Melbourne City Council Development CH2

Environmental Design Schematic Report

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Melbourne City Council

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design advice

passive systems

design analysis

low energy services

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EXECUTIVE SUMMARY

This report consolidates the advice provided in reports and workshop meetings to date regarding ESD issues and treatments considered for the new offices for Melbourne City Council (CH2).

In addition to confirming previous advice on ESD options considered, this report details the services design criteria required to meet the minimum objective of a 5 star rating and provides an outline of the services design strategies proposed for each area.

This report is a transition document and as such is not intended as a definitive status of the design performance of the building. Incorporated within each section are paragraphs, highlighted by italics, outlining further investigations required to resolve the design performance of various strategies.

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Date	05/05/2003	
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1 INTRODUCTION

This report consolidates the advice provided in reports and workshop meetings to date regarding ESD issues and treatments considered for the Melbourne City Council Building development.

In addition to confirming previous advice on ESD options considered, this report details the services design criteria required to meet the minimum objective of a 5 star rating and provides an outline of the services design strategies proposed for each area.

1.1 Sources of Information

- AEC's Passive Design Report
- AEC's Design Report
- AEC's Natural Lighting Opportunities
- AEC's PCM Based Cooling Report
- AEC's Façade Shading Report
- AEC's Adaptive Thermal Comfort Report
- Conceptual Design produced by Mick Pearce, Melbourne City Council.
- Workshop meetings with:
    - Melbourne City Council
    - Design Inc
    - Lincolne Scott

2 ENVIRONMENTAL DESIGN BRIEF – INDOOR ENVIRONMENTAL QUALITY (IEQ)/ENERGY

The tables within the following sections are divided into three separate design criteria; 'A Grade building Benchmark' which outlines the design criteria associated with a building considered to satisfy the Property Council of Australia's A Grade rating, 'Schematic Design' which outlines the design criteria currently considered for the project and 'Design Development Target' which is the design criteria that we are aiming to achieve in meeting the "green" objectives for the Melbourne City Council Offices.

2.1 Mechanical

The mechanical services are to be designed to improve IEQ and to assist the project minimum objective of a 5 star rating when assessed under the methodology of the Australian Greenhouse Rating System. This requires the design and selection of services to consider energy efficiency in operation as fundamental criteria.

	A Grade Building Benchmark	***Schematic Design***	***Design Development Target***
Office Area			
Design Internal Air Temperature	22.5 +/- 1.5 deg. C	Lower Limit 21degC Upper Limit 25degC	*Lower Limit 21degC* *Upper Limit 25degC*
Design Internal Resultant Temperature	N/A	Lower Limit 21degC Upper Limit 23degC	*Lower Limit 21degC* *Upper Limit 23degC*
Design Humidity Level	No active humidity control.	<65% Active Control	<65% Active Control
People Density	1/10m^2	1/15m^2	*Actual Occupancy Numbers*
Lighting Load	15W/m^2	8W/m^2	*8W/m^2*
Equipment Load	20W/m^2	15W/m^2	*11.5W/m^2*
Perimeter Infiltration	0.5 airch/hr	0.5 airch/hr	*0.25 airch/hr*
Perimeter Zone	4m	4m	*2m*
Average Supply Minimum turndown Air Quantity	6 airch/hr	N/A	*N/A*
Outside Air Allowance	7.5 l/s/person with high efficiency filters	1.5l/s/m^2- 100% Outside Air	1.5l/s/m^2- 100% Outside Air
System Type	VAV (industry norm.)	Chilled surfaces and Primary displacement System	*Chilled surfaces and Primary displacement System*
Return Air	Mechanically assisted ducted return to plant	Passive Relief Air discharged at roof level.	Passive Relief Air discharged at roof level.

	A Grade Building Benchmark	***Schematic Design***	***Design Development Target***
Exposed Ceiling Thermal Mass	N/A	55%	55%
Toilet Areas	Mechanical Exhaust and Supply	Natural Ventilation	*Natural Ventilation*
Lobby Area			
Design Internal Air Temperature	22.5 +/- 1.5 deg. C	Lower Limit 21degC Upper Limit 25degC	*Lower Limit 19degC* *Upper Limit 27degC* *To suit seasonal variations*
Cooling	Chilled Water Air Handling Plant	Shower Tower	*Shower Tower with Displacement Ventilation System for concierge desk*
Heating	Heating Hot water Air Handling Plant	Under Floor heating	*Underfloor heating with Displacement Ventilation System for concierge desk*
Toilets	Mechanical Exhaust and Supply	Natural ventilation	*Natural ventilation*
Retail Area			
Design Internal Air Temperature	22.5 +/- 1.5 deg. C	Lower Limit 21degC Upper Limit 25degC	*Lower Limit 21degC* *Upper Limit 25degC*
Occupancy	1person/2m^2	1person/2m^2	*1person/2m^2*
Outside Air	7.5l/s/person with high efficiency filters	15l/s/person	*15l/s/person*
Cooling	Air cooled split a/c units or water cooled a/c units.	Shower Tower fresh air supply supplemented by water cooled a/c units	*Shower Tower fresh air supply supplemented by water cooled a/c units*
Heating	Air cooled split a/c units or water cooled a/c units.	Shower Tower fresh air supply with heating hot water heating coils, supplemented by water cooled a/c units	*Shower Tower fresh air supply with heating hot water heating coils, supplemented by water cooled a/c units*
IEQ objectives Improved Indoor Air Quality Improved Ventilation Efficiency Improved Thermal Comfort Use of Natural ventilation			
Central Plant			
Central Plant design diversity	100%	100%	*85%*
Heat Rejection	Water Cooled	Water Cooled/PCM Batteries	*Water Cooled/PCM Batteries*
Heating	Atmospheric Gas Fired Boiler	Atmospheric Gas Fired Boiler	*Majority by waste heat recovery such as co-generation, atmospheric gas fired boiler as required*

	A Grade Building Benchmark	***Schematic Design***	***Design Development Target***
Chilled Water temperature	7degC	7degC	*7degC capability. Rescheduling to suit load. Rescheduled to 12degC for PCM recharging.*
Refrigerants	-	No HCFC's	*No HFC's*
Economy Cycle	Yes	N/A- 100% Outside Air	*N/A- 100% Outside Air*
Free Cooling Cycle	Nil	Condenser Water Free Cooling	*Condenser Water Free Cooling*
Dehumidification	Nil	Chilled water with heating hot water reheat	*Chilled water with condenser water or waste heat reheat*
Pump Motors	CV	VSD	*VSD*
Car Park Ventilation			
Fans	Mechanical Exhaust (variable speed with CO monitoring), Passive Supply	Mechanical Exhaust and Supply. Variable speed with CO monitoring	*Mechanical Exhaust (Variable Speed with CO monitoring), Shower tower supply.*
Air Quantity	Performance based AS 1668.1-1991	to AS1668.1-2002	*To AS1668.1-2002*
Controls			
Extent	Fully automated BAS with sub metering.	Fully automated BAS with sub metering to suit SEDA requirements	*Fully automated BAS with sub metering to suit SEDA requirements with the addition of multimedia and WEB kiosk interface*

2.2 Electrical

The Electrical services are to be designed to improve IEQ and to assist the project minimum objective of a 5 star rating when assessed under the methodology of the Australian Greenhouse Rating System. This requires the design and selection of services to consider energy efficiency in operation as fundamental criteria.

