STACKED NEIGHBOURHOOD

65-67 Waverley Rd, Malvern East 3145

CRC 4.6

CONCEPT

A stacked neighbourhood that is designed to promote wellbeing of the community through social interactions and connection with nature. The top floor shares a communal area for laundry, community grown garden and deck accessible from all buildings to promote interactions. Creating a sense of community is also not limited to the residents as the ground floor becomes a public space for small shops and workshop areas for the community to build connections.

This neighbourhood is approached from a modularity standpoint, where each module is prefabricated and connected by loose fit framing to achieve the concept of agile architecture. The focus on sustainability is evident in the design as we implement passive house design principles and effective ventilation to achieve energy efficiency. The incorporation of green communal services, water tanks and other renewable energy sources allow it to be economical in the long term.

PASSIVE HOUSE

As shown in the diagram below, the apartment design incorporates Passive House principles, which includes high performing windows, great ventilation for indoor air quality, thermal insulation and air tight construction. Along with these elements, we are also including a rainwater storage system and permeable pavings to reduce stormwater runoff.

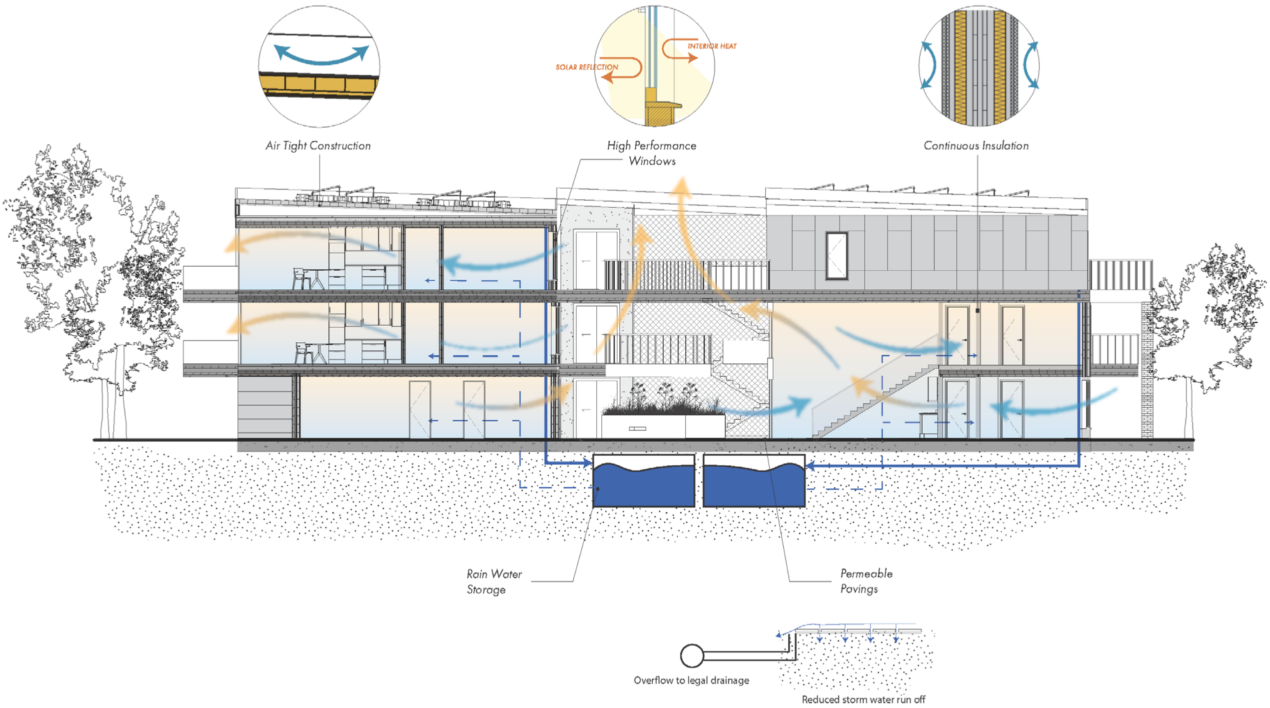
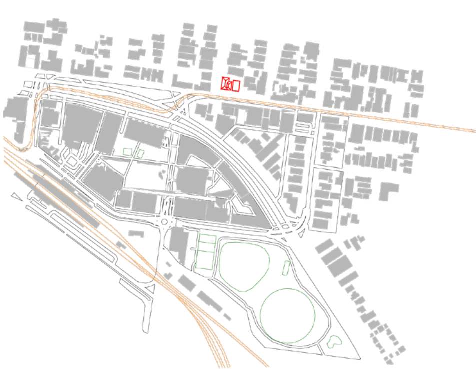


Figure 1: Passive House Diragram

SITE CONTEXT



Transportation

The site located on the tram line street with another train station neaarby, making it accessible

Urban Mixed Use

It is a highly active area as there are shops nearby, which serves the local community.

