Dural Group
Consulting

Solar Study& ESD Report

STRATHFIELD COUNCIL
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11-13 Albert Road &
2-6 Pilgrim Avenue
Strathfield 2135

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P2	Final	11/12/2020	**AKM Mahbub Hassan** BSc(Eng) , MEng, MIEAust ,CpEng,NER, MAAS	

Contents

1. Introduction

Dural group consulting has been commissioned to prepare an Ecologically Sustainable Design (ESD) report that will identify and summarise the key ESD initiatives that will make up the overall approach to sustainable designfor 11-13 Albert Road& 2-6 Pilgrim avenue, Stratified 2135.

1.1 PROPOSED DEVELOPMENT:

It is proposed to demolish the existing old residential buildings and construct a 12 storey mixed use development including 4 level carpark.The project wants to incorporate sustainable engineering solutionsvia means of natural ventilation, climate-sensitive vegetation, water efficiency,renewable energy, storm water management and a climate sensitive building design approach.

1.2 PURPOSE

The report aims to aid in environmental decision making for the architectural design by exploring climate responsive design strategies. The report also identifies a number of sustainability opportunities available that would provide on-going energy costs savings as well as help in delivering a sustainable built environment for future generations.

This reportis grouped into two main categories:

1. ESD Study:

   - Climate Analysis
   - Indoor Environmental Quality, Health & Wellbeing
   - Energy
   - Water
   - Transportation

2. SolarEnergy Study

2. ESD Study

2.1 SITE DESCRIPTION

The development site is located at 11-13 Albert Road, Strathfield, NSW 2135. An aerial photo of the site is shown below in Figure 1.

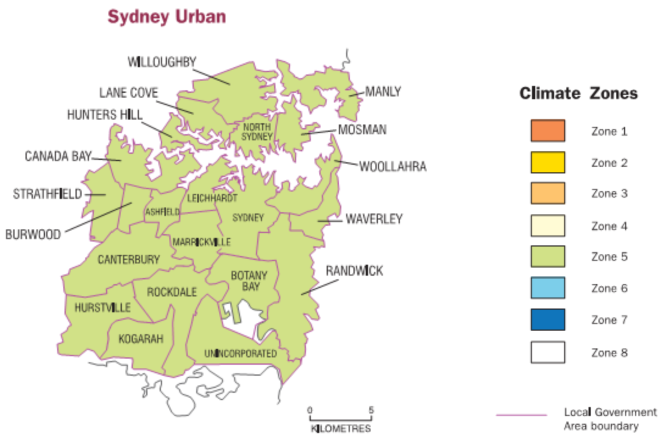
Figure 1 Site location of 11-13 Albert Road& 2-6 Pilgrim avenue, Stratified

The site is bounded by Albert Road to the south, Pilgrim Avenue to theWest and the existing residential neighbour to the East. Therail line is located directly on the northern side of the property.

The site is situated in close proximity of all the major commercial/business trips and is 200m west of the Stratified Railway station.

2.1.1 BCA CLIMATE ZONE

The site is located within Climate Zone 5 as defined by the National Construction Code (NCC / BCA). This climate zone is described as a mild temperature one.

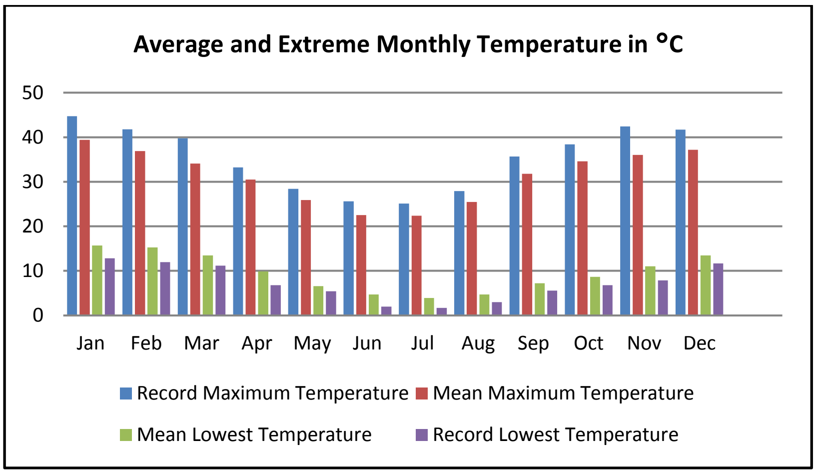


This climate zone is described as a warm temperature zone.

2.2 CLIMATE-ANALYSIS

A detailed assessment of the Bureau of Meteorology's long term Climate data for theStrathfield area is conducted to derive effective design strategies for the proposed site.