	A Grade Building Benchmark	***Schematic Design***	***Design Development Target***
On-floor lighting			
Lighting Power Density	15W/m^2	8W/m^2	*8W/m^2*
Fitting Type	T8	Downlight or semi-indirect	*Two component – General lighting + task lighting at desk – High Frequency Electronic Ballasts –T5*
Low Mercury Lamps	N/A	<8mg	*<8mg*
Maintained Design Light Level	400lux	320lux	*150lux general lighting*
Colour Rendering Index	-	>0.85	*>0.85*
Lighting Design Guidelines	N/A	N/A	*CIBSE LM3 Guidelines*
Space Reflectance			
Carpet	-	30%	*30%*
Walls	-	50%	*50%*
Ceiling	-	70%	*70%*
Desktop	-	-	*70%*
On-floor power			
Equipment Power Density	20W/m^2	15W/m^2	*11.5W/m^2*
A/C System Type	VAV (industry norm.)	Chilled surfaces and Primary displacement System	*Chilled surfaces and Primary displacement System*
IEQ objectives Improved Visual Comfort Good Colour Rendition Task Lighting User Control			
Central Plant			
On Site Generation	To satisfy essential requirements	Capstone Micro turbine (##kw)	Capstone Micro turbine (##kw)
Power Factor Correction	-	0.9	*0.95*

Lifts			
Number of	To satisfy waiting interval <30 sec.	3 passenger lifts and 1 goods lift	*3 passenger lifts and 1 goods lift. Eco drive lifts.*
Population	1/10m^2	1/15m^2	*1//15m^2*
Lift Motor Room Ventilation	A/C or ventilation to Australian Standards	A/C or ventilation to Australian Standards	*No mechanical ventilation. Cooling provided by PCM batteries.*
Façade lighting			
Lighting Power Density	5 w/m^2 (façade area)	2.5 w/m^2 (façade area)	*1 W/m^2 (façade area)*
Car Park lighting			
Lighting Power Density	6 w/m^2	6 w/m^2	*6 W/m^2*
Lighting Control	-	Movement Sensors	*Movement Sensors plus day light linking.*
Sub Mains			
Sizing to consider reductions in on floor demands and central air conditioning plant with view to cost saving and increased efficiency			
Controls			
Energy monitoring and sub metering as required to demonstrate 5 star compliance			
General Floor Lighting	minimum 4 zones per floor	1 zone per bay	*2 zones per bay*
Ancillary Lighting (Break out areas, tea rooms, lift lobbies)	No requirements	Separate lighting circuit.	*Separate lighting circuit.*
Ancillary Lighting (Meeting Rooms, offices)	No requirements	Separate lighting circuit with motion detectors.	*Separate lighting circuit with motion detectors.*
Daylight linking	-	*Daylight linking.*	*Daylight linking.*
After hours Control	Normal floor zone operation	Normal floor zone operation	*Lighting interfaced with security.*

2.3 Hydraulics and Water

The hydraulic services are to be designed to assist the project objective of a 5 star rating when assessed under the methodology of the Australian Greenhouse Rating System. This requires the design of services to consider energy efficiency in operation.

	A Grade Building Benchmark	***Schematic Design***	***Design Development Target***
Water demands			
Population density	$1/10m^2$	$1/15m^2$	*$1/15m^2$*
Dual flush	3L & 6L	3L & 6L	*single flush of 4L*
Flow Limiting Fittings	Nil	Use AAA fittings	*all fittings AAAA*
Hot water demand	-	-	*One basin supply per wet area*
Urinals	Minimal flush	Minimal flush	*waterless urinals*
Water Heating			
Heating	65°C	65°C	*Warm water with UV treatment*
Hot Water System	Gas Boiler	Solar boosted Gas Boiler	*Gas boosted Solar boiler or waste heat recovery.*
Rainwater Treatment and reuse			
Reuse potential	Nil	Toilet flushing and watering landscaping.	*Reuse rainwater for toilet flushing/cooling towers/shower towers and carpark and external washdown*
Rainwater Catchment	Nil	Yes	*Yes -90%*
Sewage Treatment			
On-site treatment	Nil	Black Water	*Grey Water on-site cost vs. Melbourne Water cost*
Shower Tower Water Treatment			
Water Treatment	N/A	Sand and UV Filters	*Sand and UV Filters*
Cooling Tower Water Treatment			
Water Treatment	Chemical Dosing	Chemical Dosing	*Non Chemical Dosing*
Pipework			
Insulated Pipework	Trace Heating	No Trace heating to be used	*No Trace heating to be used*

2.4 Building Materials

The choice of materials is designed to reduce the environmental impact of building construction. The impact of materials on Indoor Environment Quality is also important, and low-emission products should be chosen to minimise this impact.

	A Grade Building Benchmark	***Schematic Design***	***Design Development Target***
Formaldehyde			
Minimise impact on IEQ	-	No on-site cutting of MDF	*No on-site cutting of MDF*
Furniture and Joinery Selections	-	Avoid MDF and formaldehyde insulation	*No MDF and formaldehyde insulation*
Volatile Organic Compounds (VOC) - minimise impact on IEQ			
Floor covering	-	Avoid high VOC-emitting	*Use low VOC-emitting*
	-	Avoid vinyl	*Use linoleum*
Underlays	-	Avoid styrene-butadiene latex	*Use conventional carpet laying methods*
Paints	-	Avoid high emission	*Use water based or plant based low emission paints*
Plants	-	Use indoor plants	*Use indoor plants which optimise VOC removal*
Structural Concrete	-	Concrete Fly Ash Content	*>50% Fly Ash Content*
Carcinogenic emissions			
Minimise emissions	-	Avoid Synthetic Mineral Fibres	*No Synthetic Mineral Fibres*
Organochlorine emissions			
Minimise emissions	-	Use physical termite barriers	*Use physical termite barriers*
Timber selection			
Minimise emissions	-	Avoid timber products using formaldehyde	*No timber products using formaldehyde*
Pest Treatment	-	Avoid treated timber	*Use naturally resistant timber*
Timber selection	-	Use plantation timber	*Use recycled timber where possible*

Structural and Servicing Materials			
Above Ground Drainage	PVC	PVC	*PVC alternatives such as HDPE*
Cables and Conduits	PVC	PVC	*Halogen free PVC free sheath.*
Cold and Hot Water Pipework	Copper	Copper	*Copper substitution where beneficial using XLPE*
Structural Concrete	No recycled content	Concrete Fly Ash Content	*>50% Fly Ash Content*

2.5 Facade

The facade is to be designed to improve IEQ and to assist the project objective of a 5 star rating when assessed under the methodology of the Australian Greenhouse Rating System. This requires the design of the facade to consider energy efficiency in operation.