Sun Path

The smaller access road is lined with trees to the west and there is an existing tree line to the north of the property as well.

MATERIAL SUSTAINABILITY - LIFE CYCLE

Cross Laminated Timber (Clt)

We chose to use CLT as it is a greener material alternative to concrete. It generates less CO_2 emissions and consumes less fossil fuels during manufacture, transport and construction.

CLT can be upcycled and reuse as a primary structure for a new construction, or it could be downcycled and used for furniture and other wood particle products.

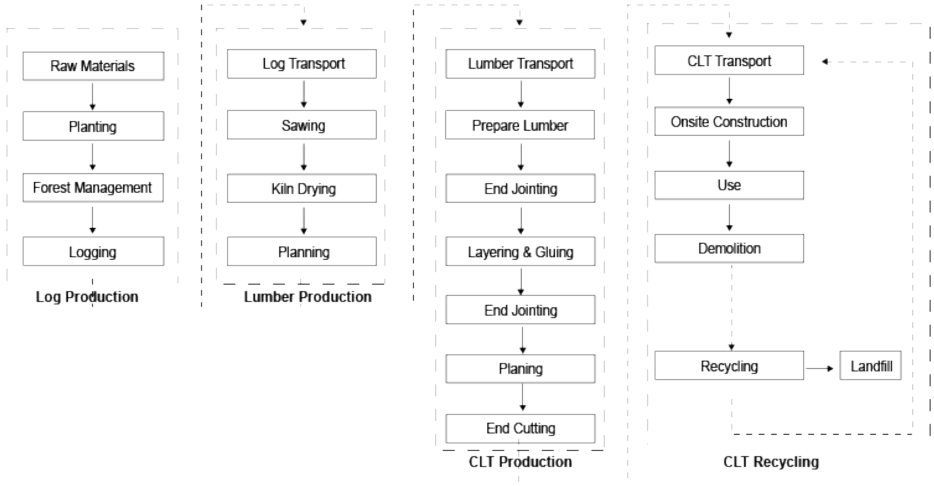


Figure 2: Life Cycle Diagram of CLT

Fiber Cement Board

Fiber Cement Cladding is made out of sustainable materials - cement, sand and cellulose - which does not cause any serious ecological impact unlike other wood cladding that damages forestry. It can be reused for acoustic panelling, decorative finishes and packing material.

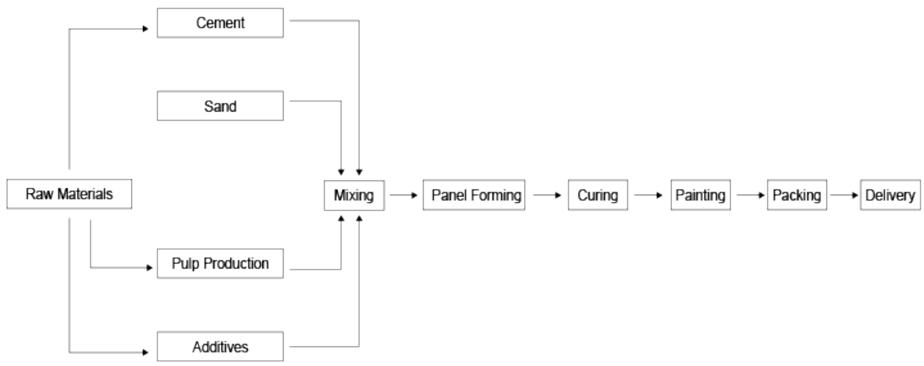
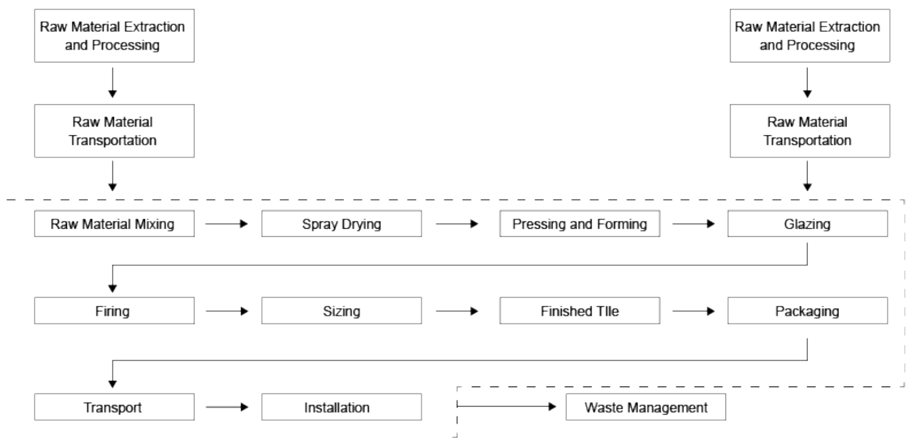


Figure 3: Life Cycle Diagram of Fiber Cement Board

Ceramic Tile

We chose to use ceramic tile for the bathrooms for its water and mould resistance. It is also low maintenance and does not release any harmful volatile compunds in the atmosphere. Ceramic tiles can be recycled into other materials without any chemicals required. It can be crushed and utilised as landscaping aggregate, road base and bedding sand.