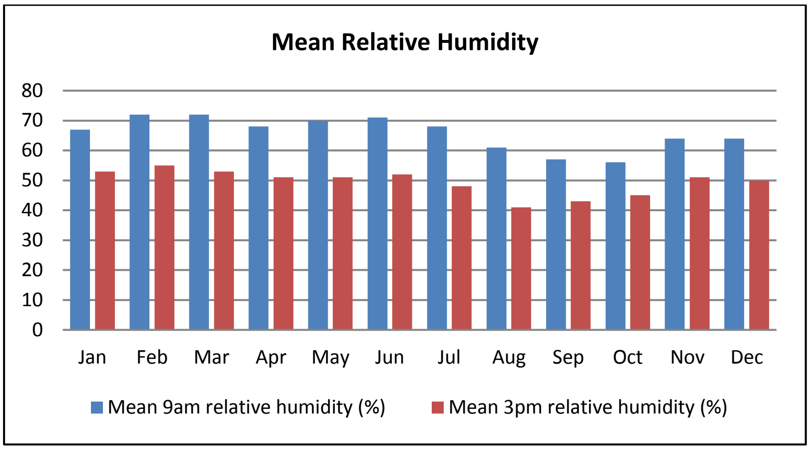
2.2.1 TEMPERATURE:



Key characteristics include a high diurnal (day/night) temperature range, four distinct seasons with spring and winter temperatures that can exceed the human comfort range; autumn and summer temperatures are partially within the comfort range.

For the whole year, the thermalneutral temperature ranges from 21°C to 24.°C, where at that temperature range humans would tend to feel comfortable.From this figure it shows that this climate will typically requires a balance of heating and cooling .

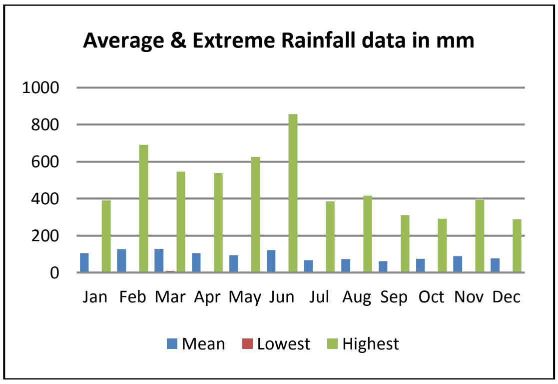
2.2.2 RELATIVE HUMIDITY



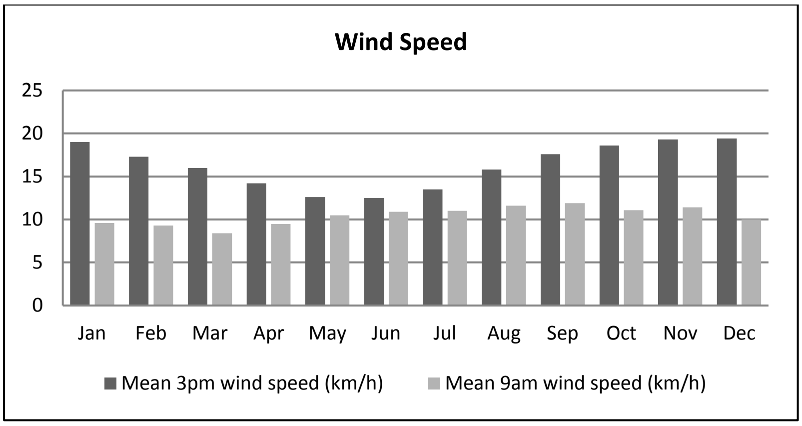
The mornings are more humid than the afternoons, with the average relative humidity in the morning being 66% and in the afternoon being 50%. Given the lower temperature, the relative humidity does not seem to be a major concern.

2.2.3 RAIN FALL:

Reasonable amount of rainfall occurs in this area, which can be utilised through rain water harvesting.

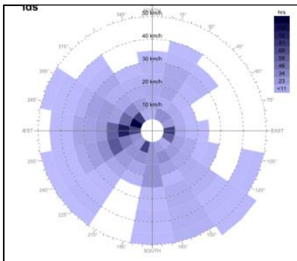


2.2.4 WIND



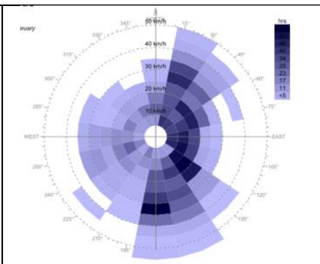
Wind speeds between 1.5 m/s and 4.0 m/s provide a physiological cooling sensation of up to 3°C. Average wind speed in the morning has the potential to provide wind speed based comfort in the balcony areas.

