

BEDP ENVIRONMENT DESIGN GUIDE

AUSTRALIAN ETHICAL INVESTMENT HEADQUARTERS, 6 STAR GREEN STAR OFFICE REFURBISHMENT, CANBERRA

Kevin Miller

The refurbishment of Trevor Pearcey House for the new Australian Ethical Investment Headquarters was designed by Collard Clarke Jackson Architects and in 2007 was the first building in the ACT and only the third in Australia at the time to receive a 6 Star Green Star rating. More importantly it was the first wholly privately funded project to receive a six star rating. This case study provides a detailed description and evaluation of the whole process of taking an ordinary 19 year old office building and changing it to a leading example of low cost environmental design.

Keywords

6 Star Green Star, comfort, day lighting, double openings, energy, efficient, insulation, natural ventilation, passive, rainwater, recycled materials, renovation, retrofit, reuse, stack ventilation, thermal mass, waste

1.0 PROJECT DETAILS

Client

Australian Ethical Investments

Architecture, Interiors and Environmental Design

Collard Clarke Jackson, Canberra

Construction Manager

Cobul Constructions

Structural and Hydraulic

Hughes Trueman

Green Star

Viridis E3

Thermal Modelling

Energetics

Mechanical, Electrical and Fire

Bassett

Landscape

Red Box Design Group

Acoustics

Heggies

Commissioning Agent

Sustainable FX

Cost at Completion

\$1.7 million

Year of completion

March 2007

Building Type

Office refurbishment

Building Area

1,100 m² GFA

Design Ratings

6 Star Green Star V2

47 per cent better than 5 star ABGR
(38 kgCO₂/m² per annum)

2.0 INTRODUCTION

Trevor Pearcey House (originally designed by Allen Jack & Cottier) is a 19 year old, two-storey, commercial building otherwise known as Block E in Fern Hill Technology Park, Bruce ACT. The refurbished block E has become the new head office for Australian Ethical Investment (AEI), a financial services company specialising in environmental and socially responsible investment. In 2007 the refurbishment received a 6 Star Green Star rating from the Green Building Council of Australia, which represents world leadership in environmental design. It is the first building in the ACT, and at the time, was only the third in Australia to achieve a 6 Star Green Star rating.

One of the aspects that sets the project apart from most recent high level environmental buildings is that it was achieved using conventional low-technology design principles and on a conventional budget.

2.1 Location and Climate

The building is located in the suburb of Bruce in the ACT. Canberra has a high diurnal range with temperatures in summer generally ranging from 15°C to 35°C, which occasionally peaks up to 42°C, and in winter temperatures generally range from -2°C to 15°C, but can be as low as -7°C. The high diurnal range during summer makes it ideal for passive cooling strategies such as night purge, with overnight summer temperatures rarely exceeding 15°C.

Canberra's average annual rainfall is 623mm although in 2007, it was a low 565mm.

2.2 Brief

Part of the philosophy of the client is to promote environmental awareness in business projects and the finished building was to become part of their investment portfolio. The client was also interested in creating a comfortable, healthy and productive work environment for their staff. The aim of the design team was to create something fresh, innovative and energy efficient while engaging and teaching staff and visitors

about how environmental buildings work and function. AEI wanted a simple environmental building and was not interested in 'buying' Green Star points through technology. To show that they were serious about their intention the comfort condition range was proposed at 19°C to 26°C.

Initially AEI was aiming for a 5 Star Green Star rating as a minimum, as it was not thought that 6 stars were achievable because of the anticipated cost. The project budget was based around what was considered a normal refurbishment and fitout cost to attract a Commonwealth Government tenant, which after concept design was set at \$1.7million.

3.0 REFURBISHMENT

Commercial buildings represent the poorest level of existing building stock in terms of environmental design. Without mandatory requirements in environmental performance until 2007, most building are little more than sheds or uninsulated boxes.

Trevor Pearcey House is typical of low-rise commercial buildings produced throughout Australia in the recent decades. As the aesthetics of these buildings do not lend themselves to refurbishment (i.e. they are not 'old' groovy warehouses and the like), they are not valued and frequently face demolition.

This project presented further refurbishment challenges as it is one block within a larger commercial precinct under the control of a body corporate. To reduce the risk of conflict with other body corporate owners, changes to the outside were kept to a minimum.

The refurbished building has been developed to minimise energy usage through improving the building

fabric, the use of natural ventilation and natural lighting. This was achieved by the application of low-technology measures such as:

- insulating the outside of the existing façade
- insulating the existing roof
- reorganising and modifying sun shading
- replacing existing fixed windows with new double-glazed, operable windows
- exposing thermal mass on the buildings interior
- improving daylight penetration
- reusing materials

A range of further environmental initiatives cover areas of the building design such as management, waste, transport, water, and indoor environment.

3.1 Solar Access

In commercial buildings it is important to prevent direct solar access, even in winter, because the heat generated by human bodies and equipment such as computers, is often sufficient to heat the space. Generally, therefore, the aim is to reduce the heat load on the building. The existing shading on Trevor Pearcey House was quite inefficient with poorly positioned, open mesh sunshades, even with some located on the southern elevation. This was improved by relocating these panels to the eastern facade, changing the mesh to suit the orientation, and adding panels where there were none previously. In addition to this, adjustable blinds have been added to windows internally, and all workstations in open areas have been moved 1200mm away from the perimeter glazing to avoid extremes of temperature and glare.

Uninsulated roof

Poor sun shading

Single glazed windows

Uninsulated infill

Thermal bridging concrete columns and beams exposed inside and out



Figure 1. Existing building exterior
(Source: Kevin Miller)

3.2 Insulation

In its pre-refurbished condition the project's fabric gave minimal protection internally to the fluctuating temperature conditions outside. The original construction of exposed concrete columns and beams with brick veneer infill panels had an approximate R value of only 1. The pitched metal deck roof had only foil and some fibreglass insulation of about R0.5 – 1. In addition all windows were single glazed with fixed panes, while all internal ceilings were set at 2400mm above floor level.