Fuigure 4 Life Cycle Diagram of Ceramic Tile

Bamboo Floor

Bamboo comes from a renewable resource as it only takes 3-5 years for bamboo trees to mature. It is extremely durable and can last a long time since it can be refinished overtime to restore its life. Bamboo floors can be reused by turning it into a mulch to create a new set of floors.

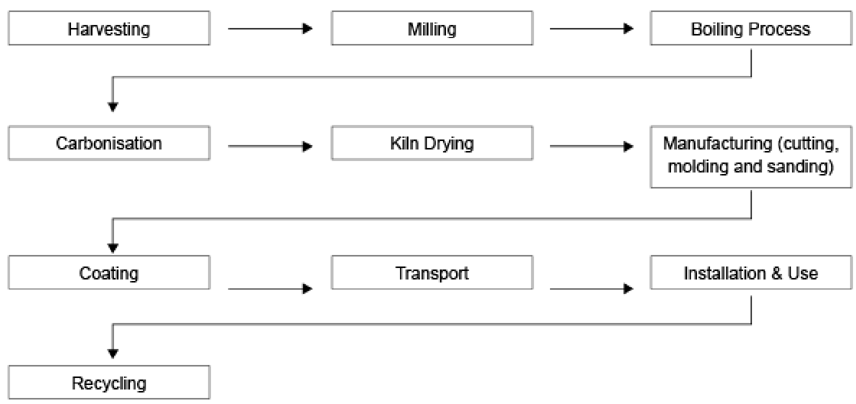


Figure 5: Life Cycle Diagram of Bamboo Floor

MATERIAL SUSTAINABILITY - LOW CARBON MATERIAL (LCM)

1 Bed 1 Bath (4 units)

Materials	Total Unit	Embodied Carbon (kgCO2e)	Total Embodied Carbon Per Unit
Fiber Cement (Exterior)	57.3 m2	10.2	584.46
CLT (Walls)	57.3 m3	67.7	3879.21
Gypsum Plaster	26.76 m2	5.8	155.208
Curtainwall (Double Glazed)	11.42 m2	101	1153.42
Tiles	121.75 kg	1.3	158.275
TOTAL			5772.298

2 Bed 1 Bath 2 Storey (2 units)

Materials	Total Unit	Embodied Carbon (kgCO2e)	Total Embodied Carbon Per Unit
Fiber Cement (Exterior)	110.409 m2	10.2	1126.1718
CLT (Walls)	110.409 m3	67.7	7474.69
Gypsum Plaster	41.9 m2	5.8	243.02
Curtainwall (Double Glazed)	11.46 m2	101	1157.46
Tiles	121.75 kg	1.3	158.275
TOTAL			10001.3411

2 Bed 2 Bath (2 units)

Materials	Total Unit	Embodied Carbon (kgCO2e)	Total Embodied Carbon Per Unit
Fiber Cement (Exterior)	115.6 m2	10.2	1179.12
CLT (Walls)	115.6 m3	67.7	7826.12
Gypsum Plaster	26.76 m2	5.8	154.28
Curtainwall (Double Glazed)	11.46 m2	101	1157.46
Tiles	243.5 kg	1.3	316.55
TOTAL			10633.53

2 Bed 1 Bath 1 Storey (2 units)

Materials	Total Unit	Embodied Carbon (kgCO2e)	Total Embodied Carbon Per Unit
Fiber Cement (Exterior)	70.303 m2	10.2	717.09
CLT (Walls)	70.303 m3	67.7	4759.51
Gypsum Plaster	36.606 m2	5.8	212.31
Curtainwall (Double Glazed)	13 m2	101	1313
Tiles	121.75 kg	1.3	158.275
TOTAL			7160.19

3 Bed 2 Bath (2 units)

Materials	Total Unit	Embodied Carbon (kgCO2e)	Total Embodied Carbon Per Unit
Fiber Cement (Exterior	74.784 m2	10.2	762.79
CLT (Walls)	74.784 m3	67.7	5062.87
Gypsum Plaster	31.35 m2	5.8	181.83
Curtainwall (Double Glazed SC Low-E Clear)	11.78 m2	101	1189.78
Tiles	243.5 kg	1.3	316.55
TOTAL			7513.83

Total Embodied Carbon of the Project

Materials	Total Embodied Carbon Per Unit
Fiber Cement (Exterior Cladding)	9908.19
CLT (Walls)	65763.24
Gypsum Plaster	2203.72
Curtainwall (Double Glazed SC Low-E Clear)	14249.08
Tiles	2532.4
TOTAL	94656.64

