k20 Architecture

Designing a 100+ year Community Building
Bayswater Early Years Hub

July 2019

100+ Year Life Cycle

The ability for a building to function and serve its users for 100+ years.

CONTENTS

THIS WHITE PAPER EXPLAINS THE PROCESS ADOPTED TO DESIGN A COMMUNITY BUILDING WITH A 100+ YEAR LIFE CYCLE.

1. INTRODUCTION: ADOPTING 3 PILLARS OF SUSTAINABILITY

From project inception the project adopted a sustainable approach based on meeting the needs of the present community without compromising the ability of future community generations to meet theirs. This is achieved by adopting the 3 pillars of sustainability on the project, being social, environmental and economic sustainability. These pillars were set as ESD benchmarks for the improvement of social interaction between people, protecting and sustaining the planet, and aiming for the project to achieve profit.

The design objectives of the project are summarised as follows:

- To establish a premium facility whereby the facility design is innovative and provides an opportunity to establish an enriching and open childhood education environment.
- The facility will serve as an attractor to participate in early years education services for some families whose area is traditionally under-represented in these services.
- Incorporate Environmentally Sustainable Design (ESD) principles in building design and construction to lower overall life-cycle and operating costs for the facility, particularly in terms of water and energy usage costs.
- Incorporates an open and flexible design that can successfully accommodate multi–uses and will enable Council to accommodate diverse functions and changing community needs over time.
- Incorporate Innovative Building Methodology including energy efficiency, accessibility and economic sustainability. In particular, consider construction methods and material that provide meaningful reductions in on-going life cycle maintenance and element renewal costs.
- The facility will set a new benchmark for a Community building as an environmentally, socially and economically sustainable project aimed at a 100+ year lifecycle with the ability to operate under its own power and water supply with reduced maintenance and operation costs.

This paper summaries the process that has been employed in the practice of building design and construction for the delivery of a 100+ Year Life Cycle Building.

The GBCA Green Star Design and As-Built V1.2 technical manual has been used to guide the design of the building as well as other ESD initiatives.

2. SITING FOR COMMUNITY USE AND INTERFACE

The following considerations were investigated and tested through multiple options to ascertain the most appropriate response for the site:

- Site context.
- Promote a welcoming community interface complimentary to neighborhood character.
- Consider the car parking requirement and interface to the site.
- Other considerations relate to the building form and its passive orientation to cross flow ventilation, the solar path, and access to natural light.
- Consideration to adjoining properties relating to fire risk and imposed form especially along abutting residential properties.
- Sun path, shadow diagrams, prevailing wind; connectivity to surrounding park, bowls club, adjacent school, church, residences, car parking.
- Crime prevention through Crime Prevention Through Environmental Design (CPTED).
- Massing of building form to suit existing site contours and features and compliment neighborhood character

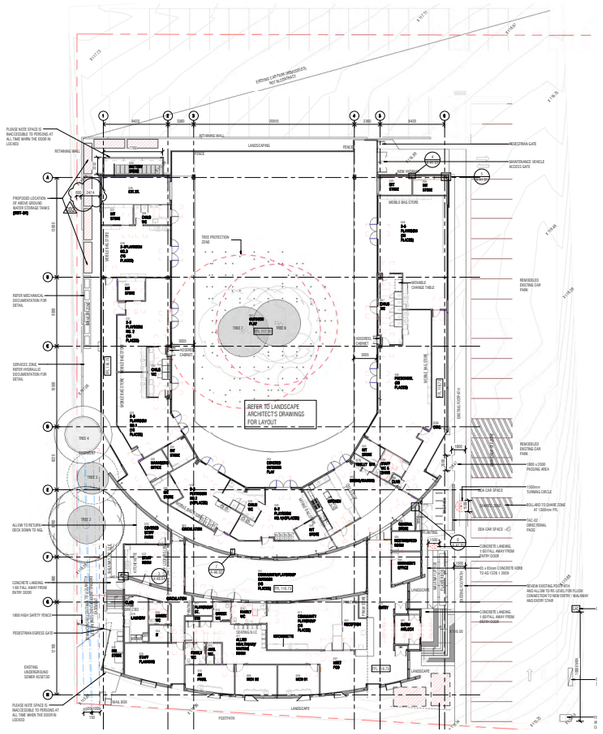
The adopted layout for the built form took the approach to place the proposed car park on the north end of the site to enable pedestrian access to the building with minimised cross overs between pedestrian and vehicular movement. This enabled the design to have a direct street presence and interface of the building to the streetscape providing a ‘Civic’ appearance. This solution also provided future opportunity for the car park to the rear of the building be reintegrated back into the surrounding park should the future outlook for persons attending the venue via transport no longer require ‘cars’ as such.