The wind speeds in theStrathfield area may offer a good possibility for cross flow natural ventilation, specially in summer.



Winter Wind:

Preventing/minimising use of any outdoor spaces against the predominant coldwinds in the winter (between northwest to southwest) is important



Summer wind:

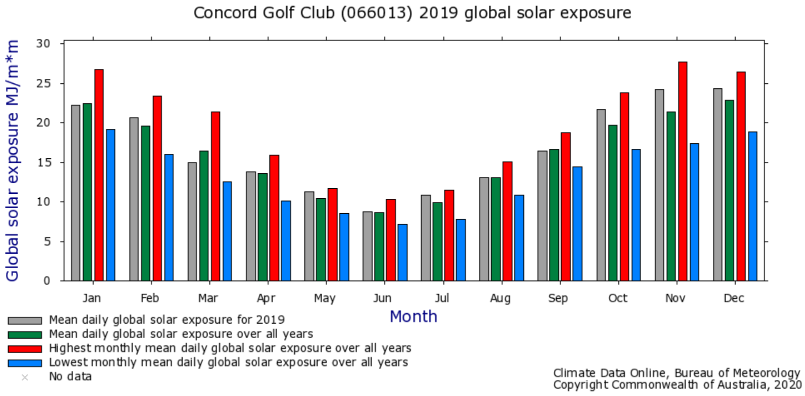
Cool breezes from the south, neutral breezes from the North East. Occasional hot breezes from the west.

Roof top Communal area: The proposed building rooftop is assumed to be used as a communal dining/barbeque area.Due to the height, open exposure and intended use of the area, it is likely that the wind speed will exceed the recommended criteria for walking. It is recommended that the minimum solid balustrade heights to be provided. However management needsto decide the safe use of the space.

Balconies: High exposure to corner balconies often attracts windy environments that may affect the use of the area. Strong balustrade is recommended.

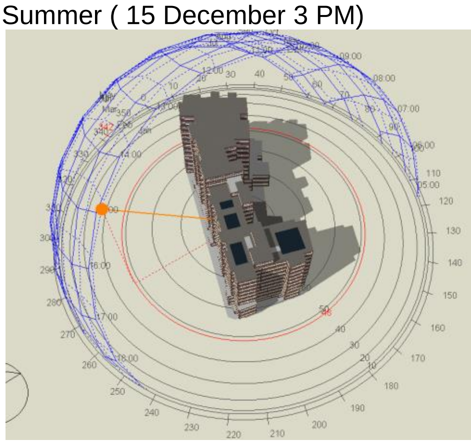
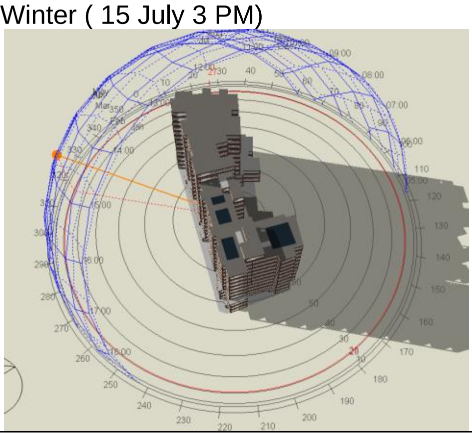
2.2.5 SOLAR EXPOSURE

Solar exposure is the total amount of solar energy falling on a horizontal surface. The daily global solar exposure is the total solar energy for a day shown below.



Australia has high solar exposure level, which can provide a good opportunity for renewable energy such asSolar PV or a Solar thermal system.

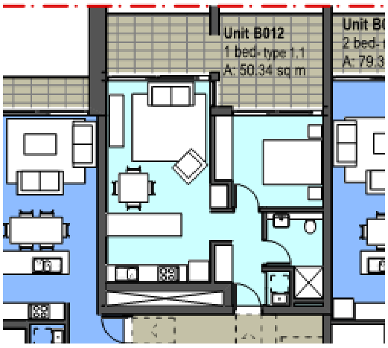
2.2.6 SUN PATH

Summer (15 December 3 PM) 	The sun rises 16 degrees south of east in summer, which impacts the east façade with solar radiation in excess of 750 W/m2, for an hour or two. The west (W) façade receives solar radiation over 650 W/m2 for 4 hours in a day. This can cause significant discomfort to the occupants. One square metre of a single glazed window on the west façade would add 550 watts to the internal loads, which in turn would be required to be treated by the air conditioning system. There is an opportunity to manage the solar loads on the building envelope through appropriate shading and rearranging internal spaces.
Winter (15 July 3 PM) 	In winter, the amount of solar availability is less, with the sun rising 15 degrees north of east The outdoor air temperature during winter is far lower than the thermal neutrality temperature. These solar loads can be utilised to reduce the heating requirements. This can be achieved by incorporating some of the principles of passive solar design and coupling it with thermal mass.