INNOVATION IN FABRICATION

Parts and Variations

The 'kits of part' building system of the project is designed as panels, beams and posts and prefab modules which allows the components to be disassembled and replaced. The walls are made of CLT panels with Fibre Cement Sheet cladding on the outer layer while we implement the prefabricated bathroom and kitchen services to fit right in. The panels, beams, and posts system also allow more flexibility in expansion both vertically and horizontally without being restricted to a certain size. Both the material and the system allows for a circular system of use, reuse and recycle over the lifespan of the building and minimising waste. In each unit there are panels, beams and posts and prefab modules which allows the components to be disassembled and replaced. The system also allows more flexibility in expansion both vertically and horizontally without being restricted to a certain size.

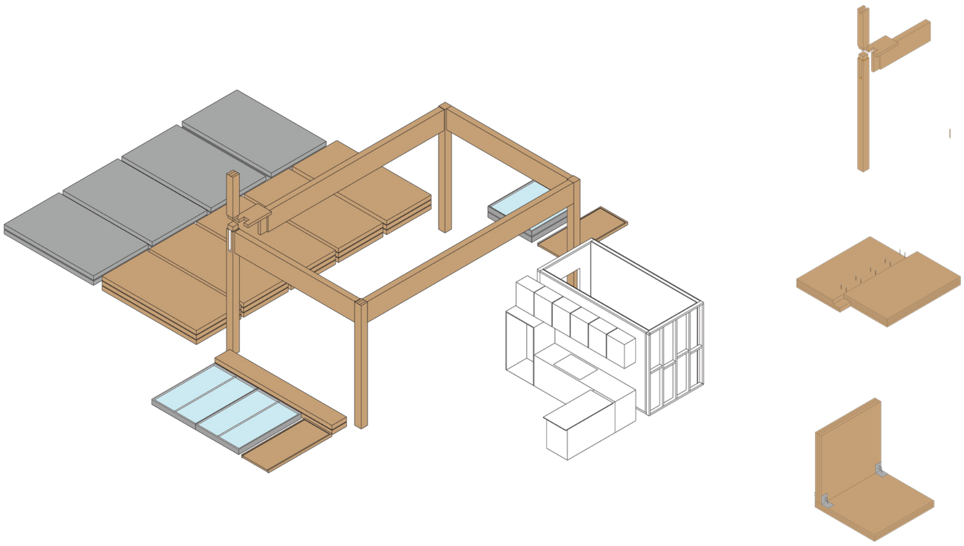


Figure 6: Kit of Parts and Connections Diagram

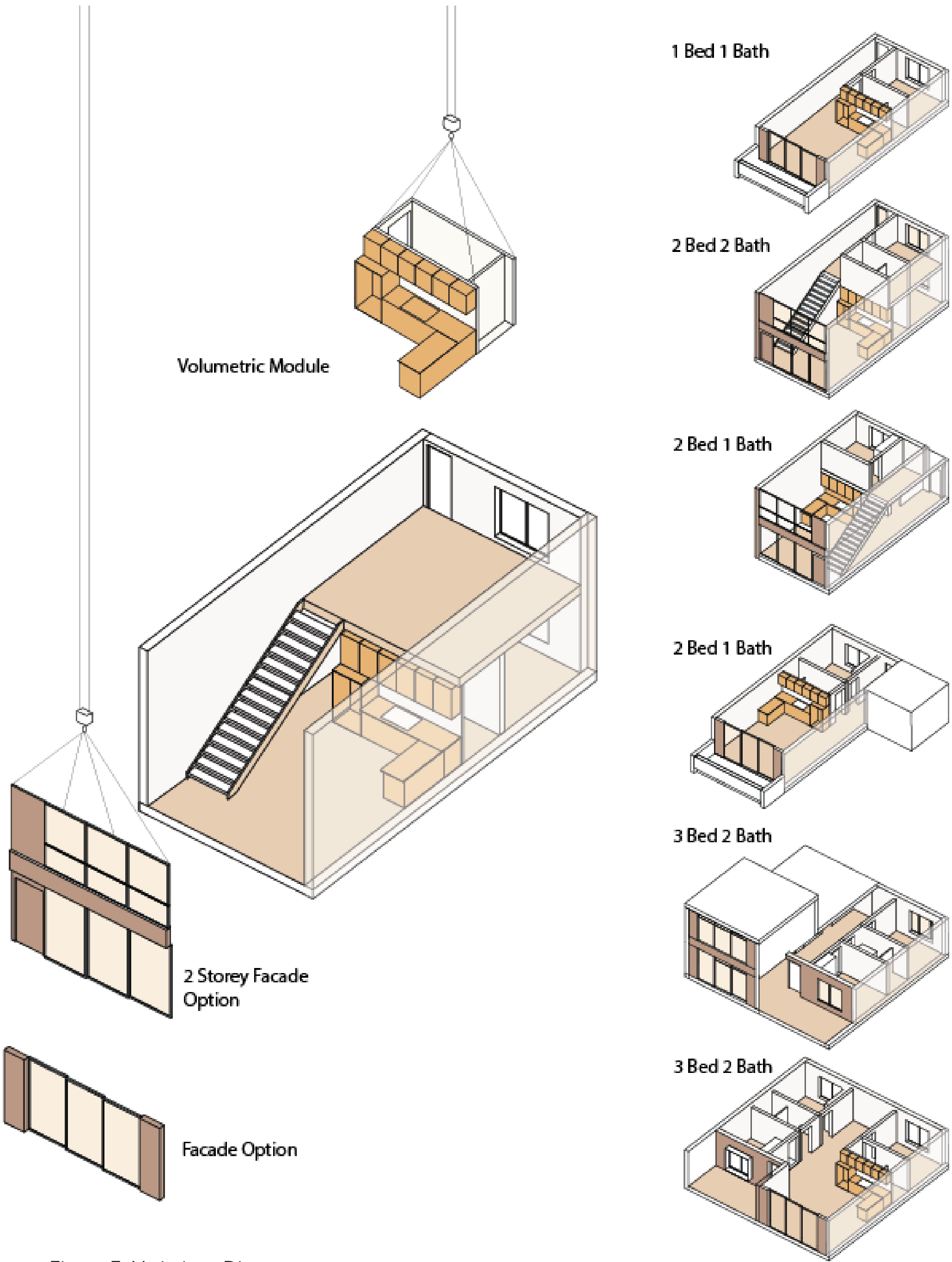


Figure 7: Variations Diagram

SOCIAL CONTEXT

48.8%
Male

51.2%
Female

21,923
Population

5,595
Families

9,793
Private Dwellings

$2,386
Average Weekly Income

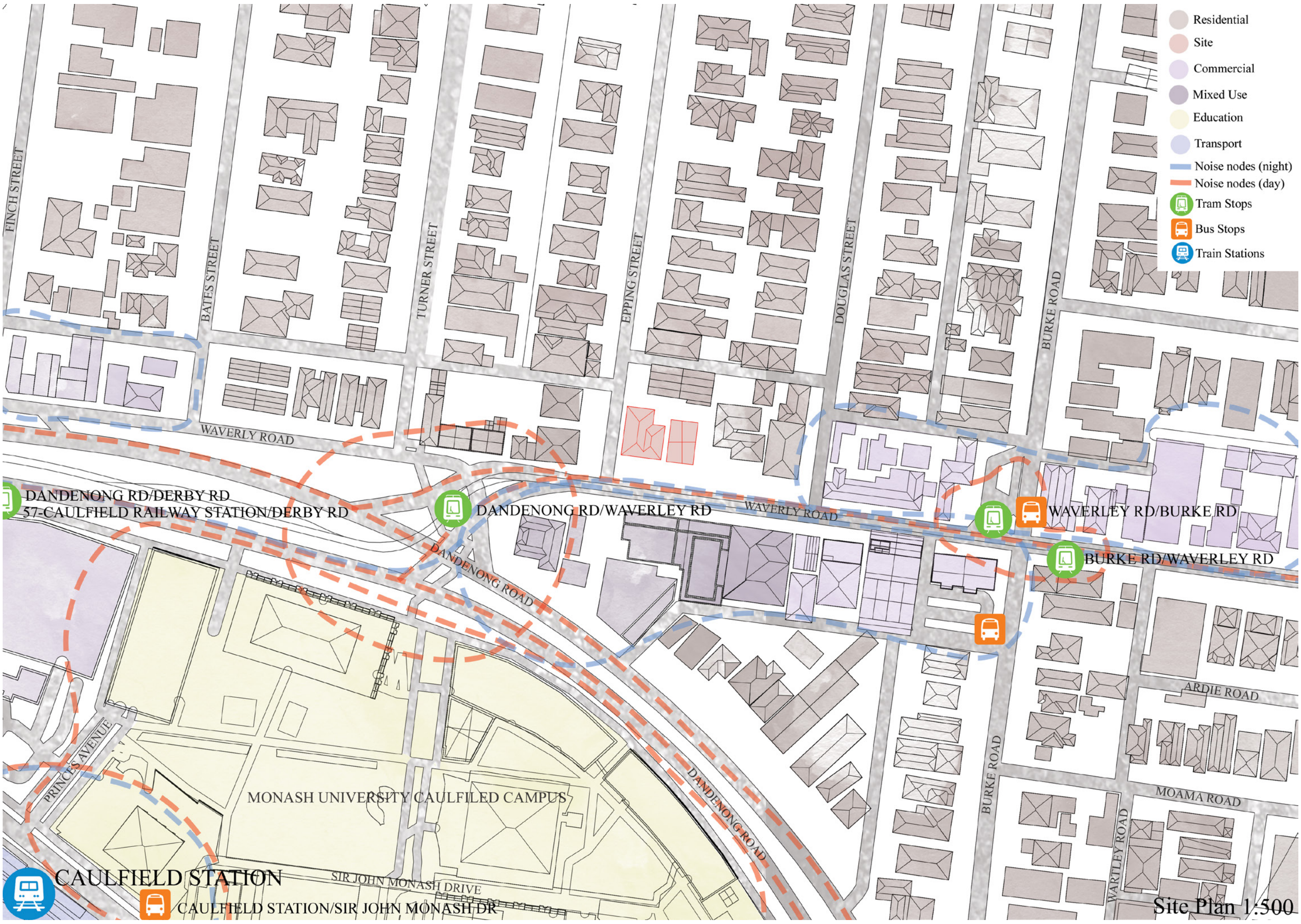


Figure 8: Site Map

As highlighted in orange in the site map, the project is located in Malvern East, a suburb in south-east Melbourne with a population of 21,923. Residents tend to be relatively affluent and highly educated, with a mix of professionals, business owners, and families. The suburb offers plenty of amenities to its residents nearby including educational facilites such as Caulfield Grammar School and Monash University.

