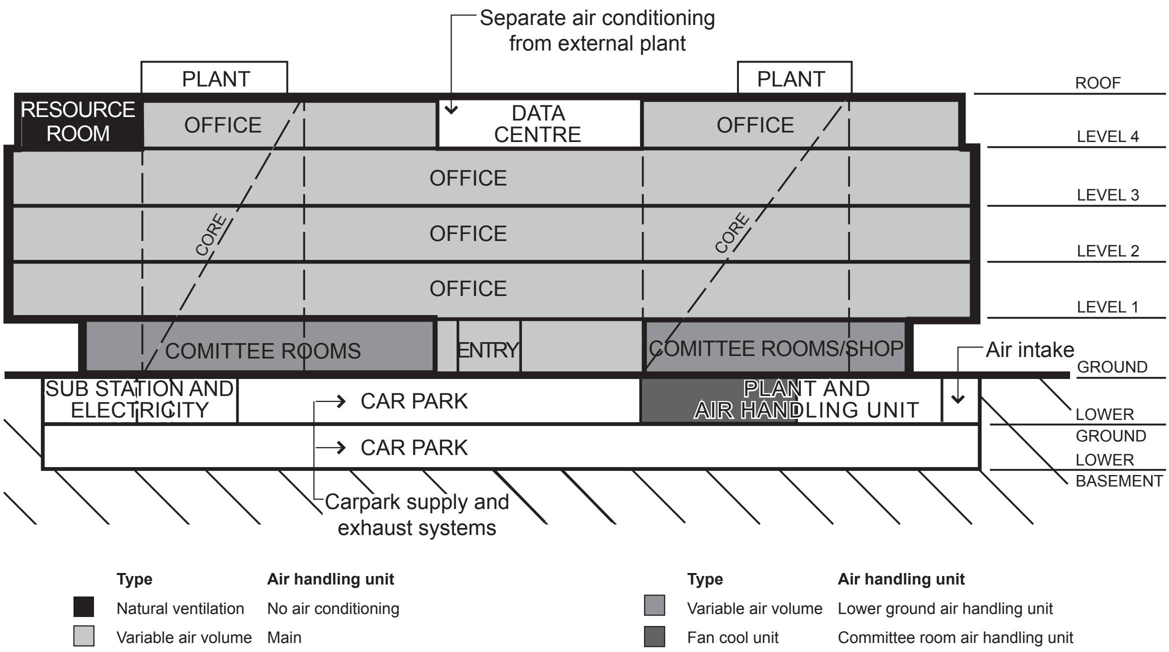


**Figure 12. Overview of different HVAC systems**
Note: the only new air-conditioning system required was for the ground floor committee rooms
(Source: adapted from the Building User Guide prepared by Cundall, 2007)

- Water efficient taps and showers, and a bioactive waterless urinal system were provided.

## 9.4 Materials

Construction waste was reduced firstly, by reusing as many materials as possible, including:

- All workstations
- 80 per cent of existing suspended ceilings (exception being ground floor)
- 50 per cent of existing office partitions
- 50 per cent of tables
- 67 per cent of storage units
- 80 per cent of air-conditioning ductwork, plant and systems.

Where new materials were used, effort was made to avoid PVC and materials that are know to have significant off-gassing:

- new pipe work and communications cabling has no PVC content
- carpet tiles have low VOC emissions and no PVC backing
- sheet flooring used linoleum with no PVC content
- joinery uses particleboard and MDF with low formaldehyde content (EI and EO standard)

## 9.5 Waste

As part of the renovation of the building, waste management features were incorporated to allow for separation and storage of recyclable waste.

- A dedicated storage area is located in the lower ground car park area and provides for the separation, collection and recycling of office consumables.
- A designated storage space is allocated on each floor for waste bins (recycled/compost/landfill).
- 85 per cent of demolition and construction waste was diverted from landfill and either recycled, or reused during the refurbishment works.

## 9.6 Transport

The building's location gives it excellent access to public transport – trams, trains, buses. Twenty secure bicycle storage racks with change facilities, lockers and showers were added during the refurbishment. Most of the existing cark park spaces on the lower ground are for small cars (i.e. 2.3 x 5.0 metres).

# 10.0 CONSTRUCTION

The building works were completed in May 2007. The combined project cost for the integrated base building upgrade and tenancy fitout was approximately $8 million including construction costs and consultant fees. This equates to approximately $1,315/m². The split between base building and fitout was approximately 60:40 giving a base building upgrade cost of $790/m² and a fit-out cost of $525/m².

