Macquarie Place, Parramatta

December 2009

Sustainability Strategy

Advanced Environmental

Site Context

The city of Parramatta is located just over 20km from the central Sydney CBD. The area is composed of a mixture of urban development with commercial, retail and residential areas. These are interspersed with natural features such as Parramatta Park and Parramatta River.

The proposed development is located on the corner of Macquarie and Marsden Streets, on a site which has remained empty for over 20 years. The new mixed use building, consisting of retail, commercial and residential areas, offers an opportunity to revitalise the area and provide much needed residential apartments to the CBD of Parramatta.

Archaeological remains on the site will be displayed on the ground floor of the new building, surrounded by low impact retail such as cafes and restaurants and small shops. Double height spaces allow light into ground floor and upper podium levels, with commercial units located above the retail on the first and second levels.

The towers above the podium will house approximately 300 residential apartments. Smart design and efficient systems, fittings and fixtures are proposed to provide comfortable indoor environments and lower environmental impact.

View towards Parramatta Park

Environmental Design Requirements

The New South Wales Government requires that all new residential dwellings must comply with certain energy and water efficiency targets to reduce environmental impact from the urban environment. These targets are regulated through the Building Sustainability Index (BASIX). BASIX requires a minimum reduction in energy and water use compared to an average home, according to the location and type of the building.

The current BASIX requirements for a dwelling in Parramatta are as follows:

Criteria	Target for multi-unit dwellings
	6 storeys and up
Water	40%
Energy	20%
Thermal Comfort	Pass

SEPP 65: Design quality of residential flat development – is a planning policy from the state government aimed at improving the design quality of residential flats in NSW. This policy includes recommended design parameters such as requirements for cross ventilation, daylight, building configuration and amenity.

Considerations arising from requirements under SEPP 65 include:

- The number of apartments which achieve cross ventilation
- Hours of daylight available to living rooms and private open space
- Functional arrangement of unit configuration
- Private open space allocated to each unit which is usable and provides a barrier between the indoor and outdoor environment

BASIX Strategy

An analysis of the building design proposed for the Macquarie Street development has been conducted to assess which water, electrical and architectural design features may need to be included in the building design to achieve the requirements of BASIX.

Water Efficiency

A major portion of water consumption in Sydney is in residential areas. Residential areas also have one of the greatest potentials for reducing water consumption of all the development types. Potable water use can be drastically reduced through strategic urban design, landscaping, use of efficient fittings and water recycling.

The most important issue in water cycle management is firstly to reduce water demand as much as possible. This is achieved through design initiatives such as water efficient fittings and fixtures, low water demand landscape selection and efficient irrigation systems.

Efficient fixtures and fittings are proposed for the building to reduce potable water consumption. This strategy alone gives the building the potential to achieve a score of up to 38% in the water category; however a minimum score of 40% must be achieved. To provide further potable water use reduction, rainwater can be collected for reuse for common landscape irrigation and to supplement toilet flushing.

Alternative water sources for non potable uses are becoming increasingly common in residential areas around Australia. Rainwater tanks are the most common, as they can be easily retrofitted to existing dwellings, require minimal treatment for use and are relatively cheap compared to other alternative water systems. Because of the unpredictability of rainfall, the supply of water is dependent upon a tank large enough to store the water for the dry periods.

A preliminary assessment shows 6000L of alternative water supply per day is required for a 350 unit building. This water supply will provide irrigation water for the roof top gardens and water for toilet flushing in a minimum of 10% of the apartments.

A hydraulic engineer is required to provide confirmation that the rainwater recycling system is capable of providing this quantity of water.

Water Balance

A preliminary water balance for the development has been conducted to estimate the potential water savings that can be made. The following information has been used for the water balance

Fitting efficiency:

4 Star WELS rated toilets

4 Star WELS rated taps

3 Star WELS rated showers 9L/min

2 Star WELS rated washing machines (although not provided in the building, this assumes an average water rating for washing machines installed by occupants.)

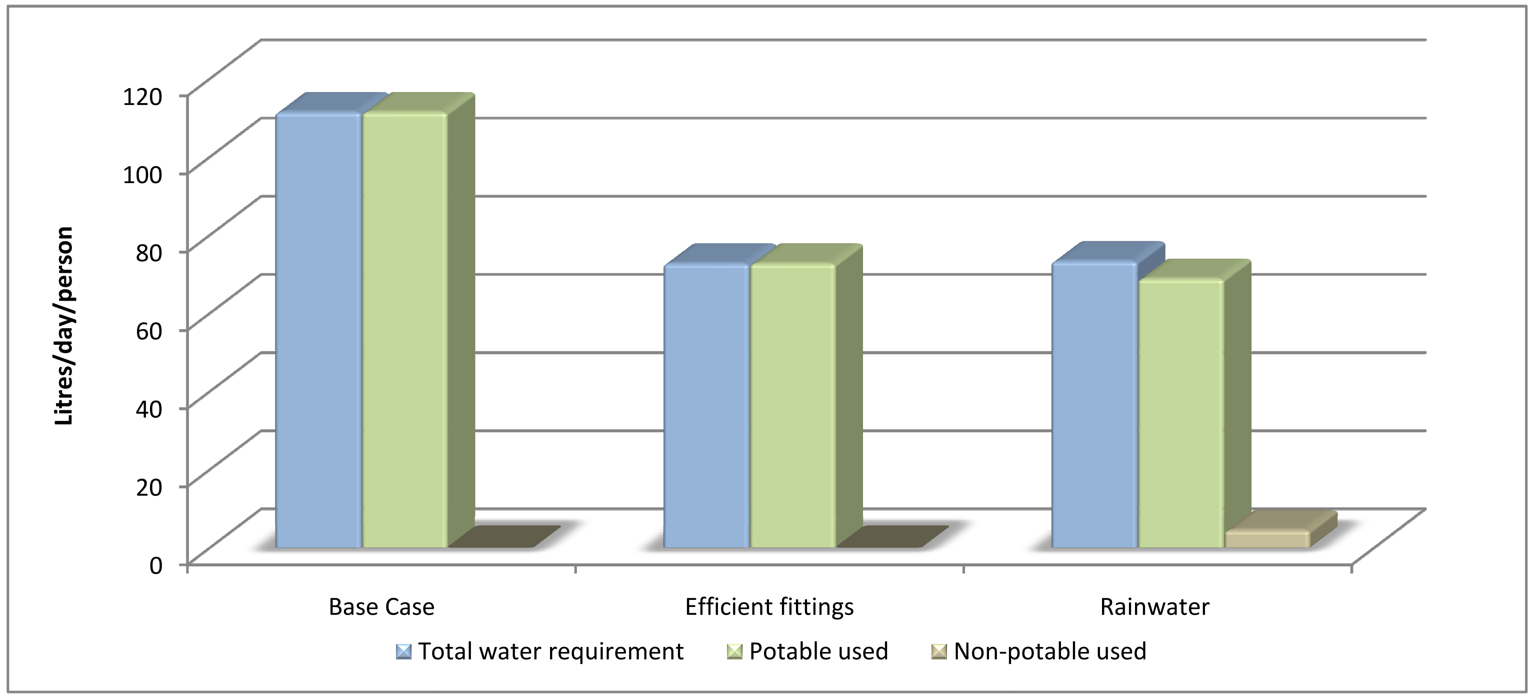
Rainwater recycling:

Efficient fittings and centralised underground rainwater tank to provide water for toilet flushing and laundries:

350kL to meet BASIX minimum requirements

The graph opposite demonstrates the water savings that may be experienced in the Macquarie Place development.

The consumption represented by efficient fittings shows a 38% reduction in potable water use. By providing 10% of units with recycled rainwater as well as irrigating common landscape, the BASIX minimum requirement of 40% reduction can be achieved.



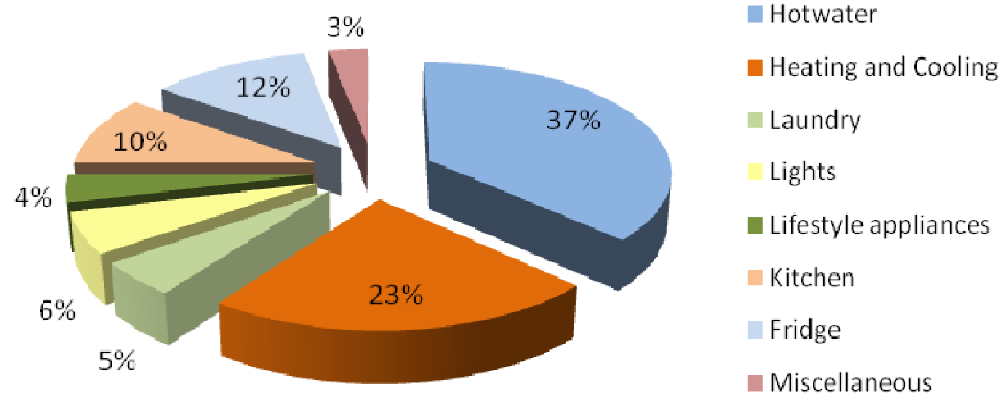
Energy Efficiency

Efficiency in the use of energy is a critical aspect of the sustainability strategy for Macquarie Street. The key to energy reduction is first to minimise demand. Through effective passive design, the requirement for air conditioning to provide thermal comfort is reduced. In a temperate climate such as that of Sydney, passive design should be capable of providing thermal comfort for the majority of the year in a well designed dwelling.

Energy Australia suggests that the typical household energy consumption is broken down as shown in the pie chart opposite. The initiatives discussed below aim to remove pieces of energy consumption from the pie.

Complying with the minimum requirements of BASIX is achieved by reducing energy consumption by 20% below the current practice. This can be achieved through the following initiatives:

- Passive design principles
- Energy efficient lighting and controls on mechanical ventilation and common area lighting
- Efficient appliances such as gas cook tops and ventilated fridge spaces
- Efficient hot water systems



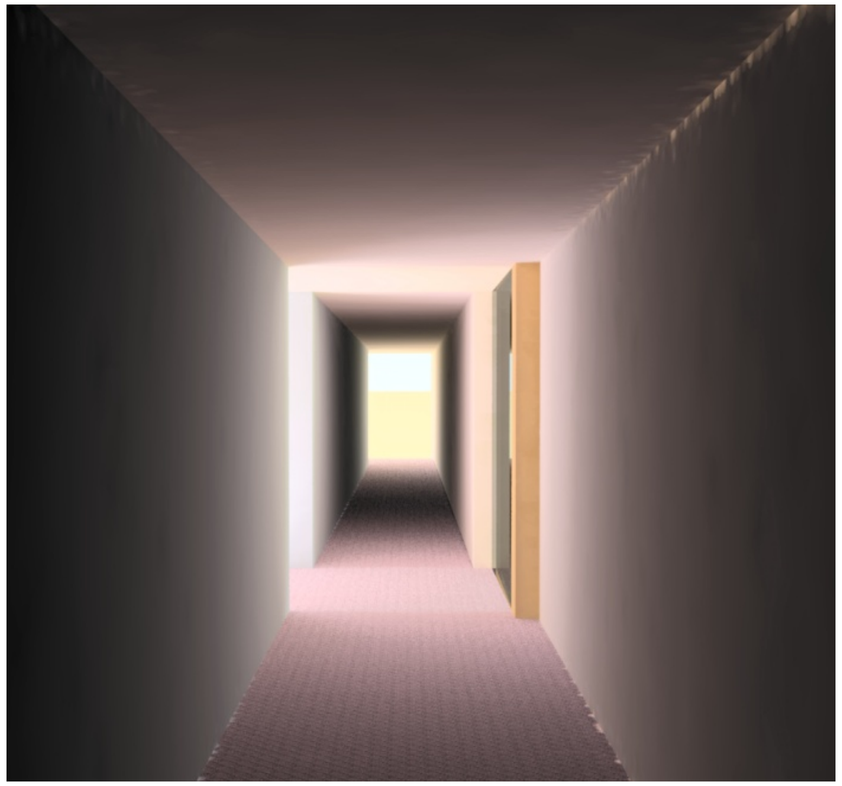
Typical household energy consumption (Energy Australia)

Thermal Comfort and Passive Design

Passive design of the building will impact on the thermal comfort of the occupants and on the reliance on air conditioning to provide comfortable conditions. By improving the passive design strategies, reliance on air conditioning is reduced and indoor environment quality in the units is improved.