2.2.7 SHADING:

Direct sun can generate heatloads to the space but effective shading can block up to 90% of this heat. By shading a building we can reduce summer temperatures, improve comfort, reduce glare and save energy.

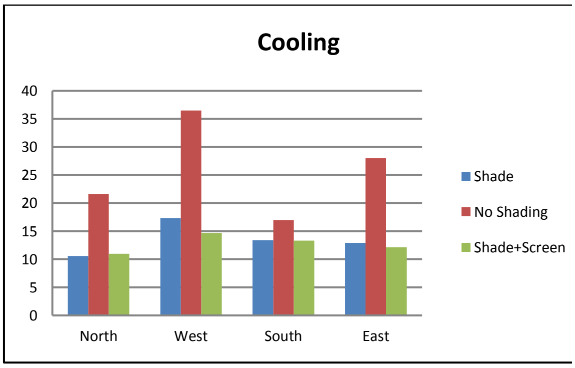
NatHERS simulation software has been used to verify the effectiveness of the proposed shading arrangement. One typical unit has been modelled. Calculate the energy use by changing the direction in fourorientations. Low E Neutral glazing is considered for this analysis.

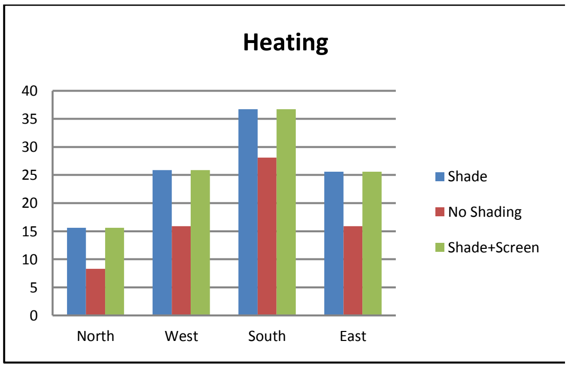


Option Considered:

1. Proposed shading
2. No Shading
3. Proposed shading + Screen in living space Door

From this analysis it is seen that the proposed shading is effective and reduces around 30-40% of energy also complies the BASIX thermal comfort target.



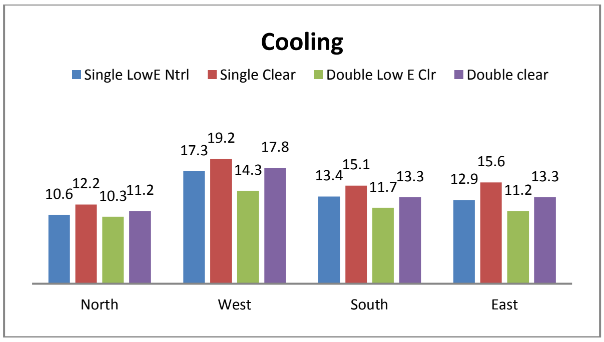


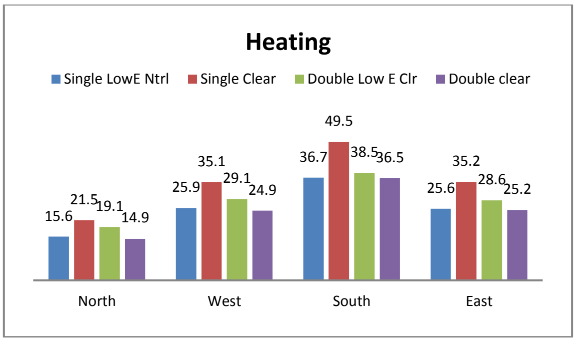
However a vertical screen in the west orientation will improve the performance, subject to asthetic consideration

2.2.8 GLAZING

Glazing represents a critical part in any building envelope. It typically forms the weakest link in a building's envelope overall performance, with the frame representing the weakest segment. Careful choice of glazing greatly improves thermal comfort for people and reduces energy.

The same apartment unit is used to identify the suitable glass type for the NatHERS simulation for all orientations.





From the analysis it is seen that double glazed Low E clear glass has better performance. However considering the cost, single glazed neutral glass will achieve the Basix target with some exception.
It is also recommended to use a relatively low thermal conductive frame for better performance.

2.2.9 STRATEGY OPTION:

We recommend undertaking climate change scenarios planning for 2050 in order to determine strategies required to meet the then comfort conditions.

With the implementation of the following strategies, comfortable conditions can be achieved for nearly 75% of the year for Sydney climate.