	A Grade Building Benchmark	***Schematic Design***	***Design Development Target***
Glazing			
Visible Light Transmission	>50%	>50%	*>50%*
Solar Transmission	<35%	<35%	*<35%*
Conductivity	> 2	> 2	*> 2*
Internal Visible Light Reflectance	<15%	<15%	*<15%*
External Visible Light Reflectance	<20%	<20%	*<12%*
Colour	Green Body Tint	Neutral	*Neutral*
Fixed Shading			
Shading Percentage Objective	Nil	100%	*Engineered Seasonally Selected*
Blinds			
Operable internal light blinds	100% coverage	Nil	*Blinds as appropriate for glare control. Blind mechanism with override.*
Operability			
Enclosed Balconies	N/A	Natural Ventilation	*Natural Ventilation*
Automated Operating Louvres	N/A	Night Purge	*Night Purge*
IEQ objectives Improved Visual Comfort Good Colour Rendition Task Lighting User Control Natural Ventilation			

3 BUILDING DESIGN STRATEGIES

3.1 Façade System

3.1.1 Façade Supply and Relief

The supply and the relief air shafts for the displacement ventilation system are proposed to be incorporated within the southern and northern facades respectively. The original proposal incorporated the supply and the relief shafts being located within alternate blades within the façade. To facilitate better co-ordination of the air handling plant at the roof level, the configuration was altered to the current configuration with supply within the southern façade and relief within the northern façade. The supply shaft will be internally thermally insulated to ensure uniform temperature of supply air to all floors.

The supply air is proposed to be supplied to the office space from a 200mm (internal dimension) high floor plenum via manually adjustable circular displacement diffusers. The original design of alternating supply and relief blades provided a superior distribution of air into the floor plenum than the current configuration. Further investigations are required to ensure that sufficient air distribution through the floor plenum can be achieved.

Computational Fluid Dynamic (CFD) modelling is required to determine plenum pressure drops required to be achieved to ensure that sufficient supply air is distributed across the whole office floor, with this façade supply/relief configuration.

3.1.2 Glazing

A high performance double glazed unit has been proposed for this development. The glazing selection for a building is important with respect to heat losses and gains, the thermal comfort of occupants, levels of natural lighting provided to the space and acoustics. The design criteria outlined within section 2.5 Façade has been determined by considering the optimisation of the above selection criteria.

A low E coating is being considered for the internal surface of the external pane of the double glazed unit. However, there is concern that the coating may disadvantage the night purge process in summer by reflecting radiated heat from the building structure back into the building space.

Thermal modelling is proposed to determine the effect on the building's total energy usage as a result of installing a low E coating within the double glazed unit.

3.2 Thermal Mass/Night Purge

3.2.1 Thermal mass

Thermal mass plays a role in the energy efficiency of a building. Materials with high thermal mass, like concrete, store and release energy needed for heating and cooling. A building with good thermal mass is protected from big temperature swings and therefore will provide a higher level of thermal comfort year round.

Three different materials were modelled on the external walls. The aim was to investigate the effect of a higher thermal mass facade on air temperatures, radiant temperatures, resultant temperatures, and cooling loads.

The following are three materials modelled in the external walls:

- 90mm concrete
- 90mm autoclaved aerated concrete (for example, Hebel)
- 12mm plasterboard.

Below is a graph showing the relationship between the different external wall materials investigated and the resultant cooling loads. We can see that only in winter do the external wall types have a minor effect on the cooling loads.

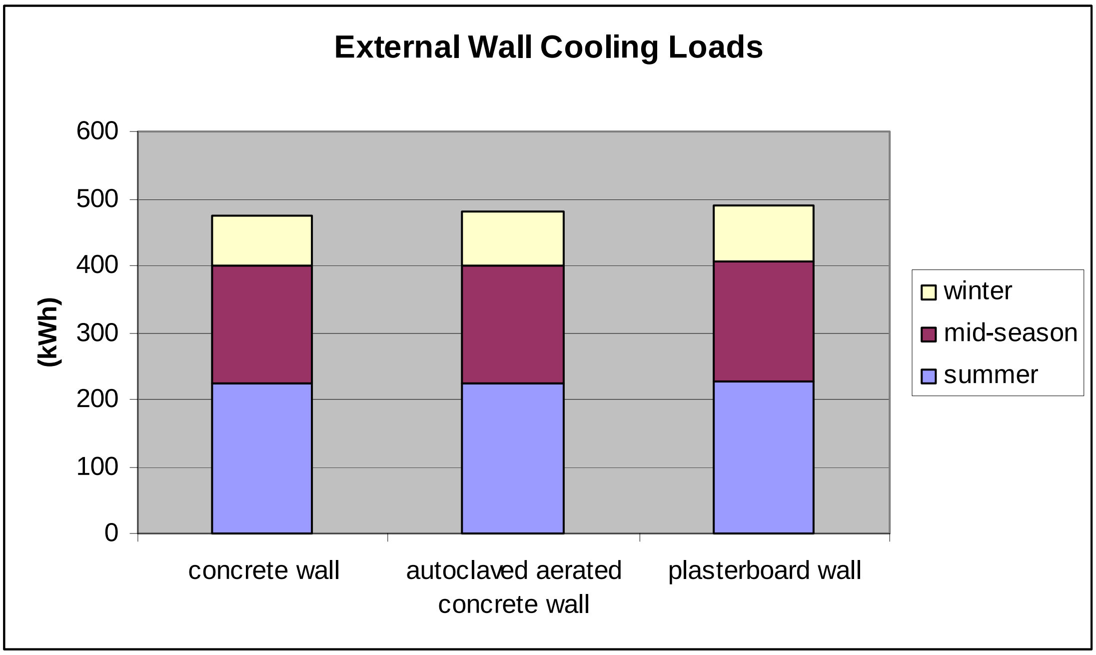


Figure 1 Effect on cooling loads for external wall options

Recommendation

The results show that none of the materials investigated had any significant effect on the heating and cooling loads for the proposed Melbourne City Council building, hence the selection of building materials for the external walls should be dependent on other factors other than thermal mass.

Thermal mass is most effective where it can offer maximum exposure to all building occupants. Thus we recommend utilising higher thermal mass materials in the ceilings as a more effective means of reducing cooling loads than the external walls. Exposed ceilings and hence thermal mass are included in the schematic design.

3.2.2 Night Purge

At night, it is considered normal that the air conditioning will turn off and the building may be cooled via openable windows using natural ventilation. We call this process night purging. The extent to which night purging is effective is dependent on the amount of free window area available.

Free window area is the area of a window which allows air to flow through. This free area is dependent on the openable proportion of the window and does not allow for any additional inefficiencies that might be associated with obstructions such as flyscreens. We measure free areas as a percentage of floor area of the space we want to cool.

For the proposed Melbourne City Council building six options of free window areas were modelled from 0% to 5%.

The graph below shows how free window areas affect night purging-space cooling in the Melbourne City Council building. We can see that after having 1% of free window area, the effect of greater free areas upon the space cooling load is minimal.