The building was made more 'esky' like by significantly improving the external fabric. This involved insulating the outside of the building with 75mm thick rigid closed cell, extruded polystyrene which improved the R value of the walls to 3.7. On the first floor the

suspended ceiling was temporarily removed and R6 insulation was added to the underside of the roof. The existing windows were then exchanged with operable double-opening, double-glazed windows.

In addition to increasing the insulation of the building, thermal chimneys and a barrel vaulted clerestory were added to improve ventilation and natural light penetration (refer to Figure 4). On the ground floor the existing suspended ceilings around the perimeter of the floor plate were removed, exposing the thermal mass of the underside of the first floor concrete slab, in order to aid moderation of the interior temperatures.

The resulting thermally efficient façade meant that the hydronic radiators added to the perimeter of the floor plate (on both levels), could easily provide a radiant offset to the large areas of glazing without the need for any additional supplementary heating.



Figure 2. Thermal insulation was added

(Source: Kevin Miller)

3.3 Ventilation and Thermal Comfort

The refurbishment has been designed specifically to be naturally ventilated and allows for individual control of comfort settings by the users as one of its strategies to increase fresh air and reduce heat load.

This building employs a number of ventilation strategies such as:

- where ventilation is from one façade only – dual low, and high-level window openings
- where ventilation is from multiple facades – cross ventilation
- stack ventilation with fan assistance

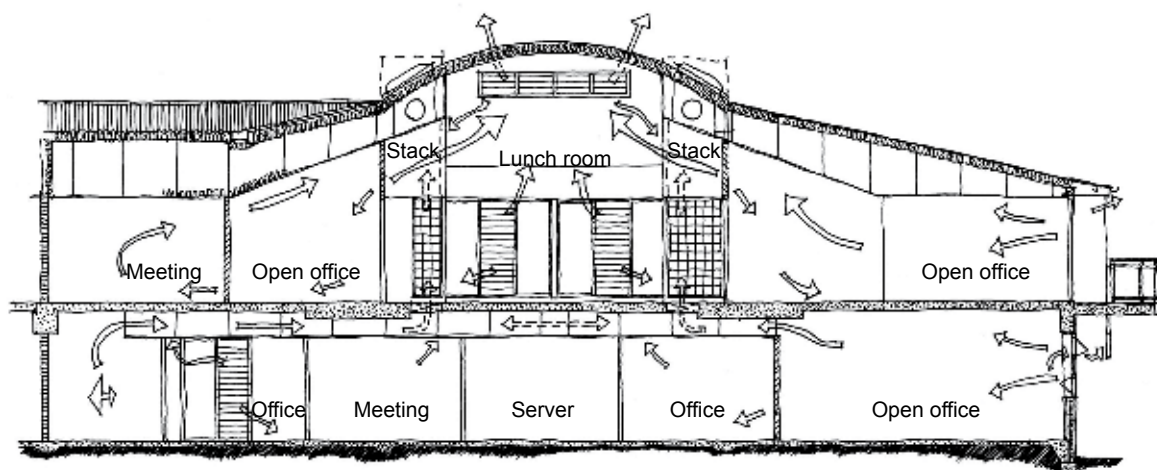
- atrium type ventilation in the lunch room and adjacent open areas
- night purge ventilation achieved through automated windows and stack louvres controlled by a computer system linked to a weather station.

3.3.1 Cross Ventilation

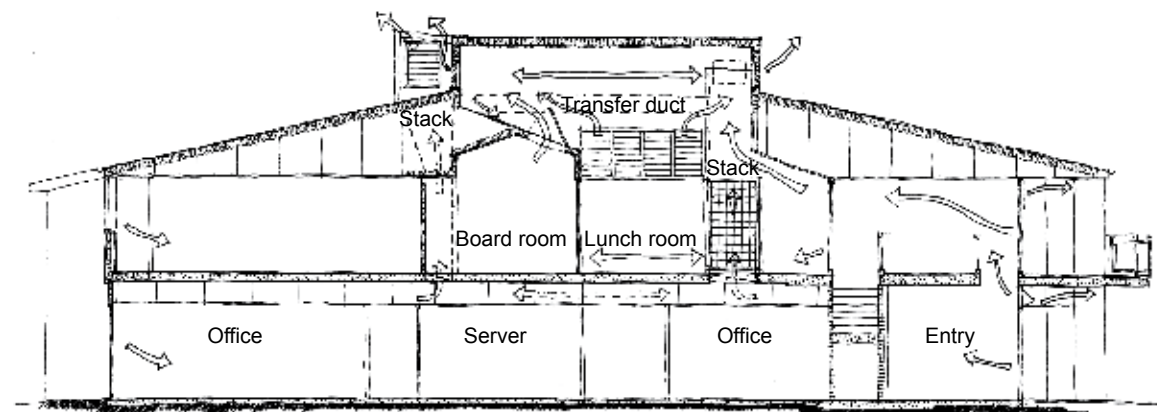
Both the ground floor and the first floor layouts have been planned to maximise cross ventilation flows throughout the building. The relevant Australian Standard for natural ventilation AS 1668.2-2002 does not give distance or area limitations on direct cross ventilation. However a general rule of thumb for this is a distance that is 5 times the floor to ceiling height



Figure 3. Thermal mass was captured
(Source: Kevin Miller)



East-west section



North-south section

Figure 4. Ventilation paths shown through building
(Source: Kevin Miller)