The local shopping scene in Malvern East can be found in Waverley Road, which offers a variety of shops, cafes, restaurants, and boutique stores. This gives the future residents of the apartment project many benefits as it is also located on Waverly Road. Additionally, the area also benefits from its proximity to Chadstone Shopping Centre, one of the largest shopping centers in the Southern Hemisphere.

STRUCTURAL

Structual and Load Forces

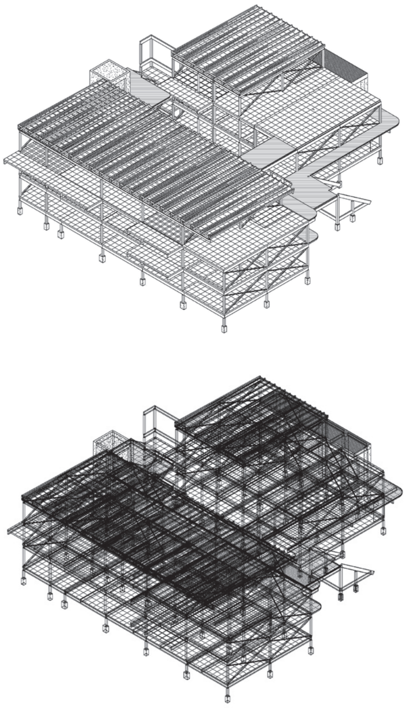


Figure 9: Structural Drawings

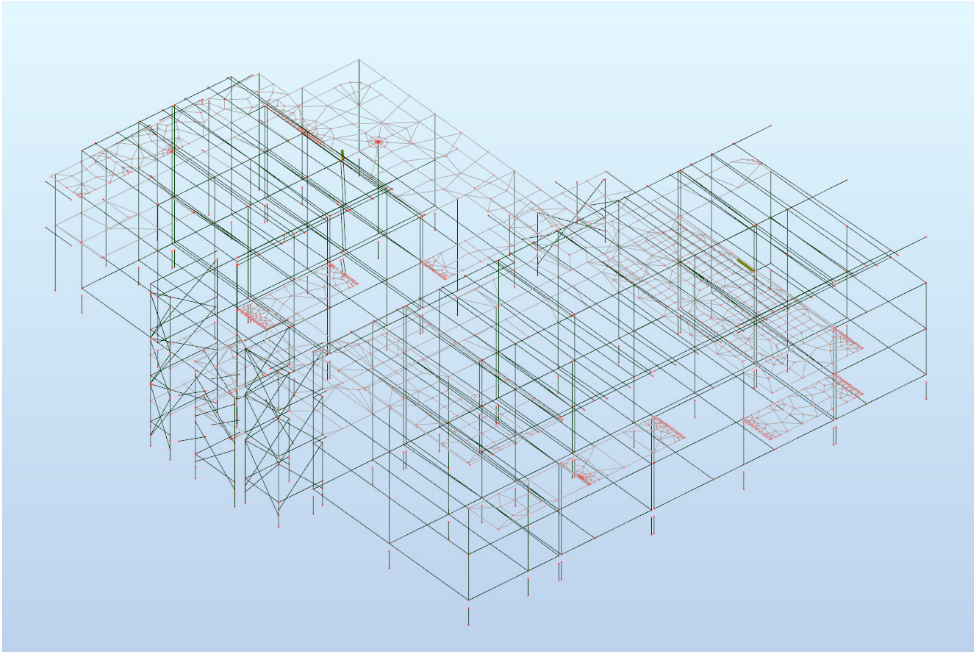


Figure 10: Structural and Load Forces Diagram

Calculations

Load on the floor: 31.5 kN/m²
Span of the floor: 3-6 m
Live load factor: 4.0
Dead load factor: 1.0
CLT Floor Panel strength: 11.8 MPa
Thickness of CLT panel: 200 mm
Cover to reinforcement: 30 mm
Calculate the total design load on the floor:
Design load = Load on the floor x Live load factor +
Self weight of the floor x Dead load factor
= 31.5 x 4 +73.2 x 1
= 199.2 kN/m²