Delays in gaining building certification have been caused by difficulties in obtaining all the necessary as-built documentation from the various trades, and this has delayed the application for an 'as-built' Green Star rating.

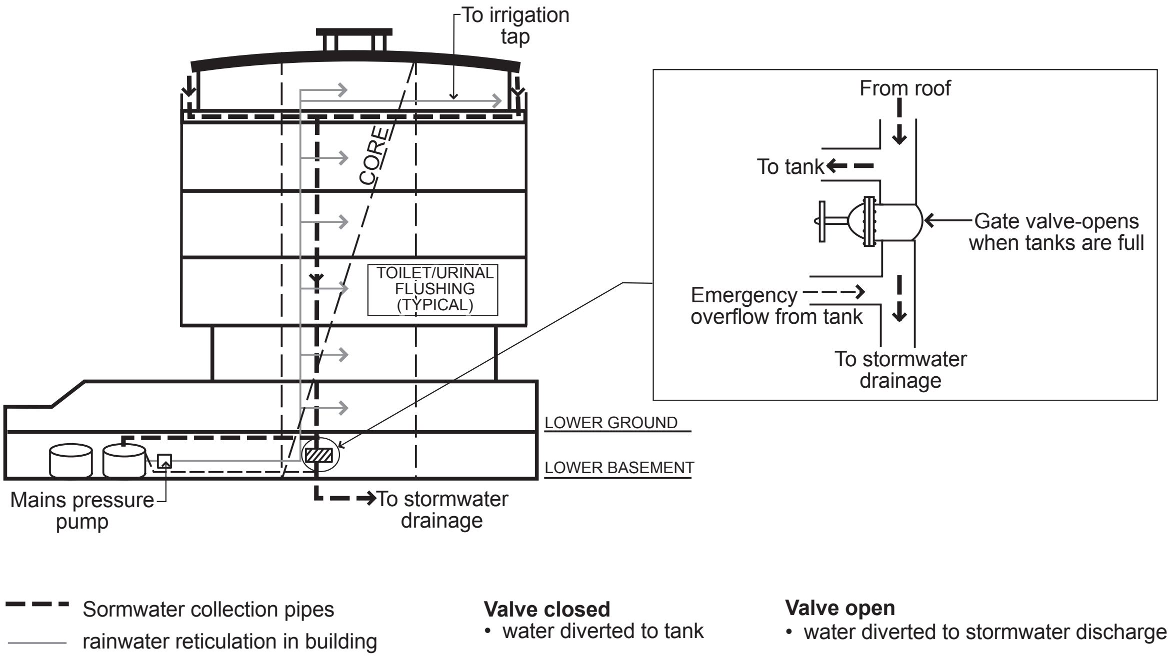


**Figure 13. Rainwater harvesting schematic**
(Source: adapted from the *Building User Guide* prepared by Cundall, 2007)

## 11.0 PERFORMANCE

According to the facility manager for the building, the indoor air quality and ambience in the building has significantly improved compared to before the upgrade. The improvement in air quality is primarily due to relocating the air intake, cleaning the ducts and filters and increasing the amount of outside air. The improvement in ambience is primarily due to replacing the heavily tinted windows with clear glass and installing daylight guidance blinds.

The automated blinds and task lights have been well received by the tenant. Typically only 5 to 10 per cent of task lights are turned on during the day, occupants instead relying on daylight and reduced ceiling lighting levels.

The authors have been unable to obtain energy data for the first 12 months of the building's operation. The graph below summarises the energy performance of the building before and after the upgrade for a typical week in August. This shows a 30 per cent reduction in total electrical use in the building for base building and tenancy (excluding the chilled water which is supplied by the central plant). The chilled water consumption will be unchanged, as the original cooling capacity was retained to enable outside air quantities to be increased. The electricity data includes the new data centre installed during the upgrade works.

## 12.0 CONCLUSION

The upgrade of 55 St Andrews Place was achieved by breaking with conventional design processes and solutions. The ESD consultant was the principal consultant and together with the client defined the project brief and budget. The ESD consultant then took on the role of principal consultant and managed the design process for the base building. This placed sustainable design at the heart of all the decisions made on the project.