Passive design measures include:

- Insulation
- Good daylight availability
- Good natural ventilation
- Well designed shading



Corridor daylight availability-

Daylight penetrates into the common corridors. A contrast between unlit areas and those adjacent to slots suggests some lighting will be required to reduce visual discomfort, however the lighting power consumption will be dramatically reduced

Daylight

Natural daylight availability is important for reducing energy consumption by artificial lighting. It also allows passive solar heating in winter and improves occupant health. Large windows on the external walls will assist in daylight penetration, however good shading must be included to control solar heat gain.

The proposed slots in the facade will promote daylight penetration further into the floor plates of apartments adjacent to the slots. Daylight will also be allowed into the common corridor by these same slots, reducing reliance on artificial lighting.

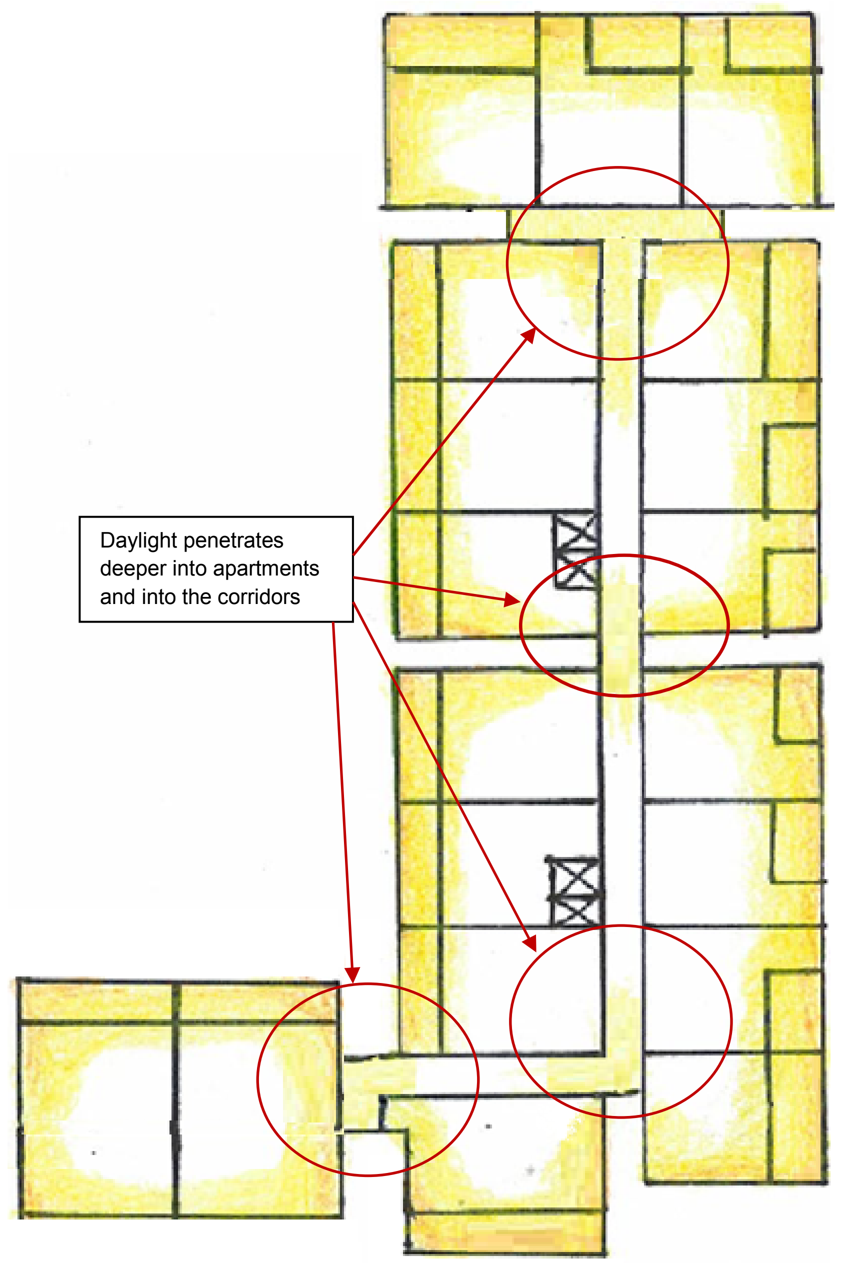
Apartment daylight availability-

The daylight available towards the back of apartments due to the slots will be particularly useful when internal walls obstruct light penetration from the facade. For example, bathrooms or second bedrooms without access to the facade will be able to be naturally lit.

In common areas such as the corridors, it will be important to include daylight sensors integrated with the lighting controls to ensure the lights are not being used unnecessarily.

In the apartments, the increased daylight availability will improve occupant well being, as well as reducing lighting power consumption.

Daylight modelling has been conducted to demonstrate the benefit of the slots in improving daylight access in the corridors and apartments. The images opposite demonstrate the increased amount of light in these areas.



Increased daylight availability with slots in the facade

Natural Ventilation

Ventilation from a single side can be effective for ventilating small spaces. For example, bedrooms with a single window on one side can generally be adequately ventilated. However, deeper spaces generally require a window on two sides of the space to provide air movement through the entire space.

The design of Macquarie Street includes slots in the facade to split the length of the building. These slots provide multiple benefits. Primarily, they enable the apartments on either side of the recess to have windows deeper in the apartment or to second bedrooms. This provides good ventilation to those dwellings.

Secondly, the slots provide ventilation paths through to the central corridor, thereby removing the need to mechanically ventilate the corridors.