Calculate the bending moment due to the design load:
Bending moment = (Design load x Span²) / 8
= (199.2 x 3²) / 8
= 224.1kNm

Calculate the effective depth of the slab:
Effective depth = Total depth - Cover to reinforcement - Thickness of mortar joints
= 200 - 30 - 10
= 160 mm

COLUMN LAYUP DESIGNATIONS AND DESIGN STRESSES[1] (pounds per square inch – psi)										
	E AXIAL X 10^6	E MIN X10^6	COMPRESSION PERP	F_T [2]	F_C AXIAL[3]	F_{BX} [4]	F_{VX}	F_{BY}	F_{VY}	SPECIFIC GRAVITY
L2 - DF	1.7	0.85	560	1,250	1,950	1,700	265	1,800	230	0.5

1. *Allowables shown for prismatic beams and columns with loads applied along the specified axis.*
2. *F_T shown for two or more laminations.*
3. *F_C shown for four or more laminations only.*
4. *F_{BX} shown for two laminations and up to 15" deep. For depths greater than 15" the F_{BX} factor is to be multiplied by 0.88.*

Allowables to be modified according to the 2018 National Design Specification for Wood Construction.

GLULAMPLUS® COLUMN LOAD CAPACITY

L2 DF column design allowables - Eccentricity = 1/6 D or W

COLUMN DIMENSIONS (W)x(D)	LOAD DURATION FACTORS	COLUMN LENGTH IN MILLIMETER 3048
213.5mm x 222.5mm	1.15	74700

L2 DF column design allowables - Eccentricity = 1/2 D or W - load applied to face of column

COLUMN DIMENSIONS (W)x(D)	LOAD DURATION FACTORS	COLUMN LENGTH MILLIMETER 3048
213.5mm x 222.5mm	1.15	37900

GLULAMPLUS® BEAM ENGINEERING PROPERTIES

	171.5mm BEAM WIDTH
DEPTH (mm)	610
WEIGHT (#/ft)	39.0
AREA (mm²)	1.03×10^5
S (mm³)	1.03×10^7
I (mm⁴)	3.13×10^9
EI x 10^6 (psi)	13564
MOMENT CAPACITY (ft #)	109382
SHEAR CAPACITY (#)	28322

Figure 11: Column and Beam Schedule

We opted to utilise CLT columns because they are sustainable, easy to cut to size and attached together using bolts instead of glue. Thus, in response to the brief's agility requirement, that means in the long term, we have the flexibility to rearrange the elements into different configurations in order to create something new.