Some of the following can be considered:

- Provide good insulation to minimise temperature loss.
- The building fabric should be air tight to minimise infiltration and exfiltration losses
- Well shaded windows
- High performance glazing (low-E) to reduce the amount of solar loads
- Specify light coloured roof and walls, with high emissivity surface properties to reduce heat absorption.
- Use green roof if suitable
- Shaded external areas for outdoor activities, preferably located west orientation.
- Provide minimum 1.5m solid balustrade at the roof area.
- Encourage the use of recycled materials where practicable.
- Use thermal mass to regulate heat at night to moderate daytime temperatures on hot summer days

2.3 INDOOR ENVIRONMENTAL QUALITY& HEALTH

2.3.1 DAY LIGHTING

Natural daylight can enhance the indoor environmental quality of space and reduce lighting energy demand. However, if inappropriately designed, increasing daylight can also increase HVAC energy demand and can even cause thermal discomfort.

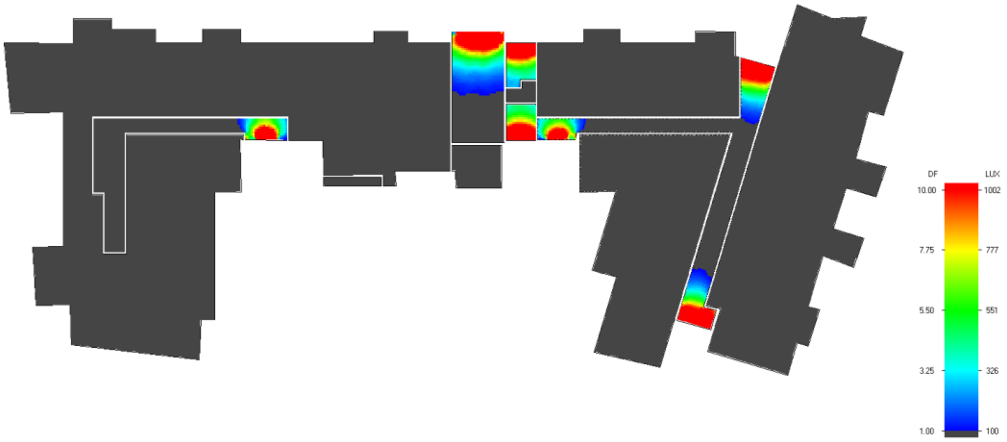


Figure 2: Day lightingof 13 Albert Road,(L-2)

The above figure demonstrates the daylighting level of one typical residential unit and common lobby space in level-2. Common lobby area does not have enough daylighting. It is assumed that artificial lighting will be on for 24/7.

2.3.2 INDOOR AIR

Indoor air is another consideration for comfortable living and to dilute the odour. Provision of Natural ventilation with sufficient access to operable windows in the residential portions of the buildingand mechanical ventilation with appropriate outdoor air flow rates in common areas.

Low-emitting materials produce little to no off-gasing of harmful fumes known as Volatile Organic Compounds (VOCs). We recommend the use of low VOC paints, finishes, sealants and adhesives, as well as zero or low formaldehyde emission composite wood products where practicable. The following guidelines come from the Australian Green Building Council's Green Star rating scheme and are measured in g/l:

Walls and ceilings – interior semi gloss	16
Walls and ceilings – interior low sheen	16
Walls and ceilings – interior flat washable	16
Ceilings – interior flat	14
Trim	75
Timber and binding primers	30
Latex primer for galvanised iron and zincalume	60
Interior latext undercoat	65
Interior sealer	65
Performance coatings for floors	140

2.3.3 ROOFGARDEN:

Bare rooftops absorb more heat which inturn add energy costs to the residential unit. Reflective surfaceslike white paint can increase the benefit.
An alternative option is to provide a green roof. Adding landscaping not only reduces energy consumption but also provides aesthetic benefits, shade and minimises the urban heat island effect,

2.4 ENERGY EFFICIENCY

2.4.1 LIGHTING & CONTROLS

Lighting accounts for a significant amount of energy usage in a common area of a strata property. Good practice lighting design generally includes for energy efficient fluorescent and LED lighting. The use of occupancy sensors to activate lighting and daylight sensing are good ways to further reduce energy consumption associated with lighting.

2.4.2 ENERGY MONITORING

Energy monitors provide a real-time display of your electricity consumption. They are a cost-effective way to track an individual unit's energy cost and power usage trends.

Monitoring allows for spikes in energy use of major equipment like air conditioning, lighting, hot water,etc to be identified quickly and rectified.

Also it allows the user to switch off the unwanted equipment remotely.
Provision can be kept in the construction phase.

2.4.3 RENEWABLE ENERGY:

2.4.3.1 Solar Photovoltaic System:

This part Covers in the section 3.1 of this report

2.4.3.2 Solar Hot water:

A central gas boosted solar hot water system can be used for saving energy. However due to the maintenance issue and the availability of the roof space, we recommend using individual Gas instantaneous hot water systems.