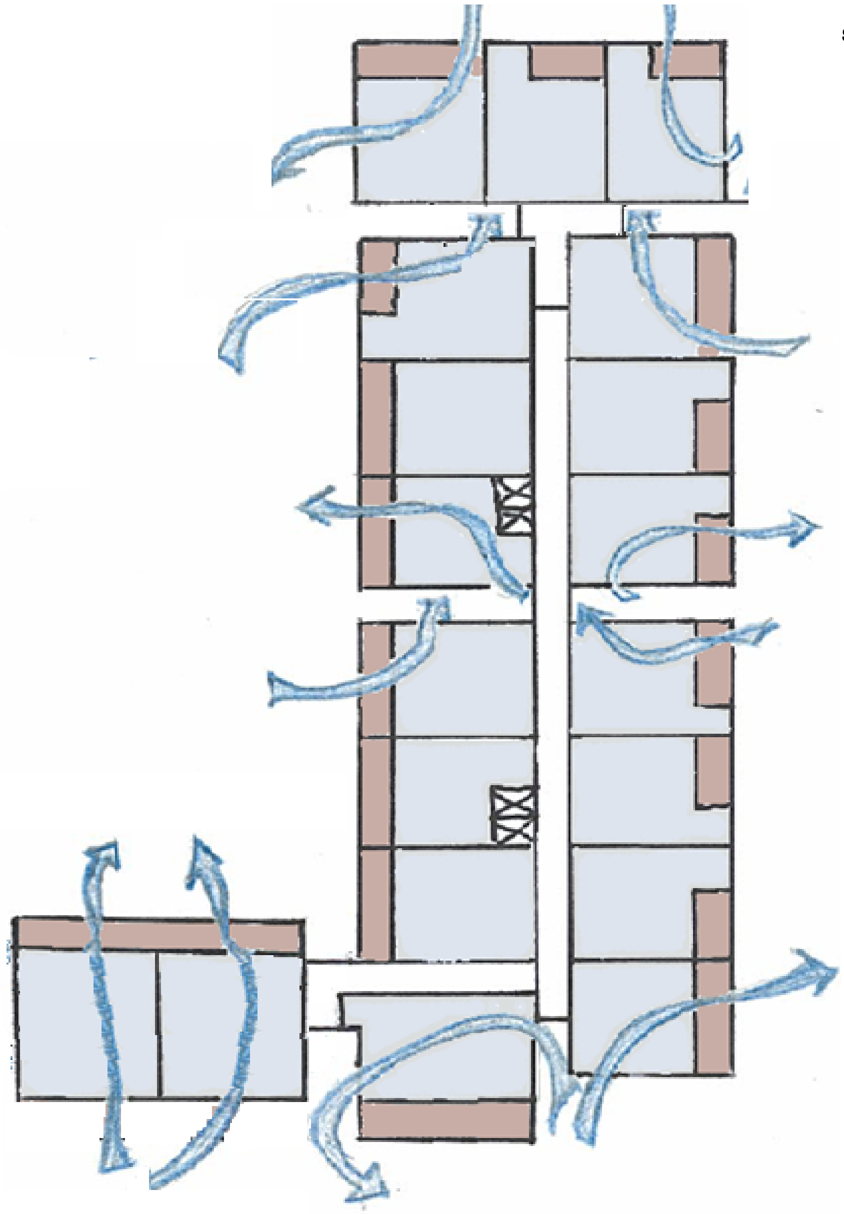
It is proposed these slots will provide:

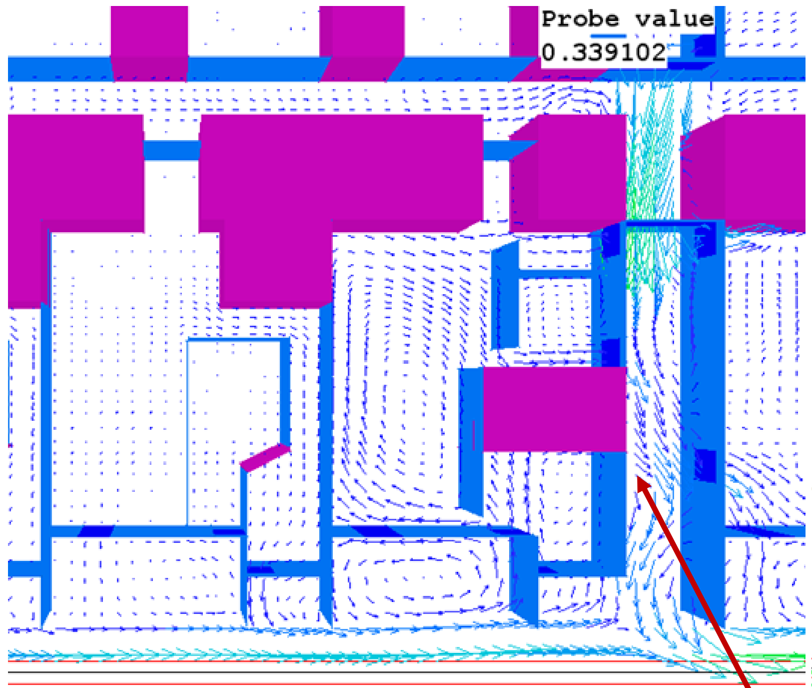
- At least 70% of the apartments with cross ventilation in accordance with SEPP 65;
- The ability to ventilate the corridors naturally, removing the need for mechanical ventilation; and
- Natural daylight to the corridors and deeper into apartments to reduce the reliance on artificial lighting.

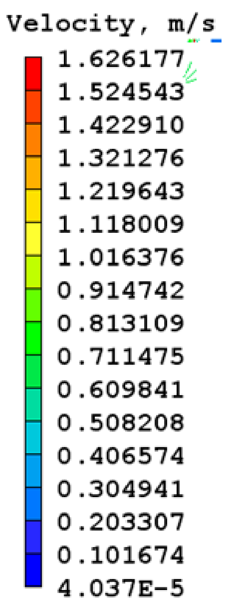
Computational Fluid Dynamics (CFD) was used to model the potential benefit from the slots on ventilation of the apartments and corridors. The results of this study are shown in the images below.

The images on the below demonstrate a greater amount of air moves through the apartments which are adjacent to slots. This is because the wind movement around the building creates pressure gradients which promote air movement from high pressure to low pressure.

The results demonstrate the air movement under a wind speed of 1m/s. This wind speed is exceeded 80% of the time in Parramatta. As the wind speed increases, the pressure gradient around the building also increases, and air movement through the apartments is greater. Therefore it is expected that good ventilation will be experienced in all apartments with access to cross ventilation either via the slots or because of their location on a corner. The presence of the slots was demonstrated to improve ventilation potential over that of the apartments without access to cross ventialtion.