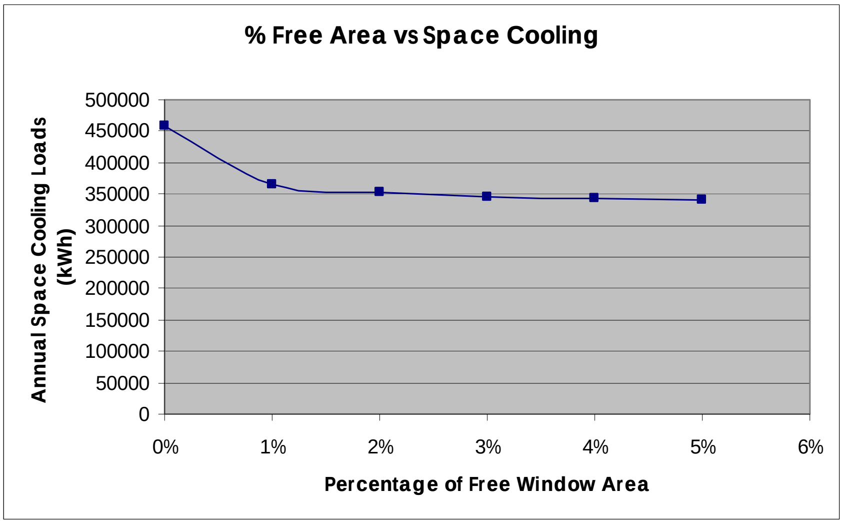


Figure 2 Free Window Area vs. Space Cooling

Thus for night purging to be carried out successfully, we only have to achieve a free window area which is a minimum of 1% of the office floor area.

Night purge ventilation will be generated by both buoyancy and wind driven forces on still nights, heat released from the structure will drive air up the passive relief shafts. On nights with a breeze, the pressure difference between north and south facades will assist air movement. Automatic controls will close the windows in the event of high winds or driving rain.

Recommendation

Night purging effects will be effective if 1% of the floor area is window area provided as openable. The above results indicate that any increase in the free window area above 1% only marginally increases the effectiveness of space cooling. A 20% reduction in space cooling demands has been predicted for this initiative.

3.3 Shading

3.3.1 External Shading

The Melbourne City Council development's objective is to have 100% external shading on all façade orientations. Preliminary investigations determined that the extent of external shading required to satisfy the full 100% shading is excessive and was deemed impractical and thus this study reviewed the external requirements with respect to 95% external shading.

An investigation was undertaken to determine the extent of horizontal and vertical shading required to meet the 95% shading requirement. The investigation involved the production of stereographic diagrams to demonstrate the effect of the position of the sun on each façade for all seasons. This enabled each façade to be analysed separately to define the extent of horizontal and vertical shading required. The results for each façade were refined by modelling the external shading requirements incorporating the effect of the surrounding building.

The following results are detailed within AEC's Shading Report issued March 2003.

The following table details the extent of vertical and horizontal shading devices required to satisfy 95% shading. The table indicates the extent of physical shading required in proportion to a glazed area of 1m x 1m.

	Level 1		Level 9	
Season	**Vertical (m)**	**Horizontal (m)**	**Vertical (m)**	**Horizontal (m)**
North (Summer only)	0.8	0.8	0.8	0.8
North (All year)	2	2	2	2
South	0.5	0.35	0.5	0.35
East	0.25	0.25	0.65	0.65
West	2.3	1.9	2.3	1.9

Figure 3 Extent of Horizontal and Vertical Shading Required for 95% Shading

Further investigations are recommended into the extent of external shading versus the resultant energy usage of the building to optimise the external shading design.

3.3.2 Internal Shading

No investigations have been conducted to date on the effect of various internal shading opportunities. Internal blinds may be necessary to assist in glare control for the occupants.

We recommend an investigation into the effect of various internal shading options on the building's energy usage and the thermal and visual comfort of the occupants.

3.4 Art and Interpretative Design Opportunities

The Council House building provides a unique opportunity to raise the bar for the sustainable design and construction of commercial grade office space within the Melbourne CBD. It is a function of good sustainable design that the best design solution does not always provide the best expression of sustainability.

It is therefore important that some of the sustainability smarts are transcribed into more visual and interpretive elements. This will perform the function of educating a wider public and the users into what makes a sustainable building sustainable. The educative role is extremely valuable to address any aspiration for the project for broader market transformation and awareness.

Where the design agenda for sustainability is being addressed by back of house equipment, we are exploring a 90/10 split between function elements and interpretative elements. This loosely means that is the most effective form of heat rejection for the chilled ceiling system is established to be cooling towers these will meet a minimum of 90% of the duty. The remaining proportion will then be served by a more visual element such as an external mounted shower tower. Whilst the tower is not serving a large proportion of the duty requirements is does provide an advantage in communicating the green story and can be controlled to ensure it is always the first element activated to serve a cooling load, thereby maximising its operation period.

The following items address the art and interpretive design opportunities that have been identified during the completion of the schematic design.

3.4.1 Shower Towers

The shower towers provide an opportunity to reveal the inner-workings of both evaporative cooling and heat rejection for the phase change material thermal storage battery.

Currently the schematic design provides shower towers above the entrances to the retail tenancies adjacent Little Collins Street. The detailed design of showers towers should consider their legibility to the public during the day and also the opportunities to subtly illuminate the falling water droplets at night.

The shower towers are to supplement the cooling tower installation for heat rejection purposes and will be investigated for fresh air supply to the retail tenancies themselves.

3.4.2 Phase Change Materials.

The majority of the Phase Change Material thermal storage battery will be located in large modules within the basement. Making the basement accessible will provide an opportunity to demonstrate how they work.

Consideration should also be given to providing maybe 5% of the thermal storage capacity within a transparent enclosure in a public area such as the lobby. This can be developed as an artwork which actively contributes to the running of the building. A suggested direction is for encapsulated PCB spheres to be floated in water or another medium with the convective currents generated from heat transfer to be accentuated by virtue of the tank geometry. Thermochromatic dyes for the encapsulation sphere would provide a colour change in the PCM spheres as heat is stored and released.

3.4.3 Thermochromatic and Photochromatic colorants

Themochromatic dyes change colour when they reach a given temperature and then returns to the original colour when the temperature is restored.

Photochromatic dyes change colour when exposed to UV radiation.

Both provide exciting opportunities to tell the story of the building. Thermochromatic dyes would seem best suited to the thermal elements of the mechanical systems such as the PCM thermal storage batteries. A thermochromatic dye is available form the US that would change colour around 15 deg C. This would coincide with the temperature of the PCM spheres after they had dissipated all their heat.

Photochromatic dyes would make an interesting addition to a façade exposed to sun for periods of the day. This pattern of sun exposure would be traced over the treated are each day. This might be considered as a local treatment on the western façade for instance.

3.4.4 Plant Rooms

Most plants rooms are accessible only by building managers and maintenance engineers. The roof top plantrooms for Council House might be designed to be accessible to study tours and building visits.

This approach would require careful planning of the plantroom to ensure circulation paths are logical and that the plant is laid out with are wider accessibility in mind. The design of the plant room might also consider natural light and good natural ventilation. Display meters adjacent to major items of plant could describe the percentage of hours the plant has been utilised and keep a running tally of energy saved or greenhouse gasses offset.

3.4.5 Honesty Panels

This concept involves replacing traditional panels and finishes with discrete areas of glazing or transparent acrylic to reveal the hidden working of a modern building. Some examples include:

Casula Powerhouse, Sydney – acrylic panels in the floor screed reveal the previous lives of this regenerated building, essentially illustrating past industrial uses and layers of pollution with oil. As the powerhouse new life is as an art gallery, the acrylic panels are a significant feature of the main gallery.