2.5 WATER EFFICIENCY

2.5.1 RAIN WATER HARVESTING

When rainwater is captured and stored correctly, it is a safe, economical and sustainable source of quality water, ideal for uses including irrigation and toilet flushing.Rainwater harvesting involves the collection, storage and distribution of rainwater from the roof.

2.5.2 EFFICIENT FIXTURES

The use of low-flow taps, dual flush toilets, and waterless urinals are encouraged for the project. Fixtures that restrict flows or flush rates do not cost more to purchase, install, or maintain and bring down operational costs for the project. The Water Efficiency Labelling Scheme (WELS) rates taps and makes it easy for consumers to understand the efficiency rating.

2.6 TRANSPORTATION

Strathfield rail station is 200m away to the property and the bus-stop is at a very close proximity. The occupant will be encouraged to use public transport instead of a private car. Also the building provides bicycle parking space. This will reduce a significant amount of Green house gas emission.

3. Solar Energy Study:

3.1 INTRODUCTION:

A solar power system is a proven technologyto generate renewable electricity onsite. It is an increasingly popular means for buildings to reduce its greenhouse gas emissions.

The main components of a solar power system are photovoltaic (PV) panels, a DC to AC power converter (inverter) and a rack system that holds the PV panels in place. Battery storage is also another component to store excess energy for night time use.

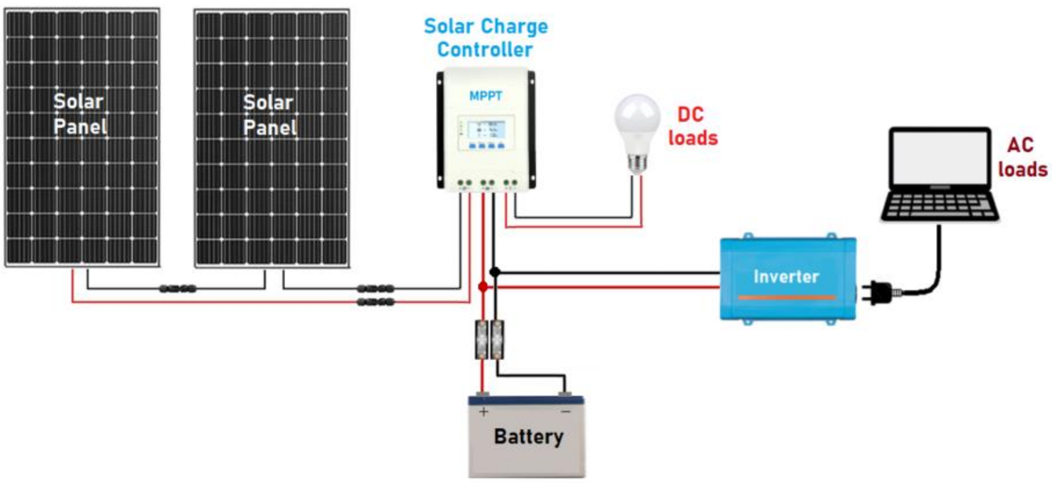
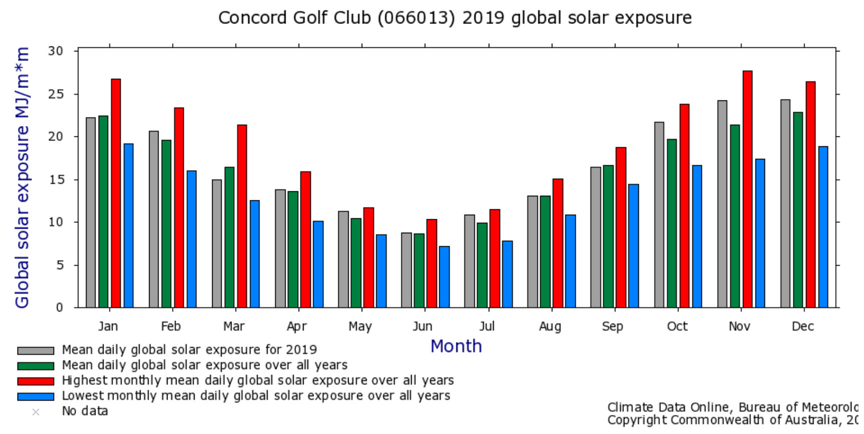


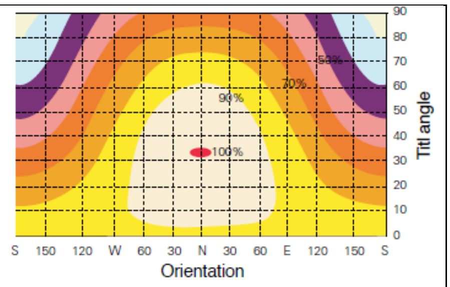
Figure 3PV System diagram

The solar panel converts sunlight into Direct Current (DC) electricity. An inverter is to convert the DC electricity into Alternating Current (AC) electricity used by typical household appliances and lighting.