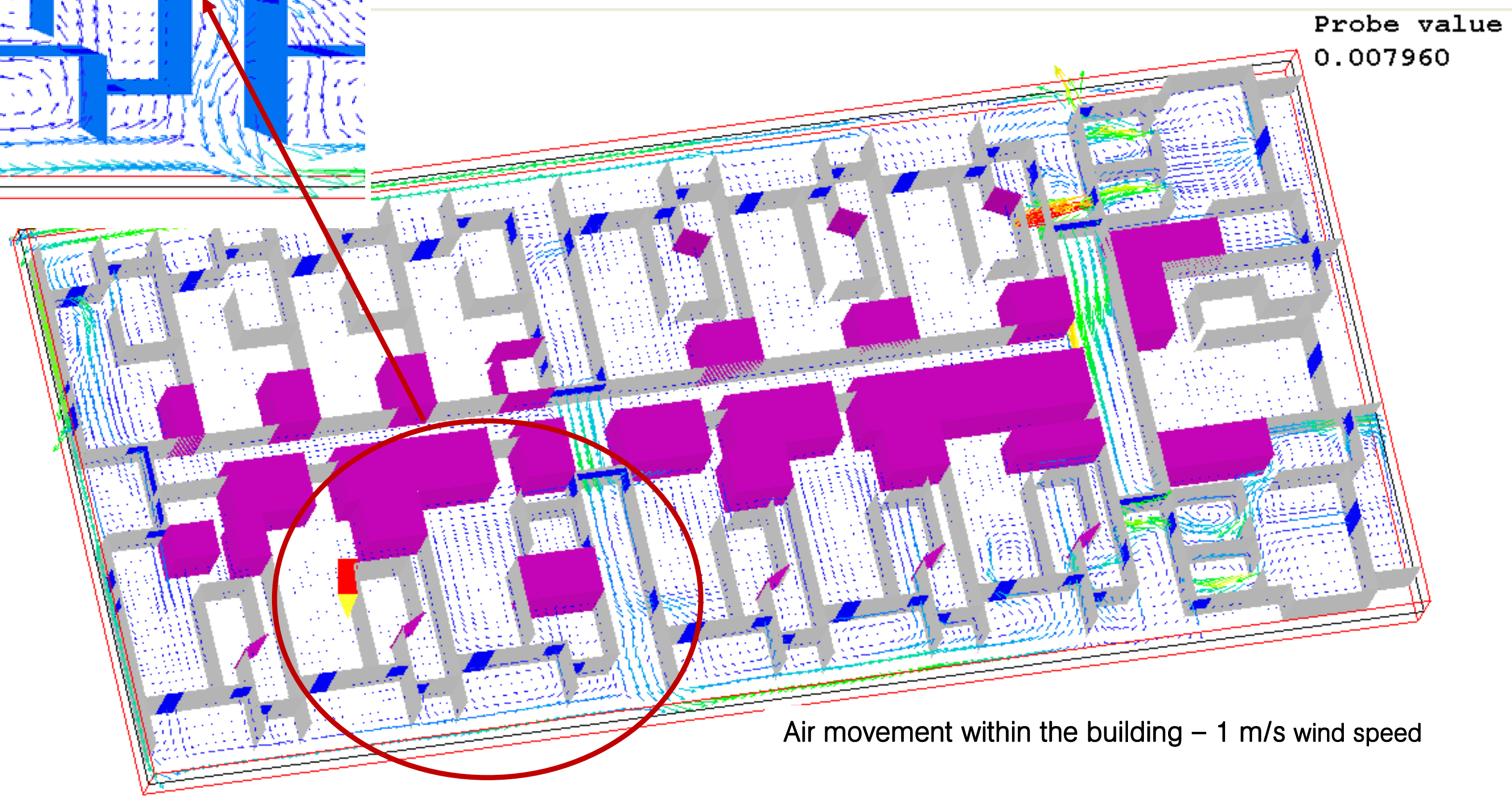






Air movement through the apartments.

The apartment on the right of this image is adjacent to a slot while the left side apartment is ventilated from one side only. This demonstrates the impact of the slots on ventilating the apartments



Air movement within the building – 1 m/s wind speed

Insulation

Both heat loss in winter and heat gain in summer can be dramatically reduced by good insulation. In a tall unit block, the most important inclusion is good insulation in the external walls, as these are the only contact between the interior space and the external air for all floors except the top floor.

The inclusion of large glazed areas such as floor to ceiling glazing or glass doors provides a large area for heat loss in winter and heat gain in summer. Therefore it is recommended to include curtains to insulate these windows and doors and maintain comfortable conditions in the space. Roof insulation will assist in providing thermal comfort of the top floor. This can be provided by standard insulation materials or the proposed roof top garden.

Insulation in the Macquarie Street building will be guided by BCA minimum requirements as well as the desired thermal performance of the building. The BCA requires the following levels of insulation for residential buildings:

- Roofs R = 3.2
- Walls R = 1.7

Shading Design

Northerly aspects are optimised through the use of well-designed shading elements. On east and west facades shading can be more difficult to design such that they can reject the sun in summer and allow the sun in winter. Vertical shading screens or operable awnings provide the best mechanisms for shading east and west facades while simple fixed elements can be applied to northern orientations. Thermal modelling has been conducted to establish which shading elements may be applicable to the east and west facades. These are discussed further below.

The proposed design of the building has a predominantly east-west orientation, which presents a challenge for designing effective shading which will not significantly impact on daylight availability and views.

Currently a popular shading design in new residential buildings involves a moveable shading screen which can be extended across the facade of the unit, reducing solar gain. This is a very effective shading mechanism.