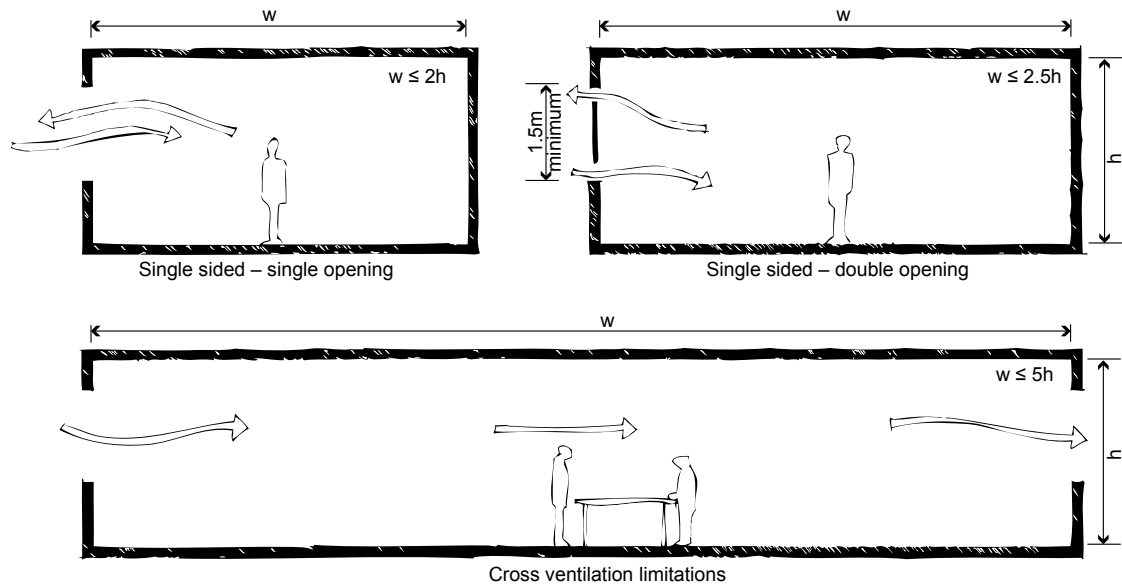


Figure 5. Natural ventilation models

(Source: Kevin Miller)

which in the case of this refurbishment is 15m width for the ground floor plate (3m x 5), and a 12m width first floor plate (2.4m x 5) (refer CIBSE, 2005). A floor plate distance between opposing operable windows greater than this will reduce the effectiveness of cross ventilation. Therefore as the building is wider than these maxima, stack ventilation was included in the central areas of both levels. Holes cut through the first floor slab allow four, fan-assisted stacks to rise from the ground floor to the roof (as seen in Figure 4). A stack effect was created on the first floor by the addition of clerestory openings in a high, barrel-vaulted ceiling space above the central lunch room.

3.3.2 Window Openings

Ventilation was further enhanced by the provision of multiple window openings at high and low level along all facades which allow air movement via convection. As well as enhancing the ventilation rate, these double openings also help increase the depth of penetration of fresh air into a space by about 20 per cent (refer Figure 5).

Each bay of windows has both automatic and manual operated hoppers, with the automatic hoppers generally located at the top of the window bay. The low hoppers open inwards and are hinged at the bottom which allows them to be opened to only to a limited degree to allow for trickle ventilation on cold and extremely hot days. At least 50 per cent of the upper sashes can be manually operated to allow for user-controlled, stack ventilation (refer Figure 6). The automated operation of some of the remaining window panes as well as the stack and clerestory openings allow for the building to 'night purge'. Night purging uses cooler night air to flush through the building, cooling the thermal mass within the building and thus reducing the need for air-conditioning on the following day. In extremely hot temperatures the fans within the stacks are used.

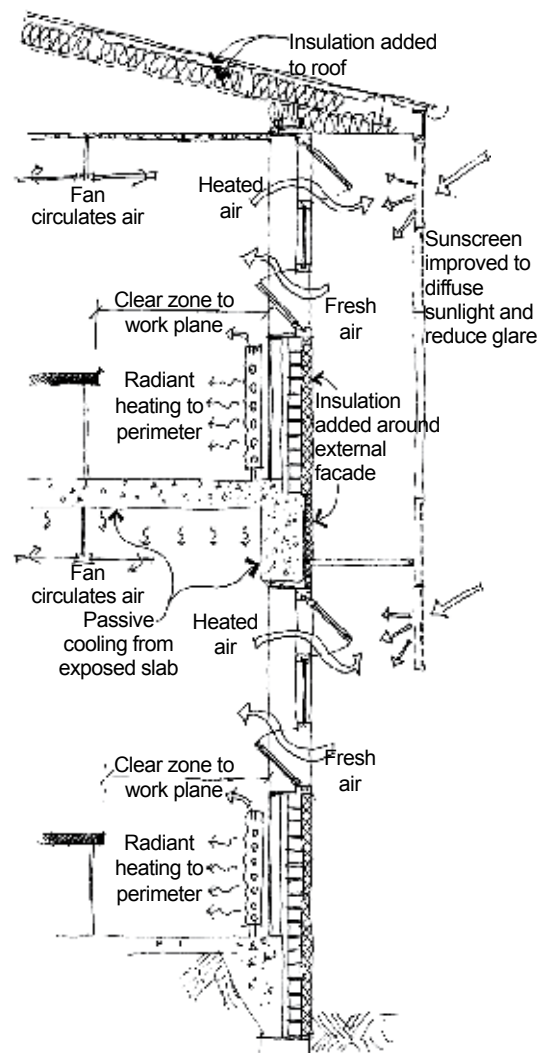


Figure 6. Increased permeability for natural ventilation

(Source: Kevin Miller)