3.2 INSTALLATION AND ORIENTATION

Various factors affect the energy output of a solar power system. One of the most important factors is the amount of sunlight available in that location.The higher the sunlight, the greater the expected output.Figure below shows the average global solar exposure in a stratified location.





In Australia, panels should face north.However, overall power output will suffer if panels are not facing north as shown by the chart above. Tilt angle to be 20-35deg.

3.3 PANEL TYPES

There are three main types of solar panel available in the market. The main differences between the three types are efficiency and costs.

- Mono Crystalline – have the highest efficiency which means fewer panels are required to produce a given amount of energy.

- Poly Crystalline – slightly less efficient than Mono Crystalline panels but generally cheaper. Lower efficiency means more panels are required to produce a given amount of electricity.

- Thin Film (or Amorphous) – significantly lower efficiency compared to crystalline modules. Approximately double the area of the other panel varieties are required to produce a given amount of electricity. However, the cheapest for coveringabig area or external cladding.

3.4 SITE ASSESSMENT

Possible locations for the PV panels are highlighted on the picture below. Total provided roof space for the solar panel is 180m^2. Installation arrangements can be either of the pictures below (canopy or on tilt frame).

PV panels to create a canopy over the roof.

By putting panels on tilt frames 20-30deg) on a flat roof

3.5 POWER DISTRIBUTION:

Due to the varied nature of renewable energy demand among tenants and available roof space, sometimes it becomes hard to select a suitable distribution of solar systems in an apartment.However the following few options can be evaluated for the proposed apartment building:

A. **SOLAR FOR THE COMMON AREAS:**Each strata block has a dedicated house meter for the common areas, where lights, lifts and other communal equipment run; the electricity bill associated with this meter is paid for out of strata levies.

B. **EACH UNIT GETS A SEPARATELY METERED SYSTEM:**Some of the unit owners are interested in solar power. In that case a solar systemcan be installed for each unit, such as in balcony or in individual façade or even at the roof.

C SINGLE SHARED SYSTEM, WITH BENEFITS ALLOCATED TO INDIVIDUAL UNITS:

Solar system is installed with a smart diverter that enables solar energy from a single rooftop solar system to be shared between multiple units. The diverter delivers the same amount of solar energy to each apartment over the course of a month, but supplies it when it's needed by each unit.

3.6 PLANT SIZING & CALCULATION

Considering the building layout option A is considered suitable and energy simulations were done based on thenearest Olympic park weather data, with the following assumptions:

Assumption:

- 12 level corridor lighting load (2w/m2)
- 4 level basement car park, lighting(2w/m2)
- Groundfloor common area lighting load(2.5w/m2)
- Considered 24/7 on

No other equipment load is considered

With the available roof space, the following PV system is considered

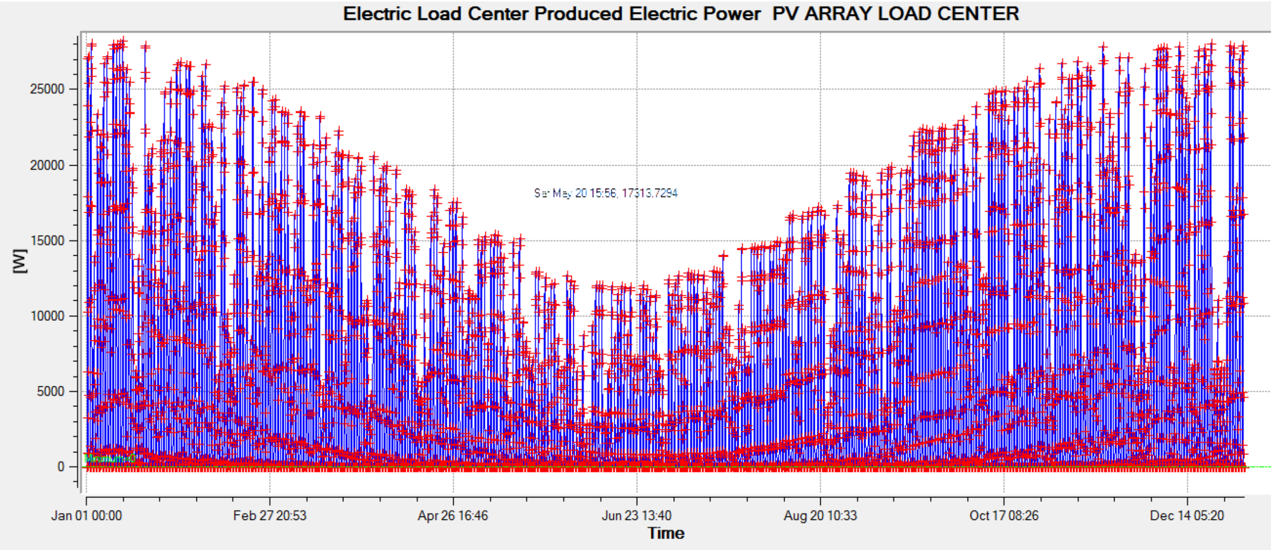
Roof Area(m2)	Approximate No of Panel(1.65x1m)	Rated Peak
7.6x12.15	49	15.7
10.5 x 5.6	30	9.6
5.6 x 5.6	15	4.8
5.6 x 3.9	10	3.2
	Total	33.3kw