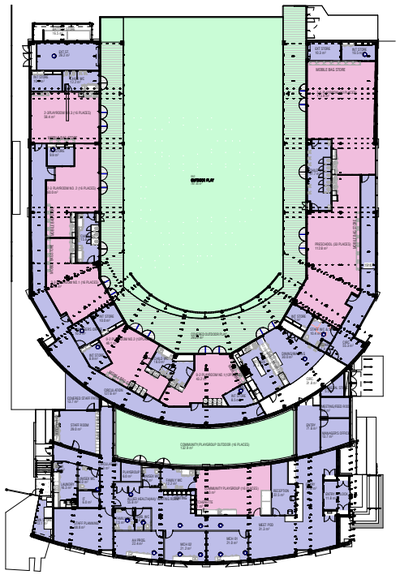
It was proposed to maintain a minimum three metre set back from the western property boundary abounding residential properties to serve a number of purposes:

A. Visual buffer to neighbouring properties
B. Provide a easily accessed service zone and ability for ease of safe maintenance/operation access, upgrade and replacement
C. Fire setback to minimise fire rating requirement
D. Provide a secure private staff access area

The siting of building masses considered existing social meeting points around the site with the ‘pause space’ located on the corner of the site being maintained and the community art fountain retained in location and the space further enhanced to continue promoting social interaction and community ownership. The building siting assists with strengthening the community links with surrounding areas including bowls club, guy turner reserve, promoting social interaction and harnesses the views across the valley towards Mount Dandenong. Siting assists with creating a safe place for people to meet.

A number of large existing trees on the subject site were also confirmed as significant items to be retained in the proposed new design and also influenced the design siting. 2no. large eucalyptus trees within the main outdoor play area have been incorporated into the design and their contribution to the overall outdoor landscaping is significant. Other mature native trees along the western boundary has also been retained and integrated into the breakout landscaping area for the facility providing a acoustic/visual break between adjoining properties and providing visual outlook for staff and children.





3. FUNCTION AND FORM

The entry point to the building was proposed to be located to the east side of the building to provide a clear entry point to the building and provide access to people approaching the building from the street, adjoining car park to the east, car parking to the north as well as allowing an entry point with a walkway connection to the accessible car parks. Entry identity is considered a very important feature of a community building for visitors to feel welcome.

To enable a flexible approach to future changes of layout and function, the main building structure and envelope has been designed to provide a structural span across the internal floor areas to provide structure free space void of columns. This provides for spaces which are flexible for ease of change as future needs may require with changing demographic and community over time. A service perimeter zone treatment has been run within the accessible ceiling area along the northern U-shape building to allow for ease of maintenance access and adaptation to future upgrades of services.

Function and form are interlinked in the design of the community spaces and also in consideration of ESD principles. The form of the building has been kept relatively shallow to allow for natural light to be maximised across the floor plate, minimising reliance on artificial lighting. The U-shaped form has also been purposefully adapted to provide for a community focused and open landscaped centre to promote visual connection across the spaces. This form also has an open aspect to the northern park land as part of the CPTED approach.

The east side of the building also promotes views out from the facility to further promote connectivity between the building occupants and the surrounding car park and adjoining bowls club facility. Visible linkages between other community facilities is considered important for promoting community linkages and strengthening the feeling of community connection.

Solar sun studies were undertaken on the computer 3D design model early in the design process to determine the shadowing to rooms and placement of windows as well as checking shadowing to roof areas for the placement of solar photovoltaics and other roof mounted equipment. The modelling of sun light was critical in determining a number of architectural building elements to control the use of solar energy for thermal benefit, natural light, and collection for energy.

The length of the subject site runs along a north-south axis, the curved U-form roof makes use of the northerly aspect of roof as well as the east and western side to assist with capturing sunlight as the sun traverses across the sky throughout the day. A second curved building form was also created to provide the additional space required by the proposed program. The program for this building at the time of the design is for an early years hub consisting of the following spaces:

- Community Playgroup: 16 places
- Preschool: 33 places
- Long Day Care: 105 places made up of following
  - Playroom 3-5 year old children
  - Playrooms 2-3 year old children
  - Playrooms 0-2 year old children
- Licensed Outdoor Areas for Long Day Care, Preschool and Playgroup
- Staff Planning room and Amenities Room
- Manager's offices
- Maternal Child Health Rooms
- Allied Health Program Room
- Commercial Laundry Facility
- Commercial Kitchen Facility
- Amenities, internal / external storage rooms

A total of 154 licensed places have been designed for the centre which include external play areas.