3.3.3 Internal Spaces

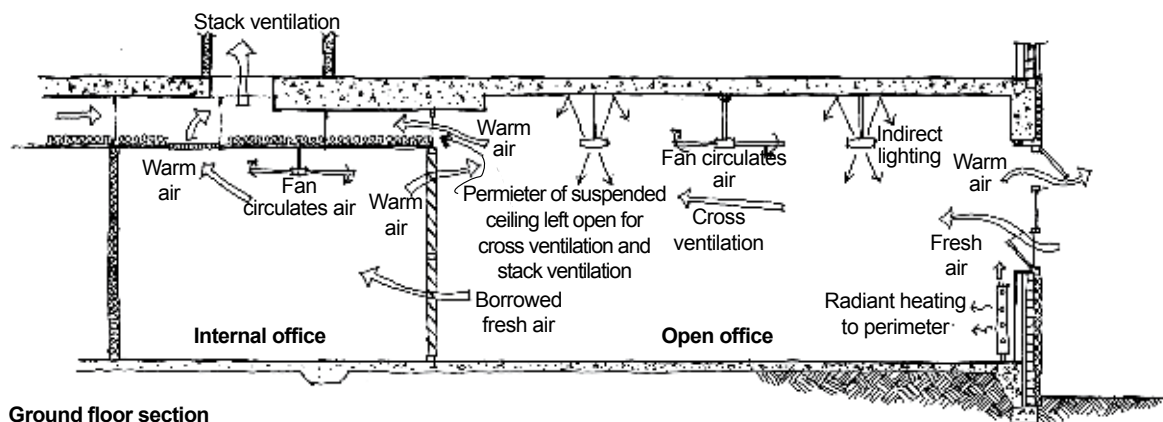
Internal offices and meeting rooms use high and low level louvre openings to allow single-sided, borrowed ventilation off directly ventilated spaces. On the ground floor this is improved by having open diffusers in the suspended ceiling that allow warm air to rise up into the new stacks (see Figure 7, ground floor section).

In addition to having external openings, offices on the external walls have louvres in their internal partitions to allow for cross ventilation. The first floor open-plan work areas have a modified ceiling which rakes upward to take advantage of the building's pitched and barrel vaulted roof line, and connects these areas to the stack induced ventilation in the lunchroom as shown in Figure 7 (First floor section).

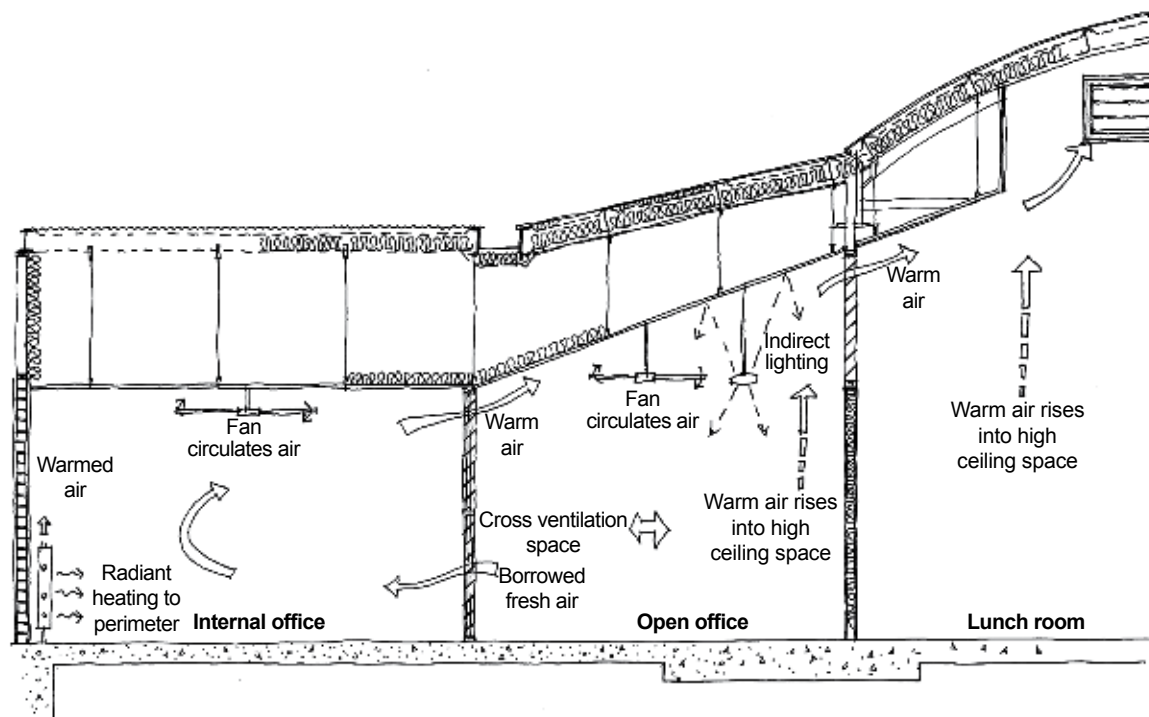
3.3.4 Mechanical Air-conditioning

The simple strategies outlined above allow the building to take advantage of an efficient building fabric and natural ventilation for conditioning of the internal spaces. It is the building's 'passive' features that reduce the need for both heating and cooling and that provides comfort through:

- radiant cooling from exposed thermal mass
- radiant heating from wall mounted radiators
- air movement from natural ventilation and ceiling fans
- a high degree of individual user control



Ground floor section



First floor section

Figure 7. Ventilation paths through building
(Source: Kevin Miller)

The predominantly high volume of natural ventilation ensures high levels of fresh air are maintained within the building without the need for recirculation.

The project design team had an aspiration for the mechanical components to be used as a back-up and enhancement of the passive systems. Radiant panel cooling and heat recovery systems were initially planned, however these were not pursued due to their cost, and the discovery in thermal modelling that showed that the building worked well without the additional systems.

Some refrigerated air-conditioning is retained within the building for specific areas, such as the ground floor, where a ducted system serves four internal rooms: a server room, print copy room and two meeting rooms. These rooms are completely internal and do not function adequately under the passive system alone. On the first floor there is a ducted air-conditioning system for backup cooling, which is locked, and may only be switched on when there is a consensus of staff on that floor. It is also temperature limited so that it only operates when temperatures are above 26°C. During the first year of occupancy the air-conditioning on the first floor has only been switched on for 20 working days.

In addition to the backup systems the print/copy rooms have their own separately ducted exhaust system to remove airborne contaminants. The ventilation stacks also have exhaust fans to aid them to draw air when during a night purge, the internal temperatures do not fall quickly enough.