3.7 ENERGY USAGE:

Energy plus simulation software is used to calculate the electricity demand and the solar contribution as follows:

	Electricity [kWh]	Percent Electricity [%]
Fuel-Fired Power Generation	0.00	0.00
Photovoltaic Power	41059.83	8.03
Wind Power	0.00	0.00
Surplus Electricity Going To Utility	1944.44	0.38
Total On-Site Electric Sources	43004.27	8.41
Electricity Coming From Utility	468426.65	91.59
Net Electricity From Utility	468426.65	91.59
Total On-Site and Utility Electric Sources	511430.92	100.00

It is seen that a small amount of energy will go to utilities during summer for some specific days only, but during winter solar contribution will be around 50% compared to summer days

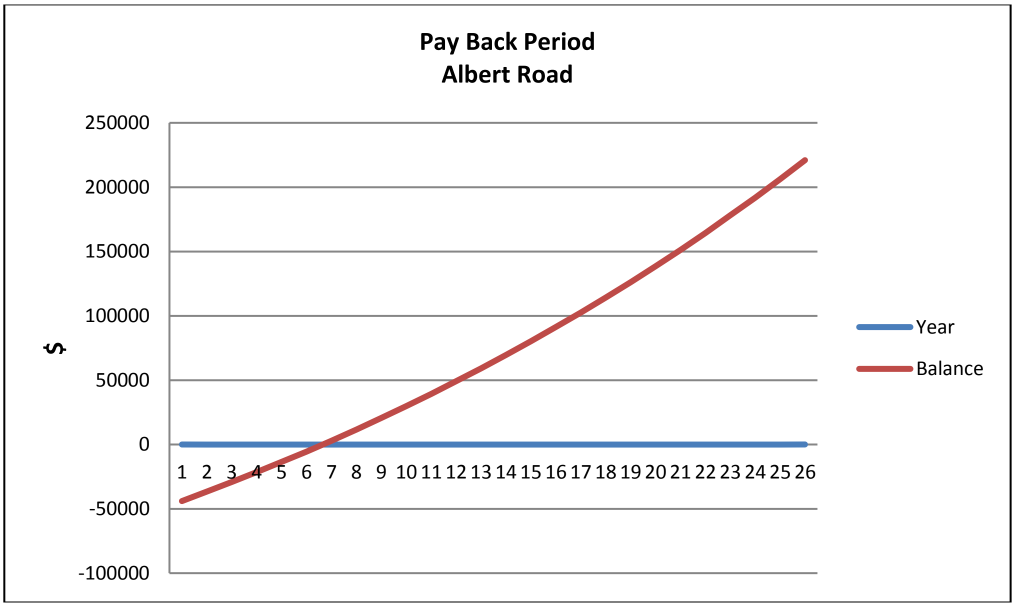


3.8 PAY BACK PERIOD:

Paybacks are based on assumption thattheannual electricity price will increase 3 per cent per year thereafter. Base case assumes all electricity generated will be used to offset energy consumption onsite, i.e. no energy is exported to grid (even though the system will be connected for grid export).

Albert Road, Streathfield	Total Fixed cost	Maintenance
Equipment +Installation cost	44,000	0
Electricity Price increase	3%	PayBack Period
Electricity charge($/Kwh)	0.15	6.5

The graph below shows the payback period in a25years life cycle



From the calculation above, It is seen that with 6.5yrs the energy saving will cover the capital cost.

3.9 CONCLUSION:

A solar PV system is an effective solution for this apartment building. Compared to other forms of renewable electricity such as wind power for example, a major advantage of a solar power system is that it is virtually maintenance free because it has no moving parts. A solar power system is considered as a prestigious feature of modern architecture which enhances the general perception of the building's environmental performance.