The design solutions are simple and, by improving the façade performance, the team was able to improve daylight and comfort, and reduce energy consumption, while retaining most of the original mechanical systems. The fit-out and upgrade works were truly integrated and this was most apparent in the design of the lighting system which combines ceiling lighting with task lighting.

The project demonstrates that to make significant environmental improvements in existing buildings it is not always necessary to 'gut' the interior, and start again. This project won the UK's *Building Services Journal*, Sustainable Building Refurbishment Award 2007.

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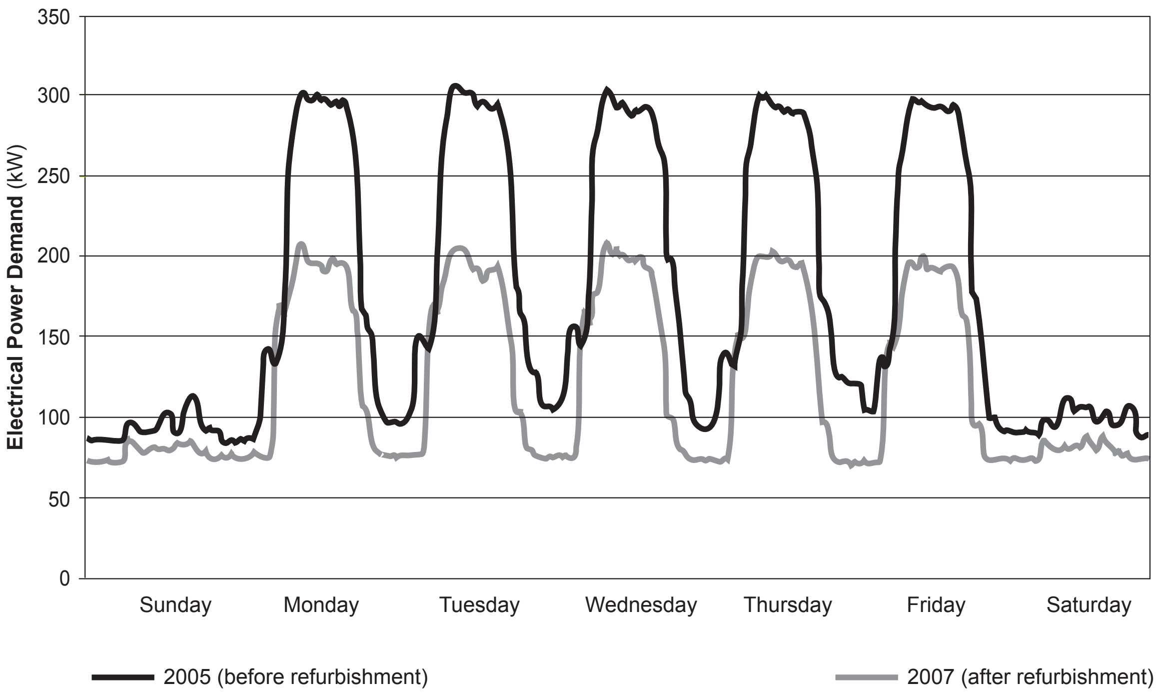


**Figure 14. Electrical efficiency gains**
Electricity profile for a typical week in August 2005 v 2007 (including data centre)
(Source: Cundall, 2007)

## BIOGRAPHY

**Roger Kluske** is Manager Built Environment with the Victorian Government's sustainability agency, Sustainability Victoria. Roger leads a team of dedicated people who working with business, aim to gain sustainable improvements in Victoria's portfolio of new and existing commercial buildings and new residential buildings. Prior to this role, Roger was Manager, Sustainability for the Victorian Government Property Group, Department of Treasury and Finance, and thus was part of the client group for this project. Before this, Roger worked for Sustainable Energy Authority Victoria (SEAV), (a predecessor organisation of SV), Australia Post and the Commonwealth Government.

**David Clark** is a Principal with Cundall in their Melbourne office, providing ESD and building services engineering, and was the design manager on this project. David was the principal technical author of the first Green Star rating tool, and has since worked on a number of 6 Star Green Star certified buildings, including VS1 (SA Water headquarters) in Adelaide and The Gauge in Melbourne. Recent projects recognised by sustainability awards include St Leonards College Sustainable Living Centre in Melbourne (UNAA Green Building Award 2008), and 55 St Andrews Place (UK's Building Services Journal Sustainable Refurbishment of the Year Award 2007). Current projects include the Plumbing Industry Climate Action Centre and CERES Community Centre, also in Melbourne.