The heating and ventilation (automated windows and stacks) is controlled with a computer system connected to a roof mounted weather station. This system uses a seasonal control to turn off heating in summer and prevent night purging in winter. Canberra has a climate where in summer you may have a cold morning, sometimes as low as 0°C, followed by a 30°C afternoon. It is not possible to heat a passive building in the morning if the temperatures will be hot in the afternoon and there is no cooling system to cope with overheating.

3.3.5 Energy Efficiency and Staff Comfort

Besides the environmental benefits, this type of refurbishment improves the comfort and internal environment for staff. The air-conditioning of many commercial buildings is generally set to allow occupants to wear suits all year round. AEI's relaxed clothing policy allowed for a design comfort band of 19°C to 26°C. In a standard office building this would normally be 20°C to 24°C. It is worth noting that an extra 5°C cooling uses nearly 50 per cent more energy. Staff were educated about the building's features, including how they should dress to cope better with a broader band of comfortable temperatures. Their relaxed clothing policy helped achieve a comfort simulation of ± 0.5 PMV for 93 per cent of the floor area and ± 1 PMV for 99 per cent of the floor area (See Box 1).

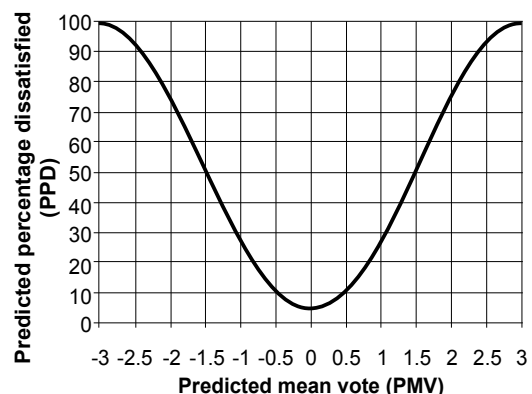
Prior to completion and during post occupancy sessions, staff were given detailed instruction on how the building works and how they can maximise their comfort. A detailed environmental user's guide has been developed to show when to open windows, when to shut the building and how to maximise the effectiveness of night purges.

3.4 Lighting and Day lighting

The building's shape and overall modifications lend themselves to good levels of natural light. The atrium on the first floor level allows access for both day lighting and ventilation. In the open areas natural light can enter from two sides of the building and can also utilise both the atrium space on the first floor and the combined light columns/ventilation stacks that run from the ground floor to the roof. Different forms of shading have been provided to each elevation to reduce direct solar gain while still obtaining indirect natural light.

Predicted Mean Vote: is a subjective predicted measure of comfort, which in the case above, a value of 0.5 would mean 10 per cent of occupants would be dissatisfied. Thermal comfort is a quantum that is influenced by many factors including air temperatures, radiant temperature, air movement, clothing worn by the occupants, stress, activity, visual simulation and general well being. This comfort is a condition of mind that expresses satisfaction with the thermal environment. Due to individual differences, it is almost impossible to specify a thermal environment that will satisfy everyone (even in an air conditioned environment). There will always be a percentage of dissatisfied occupants. The aim is to achieve an acceptably low level of dissatisfaction.

It is possible to specify environments predicted to be acceptable by a certain percentage of the occupants. Subjective indexes have been developed to predict occupant satisfaction. These are included in *ISO 7730 – 1993 Moderate thermal environments – Determination of the PMV and PDD indices and specification of the conditions for thermal comfort*. These indices are predicted mean vote (PMV) and predicted percentage dissatisfied (PPD). PMV is a 7 point thermal scale as shown below and PPD predicts the percentage of people likely to feel too hot or too cold.



Where: -3 is cold and +3 is hot

Box 1. Predicted mean vote

(Source: Advanced Environmental Concepts, Passive Engineering Concept Design Report, ANU FEIT Building, May 1999)

As a base lighting system, office areas have been provided with high efficiency, low brightness, semi-specular louvres (these help reduce glare and evenly distribute the light output), and luminaires with T5 fluorescent lamps which use about 40 per cent of the energy of standard T8 fluorescent lamps. The base level lighting is low to minimise energy consumption, though this can be supplemented with task lighting in individual work areas.

Lighting in the building is manually switched with an automated override control which turns off lights after hours. This control panel allows calendar function for programming in weekends and public holidays. Use of lights outside normal business hours is limited to 2 hour periods.

Lighting is zoned within the building, with perimeter lights next to windows and adjacent to the atrium separately switched to save energy when adequate daylight is available.



Figure 8. First floor lunch room

This area originally had a flat ceiling at 2400mm high. Note the combined light and ventilation stack to the right with glass blocks and the clerestory windows. The sink, carpet, joinery, timber panelling, doors and door hardware, glass blocks, ceiling tiles and the splashback (former computer room floor tile) are all reused.

(Source: Kevin Miller)



Figure 9. Ground floor office

The former suspended ceiling has been removed to expose thermal mass of slab over. Ceiling fans have been added for air movement, suspended T5 lighting with an up-light component and slab over painted white for greater reflectance.

(Source: Kevin Miller)

3.5 Energy Reduction



The building owner has also modelled to achieve a 47 per cent better than 5 star Australian Building Greenhouse Rating. This is 75 per cent better than the original 'average' building. Australian Ethical has also committed to purchasing 100% renewable electricity.

Figure 10. Carbon emissions

(Source: Viridis E3)

3.6 Water

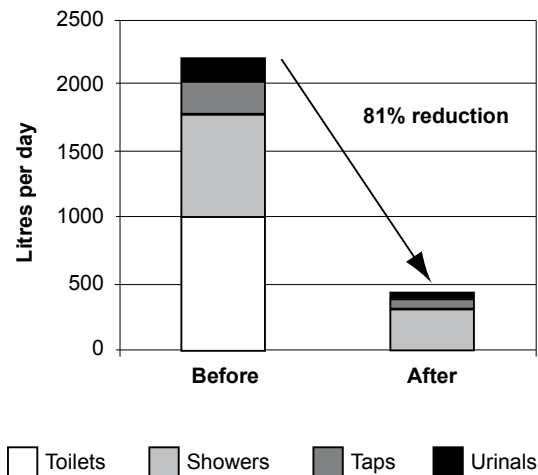
Water saving in the building was the simplest of the ESD initiatives. Existing single flush toilet cisterns (12 L/flush) were replaced with dual flush (9/4.5 L/flush) achieving a 56 per cent reduction in water use for toilets alone. As this is still a high flush toilet cistern due to the limitations of the existing pipe work in the building, two 3000 litre rainwater tanks have been installed to offset the water required for the toilets.