Straw Bail House, Neutral Bay – a glass panel is used in the rendered wall to reveal the straw bale construction behind. Without the panel, the rendering on the walls would not differentiate the building from any of its masonry constructed neighbours.

3.4.6 Multimedia Display

A multimedia kiosk should be introduced to the foyer where visitors and the public can interrogate the operating efficiency of the building.

A more adventurous multimedia element could be located above the foyer entrance on Little Collins Street.

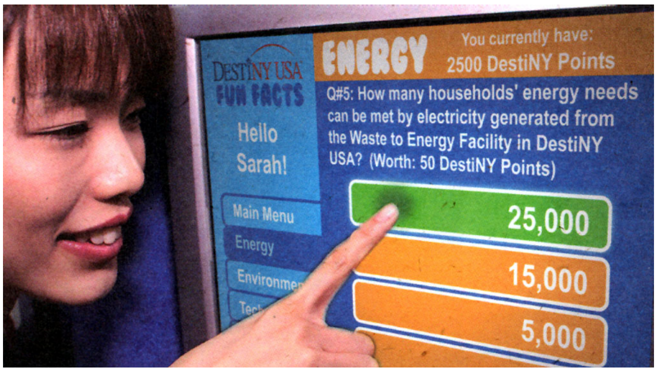


Figure 4 Multimedia Kiosk

Figure 5 External Multimedia Interface

4 SERVICES STRATEGIES

4.1 Office Areas

4.1.1 Mechanical

Ventilation

Outside air (fresh air) is distributed to offices via a displacement system. The displacement system is 100% outside air, based on 1.5l/s/m², supplied to the office space from a 200mm high floor plenum (internal dimension) via manually adjustable circular displacement diffusers. Outside air is delivered at 19 to 20degC with humidity control to <65% RH. The outside air is reticulated from a roof mounted central air handling unit via the southern façade and is discharged into the floor plenum at each floor. Mechanical heating and cooling for the air handling unit is provided from a central chiller and gas fired boiler.

Relief air from each floor will be exhausted passively. 50% of the relief air will be exhausted through the cored vaulted ceiling and to the roof level via the northern façade. The remaining relief air will be used to positively pressurise the floor to minimise unwanted infiltration. A subduct is to be incorporated into the façade relief air path to provide passive fire protection between floors. Wind assisted extraction vanes or wind turbines will be mounted on top of the façade relief.

Toilet exhaust to be naturally ventilated.

General and tea room exhaust will be provided for office floor fit out with an exhaust riser to a roof mounted exhaust fan.

Further investigation is required into the roof mounted assistance for the passive relief air, to ensure wind generated 'draw' does not place the office floors under negative pressure.

Cooling

Passive cooling is achieved from the extent of exposed thermal mass of the concrete ceiling, approximately 65% of the ceiling space. The thermal mass will be cooled using night purging. Night purging is via motorised openable louvres at high level on the east and west facades, designed to encourage cool night time ambient air to pass over the underside of the slab.

Supplementing the thermal mass is a combination of chilled beams and ceiling panels. Chilled beams are located above vision panels to cater for varying solar and transmission loads. Chilled ceiling panels are located throughout the space covering approximately 35% of the ceiling and will cater for the total internal space loads. The chilled ceiling panels and beams will be supplied with 16degC supply water temperature and have a design return water temperature of 19degC. Mechanical cooling is provided via thermal store (Phase change module batteries).

Heating

Heating is via convective fin heating elements located in the access floor zone beneath vision panels located around the perimeter of the floor plenum. In conjunction, the outside air ventilation system is able to provide warm air to the whole floor to assist in early morning warm up cycles. Mechanical heating is provided from a central gas fired boiler or waste heat from the co-generation plant.

Special Areas

Balcony rooms, such as meeting rooms, if they are to be conditioned, are to be heated and cooled via dedicated fan coil units using chilled water and heating hot water from the central thermal plant.

Computer equipment rooms are to be cooled via dedicated water cooled a/c units using condenser water from the central thermal plant.

4.1.2 Lighting

Artificial Lighting

General background lighting with localised task lighting is proposed. General lighting to consist of light fittings (CRI > 85) on the ceiling concealed within the cross beams. General lighting to be designed to achieve a general lighting lux level of 150lux with 70% wattage emitted to the office space, 30% emitted to ceiling. Lighting design to incorporate illumination of ceilings and vertical walls. Accent lighting to be utilised to highlight key building features.

Lighting to be controlled such that there is seamless integration between daylight lighting and night lighting. In addition the controls will enable the floor to be illuminated to different levels as required. The system is to be as automatic as possible with occupant control limited to dimming and on/off control.

Natural Lighting

Further investigations are being undertaken on the Natural Lighting Opportunities for the building. The most effective way in which daylight can be delivered to the lower floors of the building is through channelling or redirecting sunlight or daylight from the roof, distributing it through the building and diffusing or emitting it within the building's interior. This can be achieved through the use of a light pipe or similar system.
Potential options being considered include the following various types of light pipe systems:

- Open Shaft
- Fibre Optic
- Solid Acrylic Rod
- Prismatic Shaft
- Liquid light pipes
- Heliostat System

A detailed description of each option is available in AEC's Natural Lighting Opportunities Report issued February 2003.

Further investigations are required on the above Natural Lighting options with respect to effectiveness, architectural implications and the impact on the current cost plan.

4.2 Lobby

The building lobby is traditionally utilised as a transition area for the building occupants. As such the conditioning of the area is not deemed to be as critical as the office area due to the short period of time that occupants are located within it. The cooling and heating design conditions for the lobby are proposed to be such that a building occupant passing through the lobby will note that it is a conditioned area, however it will not be designed with the intention of people occupying the area for a prolonged period of time. Proposed maximum design dry bulb temperature 27degC, proposed minimum design dry bulb temperature 19degC.

The concierge desk is expected to be attended for all of the opening hours of the building. To provide comfortable conditions for the staff attending the desk, an energy efficient natural ventilation system is proposed for the concierge desk. This system will be fully controllable by the staff and includes a dedicated fan coil unit/ air handling system supplying air at 19degC at low level within the vicinity of the desk.

Cooling to the remaining are of the lobby is to be provided via air sourced from a dedicated Shower Tower located from level 1 down through to mezzanine.

Heating is to be provided by an underfloor heating system with the heating hot water sourced from the gas fired boiler. Further studies are being undertaken to investigate the viability of utilising the waste heat from the co-generation plant as the heat source.

The above strategy is undergoing further investigation and development to ensure that the energy efficiency of the system is being optimised.

4.2.1 Lighting

General lighting to main lobby area with localised task lighting for concierge desk. General lighting not to exceed 8W/m^2.

4.3 Retail

4.3.1 Mechanical

Fresh air requirements for the Retail Areas are to be provided via air sourced from shower towers located from level 1 down through to mezzanine.

The shower tower ventilation is to be supplemented by reverse cycle water cooled air conditioning units to be fitted off by the tenant during the tenancy works. Condenser water to be provided from the roof mounted cooling towers.

The tenant water cooled units will be required to be connected to the BAS for control and monitoring purposes.