Several shading options have been investigated to determine which materials will provide the greatest benefit to the energy consumption of the units. The options investigated are:

1. No shading as a base case
2. White painted aluminium screens to compare to the market standard. White paint was modelled at 66% reflective
3. White painted wood. White paint was modelled as 66% reflective
4. Dark painted aluminium shades to assess a darker coloured material. Paint was 40% reflective
5. Dark painted wooden shades. Paint was 40% reflective
6. Bronze performance glazing to control solar gain. VLT = 17%, Solar Trans = 15%, SC = 0.35
7. Green performance glazing as a comparison VLT = 25%, Solar Trans = 13%, SC = 0.35
8. No external shading, double glazing with internal venetian blinds
9. An external blind at the edge of the balcony, light coloured, close weave. VLT = 17%, Absorptance 31%, reflectance 52%
10. An external blind at the edge of the balcony, light coloured, open weave. VLT = 58%, Absorptance 6%, reflectance 36%

A thermal model of 11 sample units was built to assess the different shading options. The units were a selection of east and west facing units, with a mixture of one and two bedrooms. Four of the units were adjacent to slots in the facade; the remaining units were sheltered on each side by another unit.

Preliminary modelling results are shown in the graphs opposite. Both peak and annual cooling loads were assessed. Lowering peak cooling loads provides the potential to reduce the size of the air conditioning system required to control thermal comfort in the space. By reducing annual cooling loads, annual energy consumption from air conditioning is reduced, therefore it is important to analyse both results.

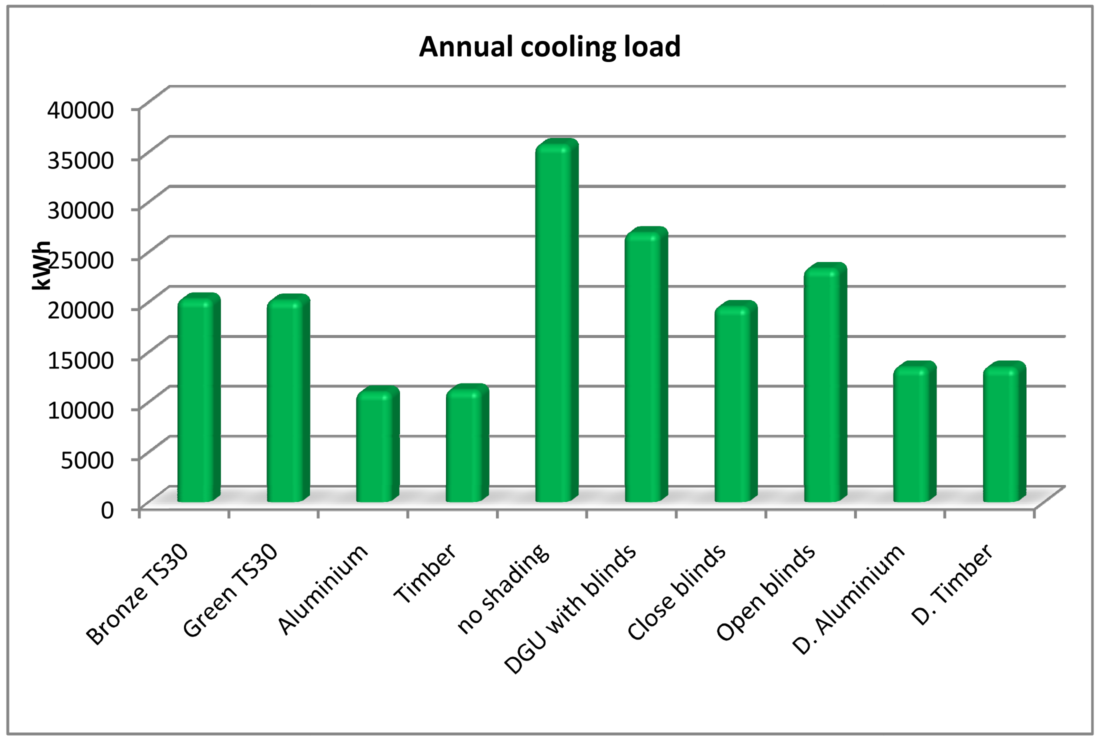
The graphs show the average peak cooling load across the sample units studied and the total annual cooling load for all 11 units. The results show that the peak cooling load is lowest in the models which contain wooden or aluminium shading, as these two shading devices are the most effective at controlling solar heat gain.

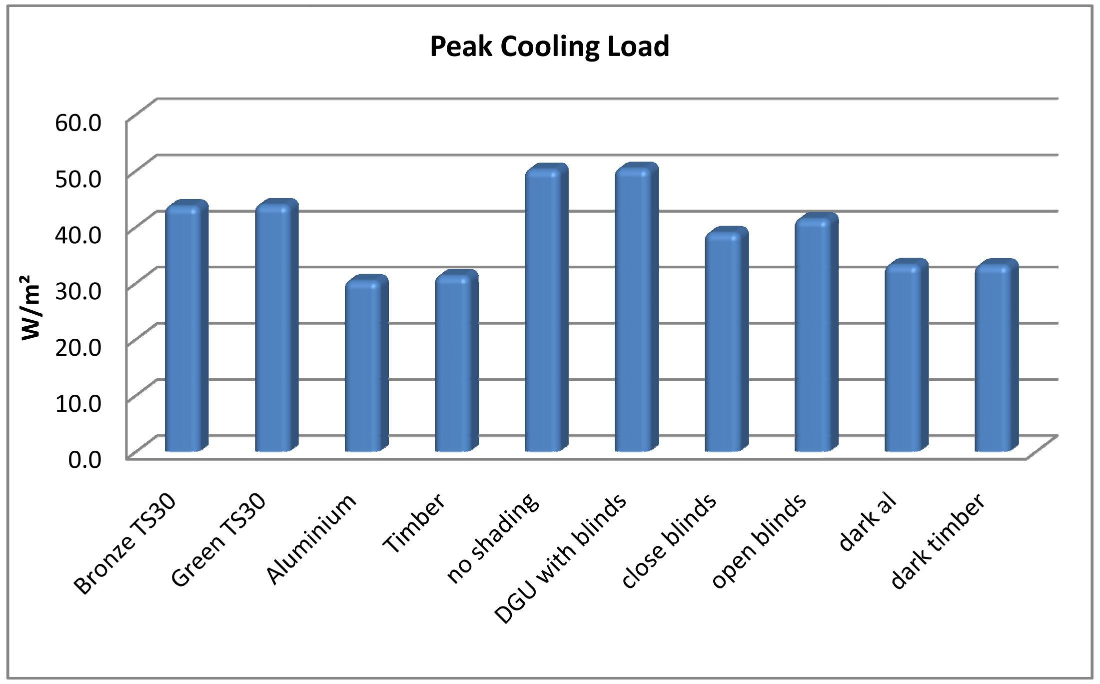
Colouring these shades darker results in heat being absorbed by the material, therefore performance of the shading decreases. However the darker aluminium and wooden shades still perform better than performance glazing or blinds.