The overall site area utilisation consists of the following:

- Site Area: 4525 sq.m. (including car park at rear)
- Building Area: 1586 sq.m.
- Open Play Areas: 1210 sq.m.
- External landscaping and service area: 1729 sq.m. (incl. car parking)

A courtyard was introduced between the public multi-purpose areas building on the south and the U-shaped building to the north to provide additional access to natural light and integration of landscaping. The floor plates were designed to be reasonably narrow to allow natural sunlight to be maximised across the floor plate, minimising reliance on artificial lighting. The U-shaped form has also been purposefully adapted to provide for a community focused and open landscaped centre to promote visual connection across the spaces. This form also has an open aspect to the northern park land as part of the CPTED approach. The east side of the building also promotes views out from the facility to further promote connectivity between the building occupants and the surrounding car park and adjoining bowls club facility. Visible linkages between other community facilities is considered important for promoting community linkages and strengthening the feeling of community connection and safety.

4. SUSTAINABLE INITIATIVES & BENCHMARKS

The main goal for the project identified by the Client was to create a socially, economically and environmentally sustainable project with a 100+ year life cycle. This was approached with the following key ideas which were later further instilled into benchmarks for the project:

1. Functional and passive design;
2. Efficient Envelope and material consideration;
3. Energy efficient appliances, equipment, fixtures and fittings
4. Renewable energy with aim to run off grid
5. Reduced on going maintenance and operation costs

Some of the ESD initiatives implemented as benchmarks on the project are summarised as follows:

- Designed ESD systems which are *simple* for ease of use by occupants.
- Reuse or recycle 80% of all demolition and construction waste (by weight).
- Recycled brickwork and materials with recycled content
- Air tightness of the enclosed spaces was designed to achieve a minimum permeability rate of 2m³ per hour per metre squared @ 50 Pa.
- Reduced cement content concrete and zero cement for non-structural concrete.
- Thermally broken and insulated well above NCC compliance requirements to achieve minimum R6.0 roof insulation, floor slab and underside floor insulated to minimum R2.5.and wall insulation to minimum R5.0 for improved thermal comfort of occupants. Enables internal temperature range of 18-24 degrees with minimum mechanical assistance.
- The building has been designed to achieve optimum levels of natural daylight for building users.
- Paints, carpets and sealants selected which meet Green Star Design and As-Built requirements for low Volatile Organic Compound (VOC) content, to improve indoor air quality; paints selected for zero VOC content.
- Material selections generally were considered for their durability, suitability, low toxicity and which are Green Tag / EcoSpecifier certified or considered for the sustainable credentials and end life recyclability.
- External shading and internal blinds have been provided to reduce glare levels for building users and to meet the requirements of a children's centre.
- The lighting design has been undertaken to ensure that the building internal lighting is not too bright as defined by AS1680.1:2006.
- Engineered and composite wood products achieve Green Star Design and As- Built V1.2 low formaldehyde requirements.
- Landscaping designed for low maintenance, low water usage with natives indigenous to the site area.
- Indoor plants; hydration stations for indoor health and well being.
- Light weight structure with ability easily change the program of spaces internally as future change from the Community may require.
- Non-combustible cladding panels selected using Magnesium Oxide Board with zero cement content and designed with venting air space to improve thermal efficiency.
- Location of services centralised and where available kept on ground to aid with ongoing maintenance and service operation from outside of licensed children's areas.
- Services run in general perimeter to building to allow for ease of change and maintenance access over time.
- The building uses the principles of a Faraday Cage structure which minimizes the impact of electro-magnetic interference on communications and building management systems.
- The structural components of the building have been designed for a minimum lifecycle of 100 years, with all material elements of the building designed to significantly reduce maintenance and renewal costs.

<u>Mechanical</u>

- Cooling and heating with Multi Split Variable Refrigerant Volume (VRV) heat recovery for improved efficiency and to run from solar array.
- All teaching spaces opening to the outside installed with low tech reed switch shut down for air conditioning system in the event the doors are left open for more than five minutes to suit simple occupant operation.
- HVAC control by the battery management system designed to optimise energy demand in line with available solar and battery power. All heating of water for HVAC/Hot Water sourced from heat pump run from solar array.

- Heat recovery is used to meet and generally exceed the fresh air requirements of the building for improved indoor health of occupants.
- Heat exchange air to air providing excellent fresh air rates to base building. Air to be drawn out through bathrooms.
- Provide High-Efficiency Particulate Arrestance (HEPA) filter in HVAC system to remove pollen and dust.
- Interactive Information display to entry area of building displaying original objectives of building design purpose.