Design conditions within the retail area are to be in accordance with the office areas: maximum design internal dry bulb temperature of 25degC, minimum design internal temperature of 21degC.

Further investigations are to be undertaken on the design strategy for the retail area to ensure that the energy efficiency of the system is being optimised. It is also proposed to develop a 'green' aspect to the tenancies lease to remove the requirement to over design base building in allowance for bad tenant practices.

4.3.2 Lighting

Lighting to be provided by tenant. Tenancy lighting design to incorporate the ESD philosophy of the building. Emphasis to be on illuminating walls and ceiling and utilising light coloured interiors as a means to maintain lighting perception, but minimising overall lux levels and energy usage. Again this will be addressed in the 'green' lease.

4.4 Carpark

4.4.1 Mechanical Ventilation

The basement carpark requires mechanical ventilation to satisfy AS1668.2. AS1668.2-2002 draft code has been proposed to be utilised for this development, as the carpark exhaust air quantity requirements have been reduced with respect to the previous edition.

Exhaust air is to be extracted from the east core riser with sheetmetal ductwork reticulating along the length of the carpark with duct droppers allowing both high and low level extractions. Exhaust air to be discharged at the roof via a masonry shaft located on the north façade. The exhaust is fan driven with variable speed motors controlled from carbon monoxide (CO) sensors located within each level to AS1668.2, such that energy use is minimised on demand.

Make up air is to be supplied via high level ductwork. Make up air is to be mechanically supplied from the roof. Riser space has been allocated.

No dedicated heating or cooling systems provided, other than passive means via the structural thermal mass.

4.4.2 Lighting

Carpark lighting to be no greater than 6W/m^2 with lighting control to operate off movement sensors with a 5 minute ‘On’ time.

4.5 Carpark Conversion (Office Floor)

It has been advised that the proposed office areas currently under design may be inadequate for the actual number of Melbourne City Council employees that are projected to be housed within this development. Consequently investigations are being undertaken into the feasibility of converting one of the basement carpark levels into an office floor.

4.5.1 Mechanical

Cooling/Heating

Due to the location and relative detachment of this basement floor with respect to the office tower, it will not be possible to extend the proposed chilled surfaces/displacement system to serve it. Consequently a number of additional options are being considered for the standalone system. Due to the nature of the development, only options that may potentially meet the ESD requirements of the development are being considered.

The following are a number of options being considered for cooling and heating the carpark conversion office floor:

<u>Option 1 – Chilled Water Air handling Plant.</u>

Conditioned air will be supplied to the floor from a roof mounted air handling unit. The air handling unit will heat reject via chilled water from the chiller located at roof level and heating hot water from the gas fired boilers or waste heat from the co-generation plant.

Outside air is to be provided at a rate of 10l/s/person to assist in minimising energy usage for the plant. Outside air is ducted directly to the air handling unit.

Conditioned air will be supplied at 14degC via variable air volume (VAV) terminal units. Air diffusion to the space is dependent on architectural requirements. Return air via ceiling plenum and ducted back to air handling unit at the roof level.

Thermal zones to be no larger than 70m^2

Option 2 – Phase Change Material

The second option being considered utilises the phase change cells outlined in AEC's PCM Based Cooling Report. This option utilises the EPSLTD produced E19 type Phase Change Material proposed to be used within the thermal plant. For this option the Phase Change Material is encased in aluminium "cells" (long, thin rectangular prisms, see figure 6 below) which are designed to be suspended from the ceiling to cool the rising warm air.

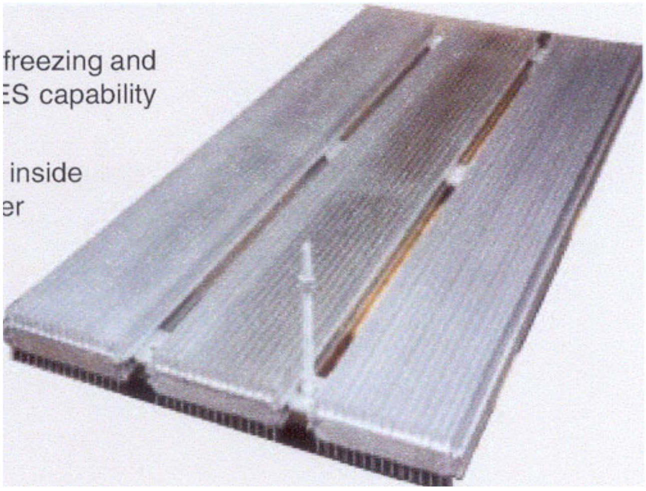


Figure 6 PCM Cells as provided by PlusICE

The Phase Change Cells would be solidified (charged) at night by forced night purge ventilation. During the day the stored cooling capacity is released by cooling the rising hot air.

Outside Air (fresh air) would preferably be provided using a displacement system similar to the typical office floors. Conditioned outside air would be delivered to the office area from a floor plenum via floor grilles. The floor grilles would be generally located at each desk with the grilles being manually adjustable by the occupants. Outside air would be supplied at a rate of 1.5l/s/m^2. The outside air would be conditioned via a chilled water/heating hot water air handling unit located on the roof.

Heating requirements are expected to be minimal, however the design would be similar to the typical office floor with convective fin elements located in the access floor zone around the perimeter if required. The outside air displacement system would be utilised to assist with the morning warm up cycle.

The source of the mechanical heating would be either from the gas fired boiler or waste heat from the co-generation plant.

Both mechanical system options for the carpark conversion floor require further investigations into their feasibility with respect to energy usage, architectural implications and the current development cost plan

4.5.2 Lighting

Due to the limited natural lighting provided to this office floor the lighting allowances are expected to be greater than that of the typical office floor. Generally background lighting is required with localised task lights.

Further investigation is proposed to examine the Natural Lighting options for this basement office level, to ensure contribution to the sustainability agenda.

4.6 Central Energy Plant

4.6.1 Mechanical

Roof Plant

The 16degC chilled water is supplied to the office chilled ceiling panels and beams from the Phase Change Material (PCM) battery modular units (PlusICE (EPS Ltd)) located on the roof plant. The PCM battery modular units consist of a series of pipes. These pipes are surrounded cylindrically by an annulus cavity containing the appropriate Phase Change Material (E13).

Phase change materials are best thought of as a very efficient thermal storage device. They work on the fact that whilst a material is undergoing a phase change (eg solid to liquid or liquid to gas, etc) it absorbs/releases a lot of heat energy for no change in temperature until the phase change is complete. This is similar to the energy required to convert ice to water. This heat is called the latent heat of the material and varies for different matter.

During the night, cool water from the cooling tower is pumped through the pipes in the module. Effectively this PCM stores the "coolness" of the cooling tower water during the night and is able to release that cooling during the day.

Originally PCM filled spheres were to be considered for this development however it was deemed that the PCM modular units were a more energy efficient, cost effective product for this application. Options are being considered for providing PCM filled spheres on the ground floor as a visual display of the operation of the cooling of the building.

The PCM batteries are sized to cater for the full building load as calculated for a design day. Further investigations are currently being undertaken to examine redundancy options for the PCM batteries, should there be a low percentile high ambient temperature day. A redundancy option may involve utilising the chilled water from the chiller plant to recharge a PCM battery, in the unlikely event that the building load exceeds the designed load.