The performance glazing is capable of reducing peak cooling loads; however the impact is not as great. Double glazing with an internal blind had the least benefit.

Annual cooling loads show similar results, with the timber and aluminium shading having the greatest positive impact.

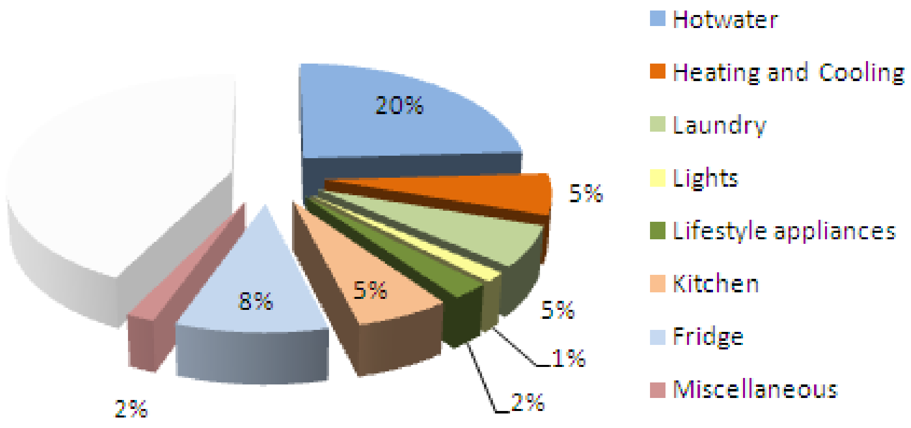
The east and west facades have overhanging balconies protecting the glazing from the majority of direct sun penetration. If additional vertical shading screens are required as determined by the thermal modelling for BASIX, operable aluminium screens will be used.





Energy Efficient Appliances

Energy efficient appliances and efficient hot water systems have the potential to further reduce energy consumption in Macquarie Street below the current standard. The following pie chart illustrates those potential savings.



Energy consumption with efficient fittings, appliances and hot water

Efficient hot water:

Domestic hot water can account for up to 37% of a household energy bill. Electric heat pump hot water systems have been found to provide significant energy savings for hot water energy when compared to electric storage heaters. In addition, they are a practical solution in tall residential buildings where insufficient roof area is available for solar hot water.

Appliances:

Appliances which will be supplied to the apartments include cook tops and ovens, dishwashers and dryers. By installing gas ovens along with the gas cook tops and 4 Star dishwashers as well as dryers, the potential energy score will be increased.

Air conditioning:

Air conditioning will be provided to the living areas of the apartments only. In the baseline case, 3-3.5EER efficiency reverse cycle air conditioners were applied. By increasing the efficiency to an EER of above 4, energy consumption is reduced.

Further ESD Opportunities

In addition to the baseline BASIX strategy, further ESD initiatives can be included to increase the sustainability of the development. This includes roof top gardens, efficient transport and improvements to daylight and ventilation in the retails and commercial areas.

Green Roofing

An opportunity to increase the onsite ecology and ecological value is to incorporate a green roof in the design. Green roofs have been installed in buildings such as CH2 in Melbourne and 30 the Bond in Sydney.

Extensive green roofing requires only a thin layer of substrate for planting. This is suitable for plant shallow growing plants types such as grasses and small shrubs. Intensive green roofing requires a thicker layer of material and is suitable for growing larger plants and even small trees.

Green roofs can mitigate pollution, reduce the heat island effect, treat rainwater for reuse, reduce run off and provide noise insulation. They also reduce the amount of standard insulation required, and as they provide more stable internal temperature and humidity, cooling loads may be reduced as heat is prevented from moving through the roof. This may result in economic benefits from reduced energy requirements, as well as a reduction in greenhouse gas emissions. The roof life is also extended as green roofs can last up to 40 years compared to standard roofs, which may only last 10 to 20 years.

Green roofs also provide an enjoyable outdoor amenity for the use of the residents, a valuable commodity in an inner city area.

In addition to being a visual amenity that can be enjoyed by building users and occupants, green roofs draw flora and fauna to the site, increasing biodiversity in the area. Such areas of native planting have been found to particularly important in supporting native wildlife to increase their population numbers in urban areas.

Retail and Commercial Areas

Daylight access into the retail commercial areas

Daylight is an important aspect of indoor environment quality and increased exposure has been shown to have a positive impact on health and productivity. Studies conducted on the effects of daylight on retail spaces have also shown that increased daylight may lead to increased spending.

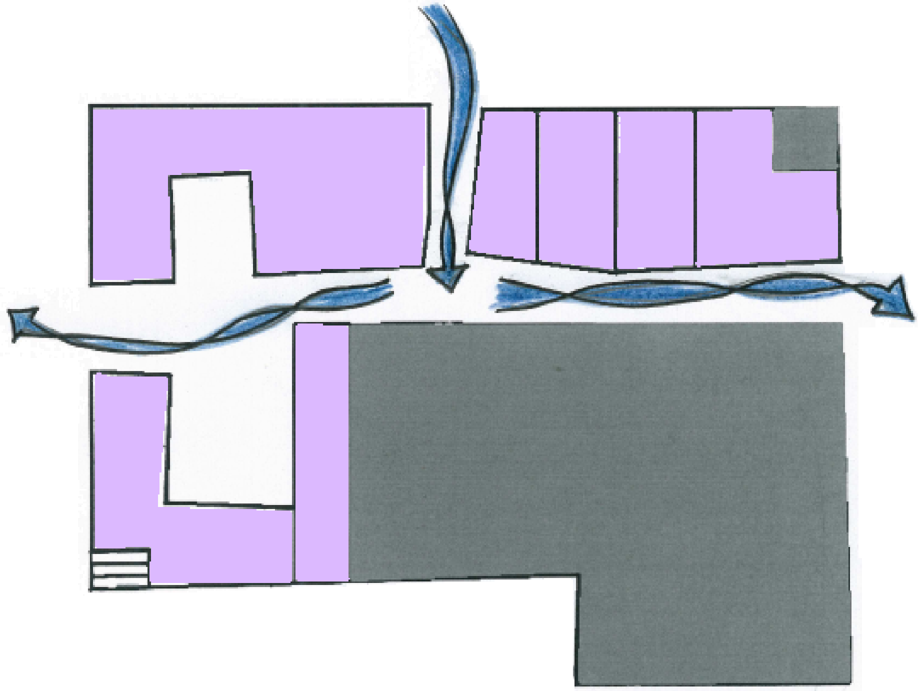
Glazed areas on the facade will increase daylight access into the retail and commercial areas. In addition, the double height space above the archaeology will further increase daylight access into the retail and public space areas.