Electrical

- 99kW solar system is to be provided, taking up approximately 600m2 of roof space predicted to be producing 135,000 kWh of energy per year.
- Battery Storage: 160kWh of battery storage to be provided consisting of 16 times 10kWh Redflow ZBM batteries, allowing for the building to run off grid.
- All lighting is LED luminaires with a minimum 70 lumens per watt, CRI of > 0.8, and a Power Factor of > 0.9; lighting systems have motion/occupancy sensors and/or timers
- Circadian Lighting used in children's 0-2 rooms to assist with sleep rhythms.
- Water meters installed for mains water supply, rainwater tank supply, and rainwater make up.
- Electrical sub-metering connected to the Interactive Information Display is provided for each major energy end use of the building including:
  1. The Mechanical Systems;
  2. Hot water;
  3. External lighting;
  4. Lighting circuits in each major section of the building;
  5. Power circuits in each major section of the building;
  6. Water reuse systems;
  7. Kitchen plant and equipment,
  8. Laundry, etc.;
  9. Solar and energy storage equipment.

Hydraulic

- All sanitary ware and fittings selected for most efficient WELS rating.
- All heating of water for HVAC/Hot Water sourced from heat pump run from solar array.
- Heat recovery is used to meet and generally exceed the fresh air requirements of the building for improved indoor health of occupants.
- Rain tank Volume =100,000L connected to 100% of roof to maximise collection. Expected up to 1 million litres annually will be harvested and stored for use in the facility.
- Rainwater connected to all toilets, laundry, and external perimeter irrigation taps.
- Commissioning, tuning and handover.
- A comprehensive commissioning and handover program in accordance for Green Star Compliance Requirements;
- AIRAH DA27 Building Commissioning 2011; AIRAH DA28 Building Management and Control Systems (BMCS) 2011; CIBSE Commissioning Code M (and the ancillary codes for relevant services); ASHRAE Commissioning Guideline 1.1-2007 (for mechanical services); BSRIA Soft Landings Framework.

Transport

- Secure bicycle parking for regular occupants is provided for 7.5% of total regular occupants, with associated end-of-trip facilities. Bicycle parking spaces provided to encourage cycling to and from the building by staff. Staff are provided with showers and lockers.
- Secure bicycle parking for visitors is provided for 5% of peak adult visitors.

Operational Waste

- A dedicated storage area for the separation and collection of recyclables has been provided to allow cardboard, glass, plastics, metals and compost material to be more easily recycled by building users.

Emissions

- Ozone friendly and low GWP chemicals used in the air conditioning systems in the building.
- The external lighting of the building has been installed to reduce light pollution of the night sky. Upwards light ratio of any outdoor lighting must be less than 5%. Lights must not shine over the project boundary and comply with AS 4282:1997 Control of the Obtrusive Effects of Outdoor Lighting.
- Facilities maintenance shall also include:
  1. Training of building users and facilities manager.
  2. The contractor has provided comprehensive training of building staff and facilities management personnel.
  3. This training was extremely important in terms of the following considerations:
  4. Optimisation of controls' set points, programming, alarms and troubleshooting;
  5. Building operation (start-up, normal operation, unoccupied operation, seasonal changeover and shut down);
  6. Interactions between systems;
  7. Optimising energy efficiency;
  8. OS&S issues;
  9. Maintenance requirements and sourcing replacements;
  10. Occupant satisfaction feedback.

Optimisation of the above ensures the highest tenant satisfaction levels.

5. MONITORING

To maintain the operation of the building at optimal efficiency requires the maintenance and operations team with Council to monitor the buildings and provide tuning over the building’s life. The monitoring commenced at project completion and from the early results the building appears to be running efficiently with the batteries operating in line with the modelling completed as part of the design process.

The simple integration of smart technology allows for the remote monitoring of water usage, electrical usage, metering, battery storage efficiency and solar generation.

Importantly the building operation information is on electronic display throughout the Hub to allow users to see their usage, storage, etc. and provides knowledge to all who visit the Hub. Their are main displays in the foyer which also double as a means to keep the Community visitors informed to community events and other programs offered by the facility.

Awareness of our impact on social, economical and environmental aspects of our buildings and facilities allow the users to take pride and ownership in their actions and encourages thoughtful use of facilities, assisting in the continued ability to achieve the 100+ year life cycle in the building.

6. CONCLUSION: BUILDING FOR THE FUTURE

This paper outlines an approach to achieving a 100+ Life Cycle in a building, the methodology used identifies that there are several key factors to achieving this output which include:

- Clear benchmarks to establish approach;
- Considered approach to siting;
- A need for flexibility of space that can adapt to future needs of the community;
- Thorough understanding of ESD principles and technical knowledge for implementation into building design.

It is acknowledged 100 + Year Life Cycle goal requires the ongoing commitment from the building users and facility managers to achieve the initiatives identified as benchmarks for the project.

k20 Architecture

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