The 16degC chilled water, as provided by the PCM Batteries, will be passed through a heat exchanger so as to create a closed loop chilled water system for the office building.

The outside air for the office displacement system is conditioned utilising a roof mounted air handling unit. Mechanical cooling is provided by the water cooled chiller plant. The chiller plant may consist of three equal sized chillers with VSD, however further reviews of the operation of the plant is required to obtain an optimal chiller configuration with respect to staging, redundancy and energy efficiency. The chiller plant size is under review as it is dependent on the results of the co-generation plant investigation currently being undertaken.

The Chiller plant will be sized to 7degC supply water capabilities, however the chilled water supply temperature will be able to be rescheduled up to 12degC should it be required to be used for recharging the PCM batteries.

Two cross flow cooling towers with VSD are proposed. These cooling towers will operate 24 hours a day providing cooling to the PCM batteries at night and heat rejection for the chillers in the day. A separate loop feeding a heat exchanger will provide heat rejection for a closed condenser water loop feeding computer room water cooled units on the office floors and the retail water cooled units.

The roof plant will also house the general exhaust fan, carpark exhaust fan (if required) and the wind turbine for the passive relief air.

Appendix A contains a schematic detailing the mechanical thermal plant equipment components.

Further investigations are required for the following mechanical plant areas:

- *Redundancy options for the Phase Change Material batteries*
- *Dehumidification controls for the displacement system with respect to maximising energy efficiency.*
- *Chiller and boiler requirements incorporating the use of a waste heat from the co-generation plant.*
- *Chiller configuration with respect to sizing, redundancy and energy efficiency*

4.6.2 Electrical

The schematic design currently includes a small scale Capstone gas micro turbine to generate on-site electricity – waste heat will also be captured for re-use.

This is an area currently under investigation with respect to power generation capacity and waste heat re-use potential.

4.6.3 Hydraulic

The approach to the hydraulic systems within the building has been to minimise the demand on both the cold and hot water supply by utilising flow limiting fittings, single flush toilets, waterless urinals and restricting hot water supply to basins within general toilets.

Investigations are currently being undertaken into the following hydraulic plant items:

<u>Black Water Treatment.</u>

A black water treatment plant is being considered to maximise the water recycling on the project. The treatment plant involves treating all waste water and reusing it for the flushing of toilets, façade washdown and landscape watering. The treated water is proposed to be stored on the roof in tanks.
Quantity of water available from the black water treatment and size of tanks required is still to be determined.

<u>Grey Water Treatment</u>

A grey water treatment is being considered in addition to the black water treatment plant. The grey treatment plant level of treatment is insufficient to recycle waste water from toilets and urinals. Reuse is similar to that of the black water treatment plant.
Quantity of water available and the size of the grey water treatment plant are yet to be determined.

Rain water collection

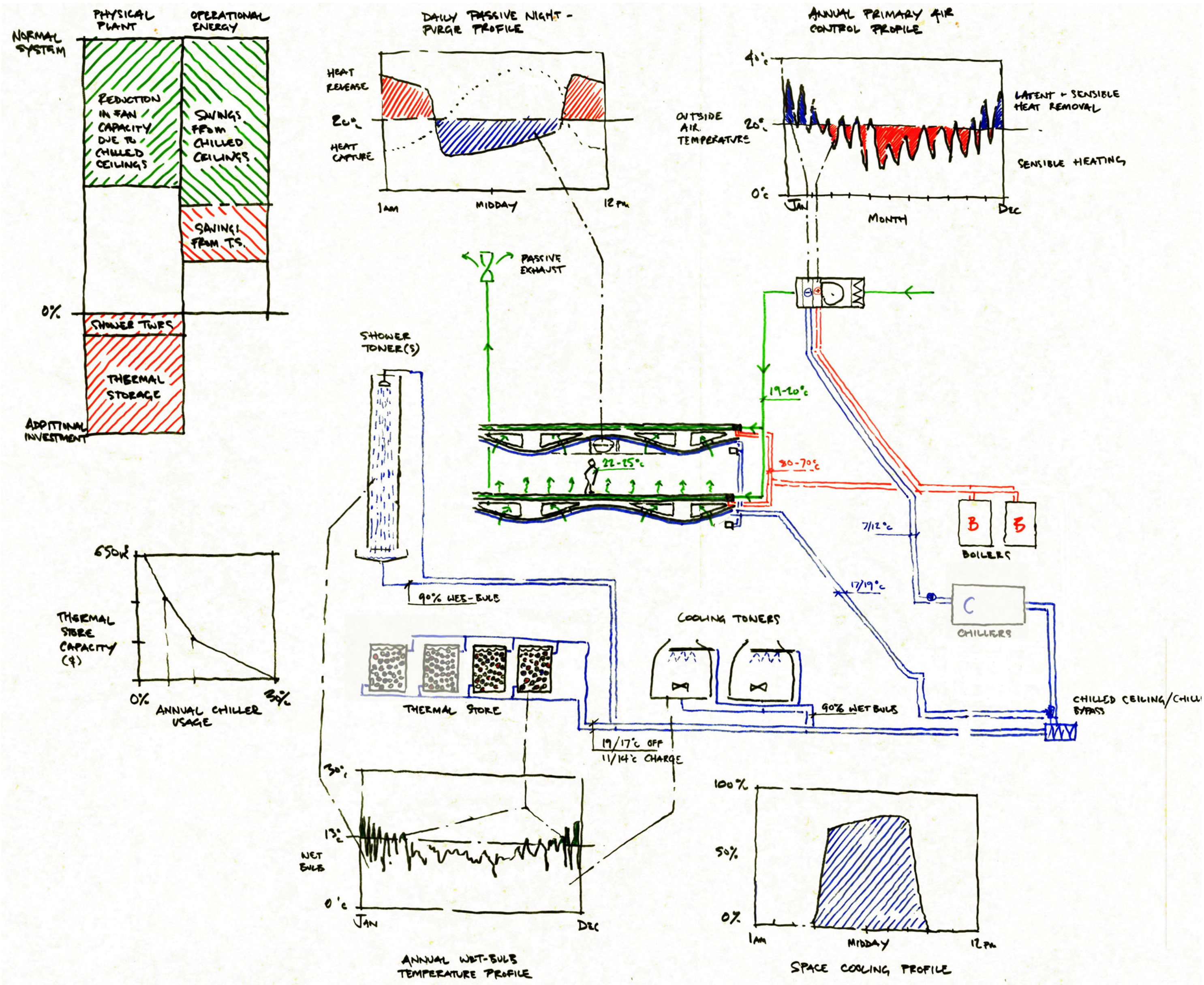
It is proposed to collect the rain water that lands on the roof for use in the cold water supply in the building.
Size of catchment areas and details of water treatment required to enable the water to be potable is yet to be determined.