The use of waterless urinals would have been ideal, however existing plumbing limited the installation to a semi-waterless system that combines a waterless urinal cartridge with an automated low volume flush system. In addition, all tap and shower fixtures have been replaced with low-flow fittings. The client is using a simple low-cost leak detection system to provide ongoing monitoring of water use, in a web format. This is one of the functions of the building that is monitored by staff.

Reduction in mains water use has been projected to be more than 80 per cent through these initiatives. Current figures show that water use in the building is less than expected. The building's total water use over the last year has been 109 kl, this equates to 0.11 kl/m²/year. This is a 90 per cent reduction on the Canberra average (1.30 kl/m²/year) and 68 per cent better than NABERS Water 5 Star benchmark for Canberra (0.35 kl/m²/year).

3.7 Indoor Environment

As general churn in contemporary fitouts is now around 2-5 years, the design team thought that designers and architects have a responsibility to resist changing existing fitouts just for the sake of fashion, making a mark or to privilege the visual. The temptation to pursue an outcome with the strong visual appeal of 'the new' can devalue the worth of otherwise functional elements in an existing interior.



Reduction in mains water use is estimated at more than 80 per cent through water efficiency and capture of rainwater to supply toilets.

Substantial water savings achieved through:

- Replacing single flush cisterns (12L/flush) with dual flush (9/4.5L/flush) achieving a 56 per cent reduction in water use.
- Upgrading urinals with a system that combines a waterless urinal cartridge with an automated low volume flush system. The system avoids replacing the original urinals and delivers a 96% reduction in water use.
- Installing two 3000 litre water tanks to provide all water required for toilets.

Figure 11. Water usage

(Source: Viridis E3)

Fashion ignores functionality of the existing

- increases want
- creates artificial need
- increases consumerism

= Waste and churn.

Therefore part of the character of the project is the deliberate anti-fashion 'rawness' to the aesthetic. The design team decided from the project's inception to avoid unnecessary additions to the finishes and internal structure of the building and to work primarily with what was already there. This allowed the building to display traces of its previous life, making it easier to highlight the extent of the conversion that has taken place. For example, the ceiling on the ground floor is an exposed concrete slab painted white only in the areas above workstations, where this assists with light reflection. Colour schemes are deliberately subtle, giving the recycled timber features and various artworks a greater presence within the fitout.

The project architects focused heavily on human health issues, with a concerted effort to minimise pollutants in the new environment by selective use and choice of finishes, paints, sealants and adhesives. Only products that had very low or no volatile organic compounds were used where new materials were required.

3.8 Materials and Their Reuse

The Trevor Pearcey House project has demonstrated significant environmental innovation in the reuse of

materials beyond that recognised in the Green Star Office Design V2 tool. The existing building contained a substantial existing fitout that was carefully assessed for reuse potential. The demolition phase of the project ensured that reuse items were carefully deconstructed and removed for reuse within the new fitout. This high level of reuse reduced waste to landfill, and also ensured that the materials were reused at the highest value, rather than recycled to lower value materials. Specific reuse items in the project are included in the appendix at the back of this paper.

The extent of proposed recycling and reuse went beyond the previous experience of both the design team and the construction team. Initially no one was sure how much could be reused, how hard it would be, or the cost implications. As it turned out much more was recycled and reused than was anticipated, due to a cooperative, team-like approach between all parties. A charrette type process formed where frequent meetings between client, construction team and design team helped to solve problems that arose during the refurbishment and identify previously unseen opportunities.

Unlike most construction contracts and processes the client's environmental commitment allowed the green obligations to share an equal footing with the standard budget and programme constraints. Although the project had a fixed budget, it had a flexible way of achieving the refurbishment requirements. Therefore savings achieved in one area, such as reduced material supply cost, offset areas of increased cost, such as increased labour costs incurred in disassembling or recycling existing materials for example.

As the project progressed the recycling and reuse became quite competitive. It became a challenge to see what and how much could be recycled. This produced surprising results such as the reuse of electrical cabling and the innovative use of the old computer floor tiles as 'canvases' for artworks. During this phase the design team formed a close bond with the construction team as they worked in the building to produce the artwork amidst the sub-contractors.



Figure 12. Reception feature wall emphasising materials reuse

The feature wall made from odd sized pallets destined for landfill with the client's tri-circle logo made from old timber cable reels.

(Source: Ben Wrigley)



Joinery cupboards – 90 per cent reused.

These had to be stacked and moved around as the construction work progressed.



Glass blocks – reused.

The specification had allowed for 30 per cent wastage, however all were saved and an additional wall was able to be built.



All existing carpet tiles – reused.

Also steel partition studs, ceiling tiles, doors and door frames.



Old light diffusers – reused.

As skylight diffusers under the ventilation stacks.



GPO's and light switch plates – reused.



Cabling – reused.

Exit signs were not reused as they now require the 'running man' symbol.



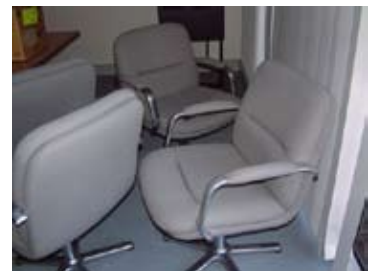
Steel – reused.

Steel from the hanging platforms from the dismantled air-conditioning units was reused for a bike enclosure.



Old workstations – reused.

These were left in the building by a previous tenant, and were reused in the IT area.



Conference chairs – recovered and reused.

They were also left by a previous tenant.