The daylight access will also provide those within the building a connection to the outside. Increased daylight may also decrease reliance on artificial lighting and lead to reduced energy consumption.

Ventilation of the retail and commercial areas

Ventilation, heating and cooling requirements in retail and commercial areas amount to a significant portion of energy consumption in these spaces. In addition, the method by which heating, cooling and air conditioning are provided to a space will have a big impact on indoor environment quality.

Natural ventilation of the common areas such as the access through the ground floor will assist in both reducing energy consumption as well as improving the amenity of the spaces.



Natural ventilation of the Ground floor corridor and lobby

Efficient plant and equipment

Mechanical plant will be required for heating and cooling of the retail and commercial areas of the development, as well as ventilation to the car park beneath the building.

Energy consumption of these areas can be reduced by efficient plant selection, such as high efficiency air conditioning units and Variable speed drives (VSDs) on fans and pumps.

Air conditioning for the retail and commercial areas will be provided by condenser water:

- Higher efficiencies than option 1;
- Can be the easiest to accommodate spatially;
- A cooling tower will be required, however it can be located on the roof of the residential tower;
- Condenser water is reticulated to the retail and commercial units for connection to packaged air conditioning units;
- Condenser water can be effectively metered;
- Environmental impact is minimised.

Based on the above preliminary assessment, the provision of condenser water to the retail and commercial tenancy is the preferred option for reducing environmental impact. The cooling tower provides an energy efficient mechanism of providing condenser water to the retail areas with the smallest spatial requirement.

As discussed under the water section, if a blackwater system is included, surplus treated water can be used in the cooling tower to dramatically reduce water consumption.

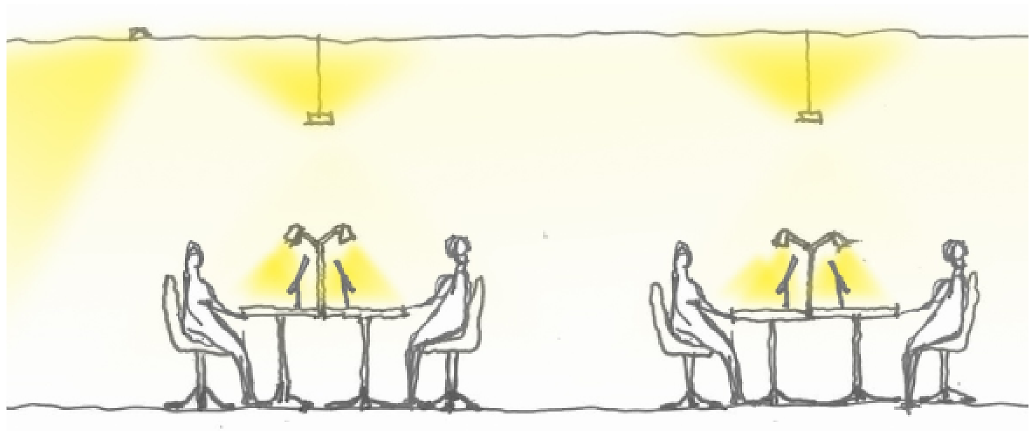
Providing controls on equipment are critical to ensure unnecessary energy consumption does not occur. This includes controls such as:

- Timer switches so that plant operates only during operational hours;
- Occupancy sensors to ensure plant and lighting are not on when spaces are unoccupied;
- Plant interlocked to any natural ventilation strategies so that air conditioning does not operate while doors/windows/openings are open for natural ventilation
- Carbon monoxide sensors on car park ventilation so that the ventilation only operates when necessary.

Lighting

Lighting is another major energy consumer in retail and commercial spaces. Key initiatives in a reduced energy lighting strategy include:

- Efficient T5 luminaires and electronic ballasts
- Direct/indirect lighting system to reduce lighting power density
- Task lighting in office spaces to reduce lighting use and lighting power density;
- Lighting controls such as daylight and occupancy sensors and timer switches.



Efficient Transport

Transport is a major contributor to the world's greenhouse gas emissions. Building developments have a good opportunity to reduce these emissions through promotion of alternative forms of transport such as:

- Fuel efficient vehicles
- Bicycles
- Public Transport
- Walking

Fuel efficient vehicles include hybrid cars, small cars, mopeds and motorbikes. By providing preferred parking to these vehicle types, occupants of the building can be influenced in their preferred mode of transport. Preferred parking can include spaces closest to lift cores and main entrances.

Bicycle riding can be promoted through the provision of bicycle facilities for occupants of both the residential and commercial areas of the building. For the residential apartments, bicycle facilities include providing secure parking facilities for the occupants, such as secure bike lockers in the car park.

Retail and commercial tenants require further facilities for the promotion of bicycle use, such including showers and lockers for secure storage of personal belongings.

It should be noted that the previous DA approval for the Becton development included a condition of consent which required shower facilities for bicycle riders in the building.

Parramatta is a major urban centre in Sydney; accordingly it is located at a major stop on the train line. In addition, bus lines are provided by State Transit, West Bus and Hills bus, resulting in a suburb which is well serviced by public transport.

Pedestrian and public transport use in the area can be promoted by safe and amenable public access to, from and through the site. This includes aspects such as good lighting to promote security during night time hours, and wide footpaths and corridors.