Hot Water Generation Plant

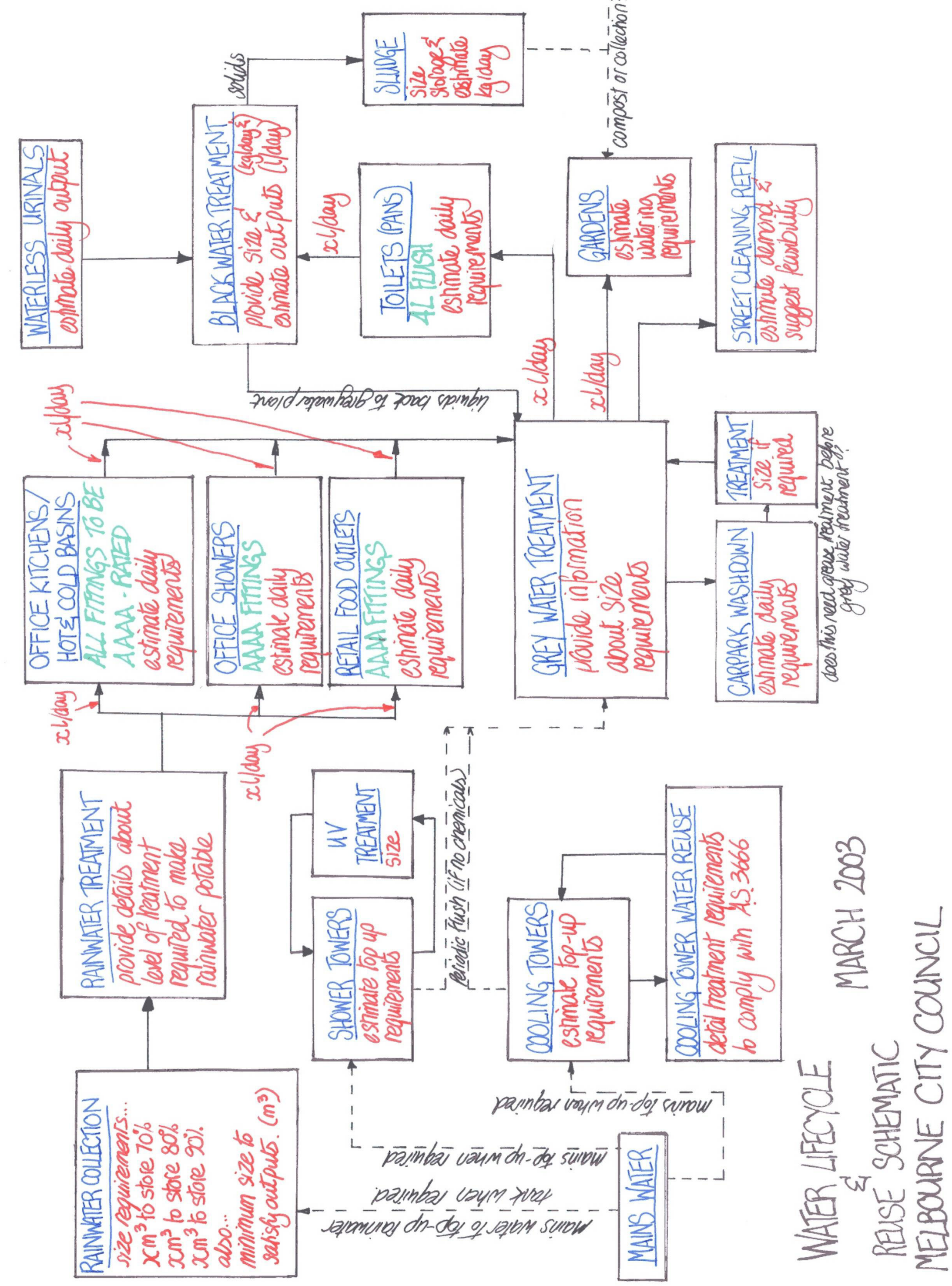
The current proposal is for the hot water to be generated at roof level by a solar boosted gas boiler.
Further investigations are to be undertaken into the use of waste heat from the co-generation plant with supplementary gas boosted solar boiler for hot water generation.

Appendix B contains a Water Lifecycle and Reuse schematic detailing water usage objectives outlined above.

APPENDIX A – CENTRAL THERMAL PLANT SCHEMATIC


PHYSICAL PLANT
OPERATIONAL ENERGY
NORMAL SYSTEM
REDUCTION IN FAN CAPACITY DUE TO CHILLED CEILINGS
SAVINGS FROM CHILLED CEILINGS
SAVINGS FROM TS
0%
SHOWER TWRS
THERMAL STORAGE
ADDITIONAL INVESTMENT
DAILY PASSIVE NIGHT - PURGE PROFILE
HEAT RELEASE
20°c
HEAT CAPTURE
1AM
MIDDAY
12PM
ANNUAL PRIMARY AIR CONTROL PROFILE
40°c
20°c
0°c
OUTSIDE AIR TEMPERATURE
LATENT + SENSIBLE HEAT REMOVAL
SENSIBLE HEATING
JAN
MONTH
DEC
PASSIVE EXHAUST
SHOWER TOWER(S)
19-20°c
22-25°c
30-70°c
7/12°c
17/19°c
BOILERS
CHILLERS
90% WET-BULB
COOLING TOWERS
THERMAL STORE
90% WET BULB
CHILLED CEILING/CHILLER BYPASS
19/17°c OFF
11/14°c CHARGE
THERMAL STORE CAPACITY ($)
650k
0%
ANNUAL CHILLER USAGE
35%
30°c
13°c
WET BULB
0°c
JAN
DEC
ANNUAL WET-BULB TEMPERATURE PROFILE
100%
50%
0%
1AM
MIDDAY
12PM
SPACE COOLING PROFILE

APPENDIX B – WATER LIFECYCLE & REUSE SCHEMATIC


WATERLESS URINALS
estimate daily output
BLACK WATER TREATMENT
provide size & estimate out puts (kg/day & l/day)
solids
SLUDGE
size storage & estimate kg/day
compost or collection?
TOILETS (PANS)
4L FLUSH
estimate daily requirements
x l/day
GARDENS
estimate watering requirements
STREET CLEANING REFIL
estimate demand & suggest feasibility
liquids back to greywater plant
x l/day
OFFICE KITCHENS/ HOT & COLD BASINS
ALL FITTINGS TO BE AAAA - RATED
estimate daily requirements
OFFICE SHOWERS
AAAA FITTINGS
estimate daily requirements
RETAIL FOOD OUTLETS
AAAA FITTINGS
estimate daily requirements
GREY WATER TREATMENT
provide information about size requirements
TREATMENT
size if required
CARPARK WASHDOWN
estimate daily requirements
does this need grease treatment before grey water treatment?
RAINWATER TREATMENT
provide details about level of treatment required to make rainwater potable
UV TREATMENT
size
SHOWER TOWERS
estimate top up requirements
periodic flush (if no chemicals)
COOLING TOWERS
estimate top-up requirements
COOLING TOWER WATER REUSE
detail treatment requirements to comply with A.S. 3666
RAINWATER COLLECTION
size requirements...
x m3 to store 70%
x m3 to store 80%
x m3 to store 90%
also...
minimum size to satisfy outputs. (m3)
MAINS WATER
mains water to top-up rainwater tank when required
mains top-up when required
mains top-up when required
WATER LIFECYCLE & REUSE SCHEMATIC
MELBOURNE CITY COUNCIL
MARCH 2003