Figure 13. Materials reused and recycled within the project

(Source: Kevin Miller)

Two resulting features provide a good example of both the amount of recycling and of the refurbishment's personality. One is a display of art work around the building depicting environmental degradation made from recycled computer floor tiles and the other is a wall in AEI's reception constructed from odd-sized timber palette ends and timber cable reels destined for landfill.

4.0 PROJECT PROCESS

In the early part of the process the architectural design team advanced the design in order to prioritise the environmental objectives with direct input from the client and other specialist consultants. This had some relationship to the focus of a Green Star rating tool,

however the design team and the client would have followed this process regardless of the Green Star requirements. The tool formed a framework to work to and helped set guidelines for both sub-consultants and contractors to follow.

To achieve a six star rating all areas of the project had to be covered from transport, energy, and water, through to waste and material reuse. The whole project process entailed a higher than standard labour component for both the documentation and construction. Reusing materials required accurate measuring, quantifying, and scheduling before they could be planned to be reused. Then followed preassessment for usability, deconstruction by the builder, assessment of the remaining items by the design team, combined site

evaluation of existing components, documentation by the design team, then reconstruction.

So why did the designers bother to go through this process? This project is the result of a highly collaborative effort where everyone is part of the team. Design and construction are not separated, and thus the conflict that arises through traditional contracts is reduced. Such teamwork does however need everyone to have a common goal, be flexible, and have the skills required, or at least a willingness to expand their knowledge base.

In any innovative project it is hard to expect high profitability for consultant and construction team members. Generally the participation in such a project results in an expansion of knowledge and skills, plus an improved industry profile and marketing prospects via recognition of the high Green Star rating. The next similar project will be easier for all concerned, and the barriers lowered. For example, the architects have now incorporated the specification for this project as standard documents for future projects.

5.0 EVALUATION AND COMMENTARY

Australian Ethical Investment's staff have recently been surveyed through the internationally recognised BUS (Building Use Studies) and the results of the survey rank AEI in the top 11 per cent of buildings assessed nationally. The feedback from the building users regarding all aspects of the refurbishment has been generally positive with staff feeling that it is a great place to work. The perceived improvement in productivity is 20 per cent.

AEI's decision to procure a green building matches their philosophy, and staff similarly have a commitment to also work in a green building. This includes wearing the seasonally appropriate clothing, manual adjustment of windows, blinds, and ceiling fans, etc. This also means that the staff are generally quite forgiving of the idiosyncrasies of how the building works and when things don't go according to plan.

In other workplaces this expectation and forgiveness may not be as high, therefore careful evaluation of the client is needed to assess whether the occupants will be able to effectively operate and take advantage of a building of this type. It helps greatly in maximising the building's effectiveness if the people working within it are committed to environmental sustainability. In this case it is core to the culture of AEI, and therefore the staff are more aware of the reasons for working in a passive building. In addition, the staff have been involved in the design and construction process and understand how each element works.

A main source of post occupancy complaint from users has been internal and external noise nuisance. Internally the areas of hard surfaces exposed for their thermal mass, combined with an open plan to allow for better passive ventilation, has meant that noise does carry between areas. Baffles are currently being

investigated to reduce this transfer. Other noise sources have been construction on an adjacent site, and ironically, from noisy condenser units in the adjacent building.

Energy has been monitored for the first year of building use (combined base building and tenancy use) amounting to 74 MWh of electricity and 120 GJ of gas equating to 388mg/sqm/year. A formal Australian Building Greenhouse Rating (ABGR) has not been obtained, however the energy use indicates the whole building is at more than 30 per cent better than a 5 Star ABGR rating.

AEI has purchased 100 per cent Green Power for the building since occupation and offsets all of its transport use, further reducing its environmental footprint.

6.0 CONCLUSION

Through a cooperative design approach the project has been sculpted into a high class sustainable building which is humane and liveable and at a conventional construction cost (\$1,700/sqm refurbishment and fitout). It appeals to the public's general instincts of how an office building should feel and look without obvious 'green' gimmickry. The resulting form and appearance is a reflection of all the elements which interact on its design – structure, environment, people and location, and it is original and character filled due to the process employed in its production.

6.1 Measurable Environmental Benefit

The following measurable environmental benefits have been achieved:

- reduction of energy use over a standard average building by at least 75 per cent.
- reduction of water use over a standard average building by 90 per cent.
- reduction of waste material going to landfill
- retention of materials for higher level reuse rather than being degraded into lower value recycled materials. This saves the energy and materials that would be required to manufacture a new product and/or recycle the old material into something new (for example the reuse of steel on the bicycle enclosure avoids the energy required to melt down the scrap steel and fabricate a new screen).
- reduction of transport costs to remove/recycle materials and bring in new materials. Many building materials are bulky and/or travel long distances to be delivered to a building site.
- reduces the lifecycle impact of the original product by extending its effective life.
- creates local employment through the extra labour required to dismantle and then reuse the materials.
- reduction of staff sick days and increased productivity due to increased user comfort

6.2 Lessons Learnt

The following lessons learnt have increased the knowledge of our company:

- Understand the client involved and tailor the environmental initiatives to their needs. Don't impose environmental initiatives (particularly passive systems) on a client who won't use them.
- Engage in a team process and instil everyone's sense of ownership of the project.
- Be flexible, you may not always get what you want but you may get some unexpected surprises.
- Innovative projects lead to general improvement of skills for all concerned.
- Material reuse and recycling is not as difficult as the design team had anticipated.
- Ensure the design team is willing to invest in upskilling/expanding their experience (even if at the expense of lower financial gain).

6.3 Moving Forward

Collard Clarke Jackson Canberra have always believed that environmental design is a rolling snowball with the experience gained in one project becoming implemented into the next project, and so forth. The experience gained in material reuse on this project has been employed in further projects and specifications. The ultimate aim is for true environmental sustainability, where a building or project will give more to the environment than it takes.

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BIOGRAPHY

Kevin Miller is a director of Collard Clarke Jackson Canberra and was the project director of the Trevor Pearcey House refurbishment for Australian Ethical Investments. He has been working in the area of environmental design for nearly 17 years and projects have included Ainslie Village Redevelopment (RAIA Canberra Medallion 1994), Ian Ross Building (RAIA Sustainable Architecture Award and National MBA Energy Efficiency Award 2001), Birrigai Redevelopment and Burgmann Anglican School. The Trevor Pearcey Building is his first 'Green Star rateable' building. Kevin also regularly provides presentations to various groups on environmental design in commercial buildings. He is a Green Star Accredited Professional and Collard Clarke Jackson is a member of the Green Building Council of Australia.

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APPENDIX – MATERIALS SELECTION, REUSE AND RECYCLING

Item	Reuse	Comments
Reused items		
Internal glazing	New glazing in office partitions.	Some were lost to an over keen recycling contractor.
Glass blocks	Ventilation stacks and office wall to increase natural daylight.	Allowed for 30 per cent wastage and actually had no wastage therefore were able to build an extra wall panel.
Partition framing	Reconstructed for new partitions.	Required detailed scheduling due to different stud sizes.
Plasterboard	Reused for new partitions.	Not expected but managed to reuse most plasterboard.
Doors	Reused for offices, meeting rooms, server room and conference room.	Reused every door including the door frames and door furniture.
Carpet tiles	Generally in new areas.	All existing carpet tiles (250m ²) were lifted and combined with additional (recycled) carpet tiles.
Insulation	Existing insulation batts in the ceiling of the first floor and existing tenancy partitions were reused in new wall partitions and ceilings on the ground floor.	Confirmation of sound ratings is difficult.
Ceiling tiles	The suspended ceiling system was removed in most of the ground floor (to expose thermal mass). Recovered ceiling tiles and support grid were then used as either acoustic wall cladding, for the new raked ceiling on the first floor, or for additional acoustic treatment on ground floor office ceilings.	This was a simple reuse exercise however we ran out of tiles for the additional acoustic wall cladding.
Ductwork	Large sections of the existing mechanical ductwork was retained in place, cleaned, and incorporated into the new mechanical air distribution system.	
Electrical cabling	Recovered for reuse or recycling.	All electrical cabling was recovered for recycling. Where feasible this recovered cabling was used for new electrical works. Note that PVC reduction achievable did not allow for Green Star credit points as it was not possible to assess the cost.
Gpo and light switch plates	Reused in lieu of new as specified by electrical engineer.	Existing GPOs and light switch plates were also retained, tested, and then reused although the engineer had specified new.
Skirting duct	Reused	Generally reused in place on perimeter walls. Cleaned and reused on partitions.
Joinery	A substantial amount of existing joinery was retained and then adapted for reuse within the new fitout.	Over 90 per cent of the joinery for the refurbishment was reused.
Kitchen sinks	Reused in lunchroom and tea area.	Two stainless steel sinks and boiling water units were reused.
Domestic hot water	Existing hot water tank reused.	The existing hot water system was upgraded to an evacuated tube solar system and the existing tank was able to be incorporated.
Loose furniture and fittings	An existing server rack, 8 workstations (including screens) and 20 conference chairs that were in the existing tenancy were reused in the fitout.	These were all left behind by a previous tenant.
Items taken off site for recycling		
Existing windows and glazing		Taken by recycling company for use in another building (some glazing intended for reuse was also taken)
Broadloom carpet and underlay		Taken for reuse in a club in NSW
Existing floor tiles	Removed and recycled as masonry waste.	Recycled at concrete recyclers.
Mechanical plant	Metal and gas recycling	Decommissioned and degassed (recycled) before being sent for metal recycling.
Existing light fittings		Removed for resale.

Item	Reuse	Comments
Adapted reuse of items on site		
Return air grilles	The return air grilles from the old HVAC system were reused as air relief grilles in the internal ground floor offices and meeting rooms.	These had to be carefully placed to avoid sound issues between offices and meeting rooms.
Light diffusers	Light diffusers from the existing light fittings were reused for skylights under the ventilation stacks to provide light to ground floor offices.	There were surplus diffusers in this case.
Steel hanging frames, mesh from the roof space and sunscreens	Used to make a bike enclosure.	The bicycle enclosure has been fabricated from almost all recycled metal including shading panels, structural steel support frames for old mechanical services and steel mesh removed from the building.
Sun shading on the external face	Reorganised instead of being replaced.	Reorganised to appropriate elevations from the southern façade. Only some of the mesh within the frames was exchanged and the old mesh was used in the bike enclosure.
Raised computer floor tiles	Reused as artwork (plus a splashback to a cook top).	Metal backed computer floor tiles were recovered and used to create a number of artworks that are located around the building. The artworks show a time series of environmental degradation worldwide such as coral bleaching of the Great Barrier Reef and deforestation of the Amazon.
Recycled items brought on site		
Entry mats		Made from old car tyres.
Carpet tiles	Floor covering	Reconditioned tiles that have been removed from other buildings, steam cleaned, shaved and then over-printed with a new pattern. This product avoids old carpet tiles going to landfill and extends their useful life.
Recycled timber	Timber flooring, cladding and reception counter top.	Re-milled recycled brushbox sourced from a local timber recycling company.
Pinboard material	Pinboards in workstation screens.	Made from recycled compressed newspaper.
Disused pallets and timber cable reels	Feature wall in reception.	The wall behind the reception desk and a feature wall in the ground floor corridor have been constructed with timber from discarded pallets. These particular pallets were of low quality and odd sizes and would have been likely to end up in landfill. In addition three cable reel ends were used to make the symbol for AEI (three interconnecting circles).
Desks		AEI brought all their existing desks into the new fitout.
New furniture		Sourced from ex-government furniture supplies.
Other	Type	Comment
Paint	Low VOC used	Note that paint with dark colours has a higher VOC than light colours.
MDF	E0 board (zero off-gassing)	Low formaldehyde content. Hard to source in low quantities.

(Source: Collard Clarke Jackson Canberra)