MEP SERVICES

Exploded Axo of Services

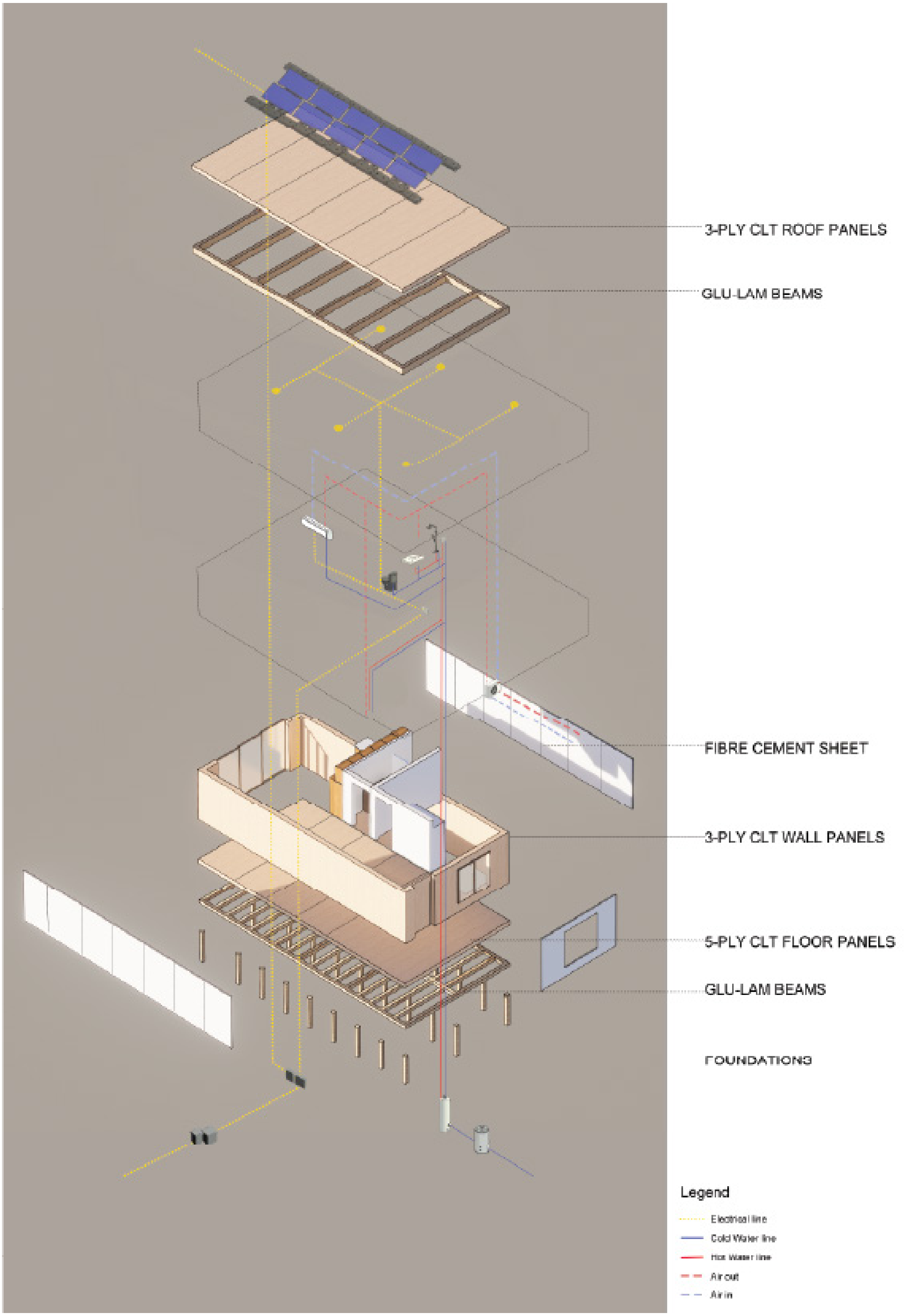


Figure 12: Exploded Axo of one unit including services

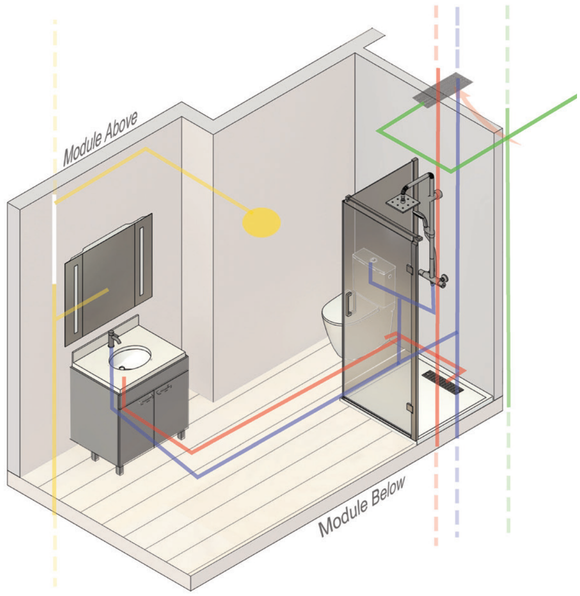


Figure 13: Bathroom Services Axo

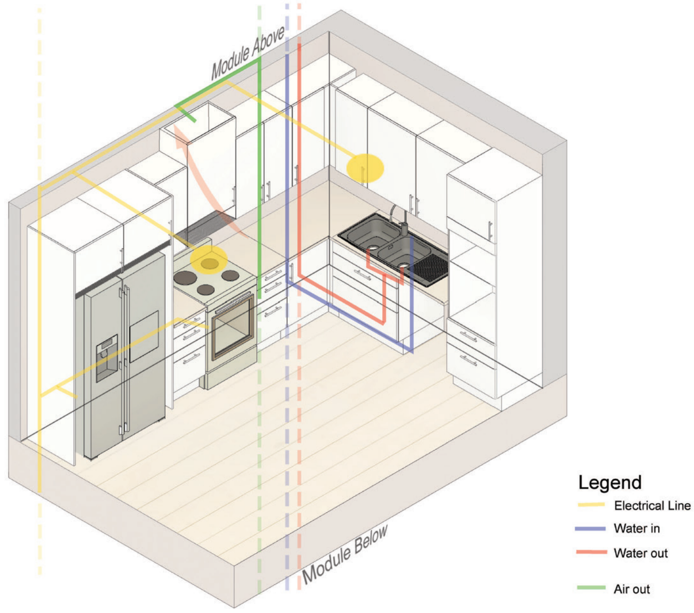


Figure 14: Kitchen Services Axo

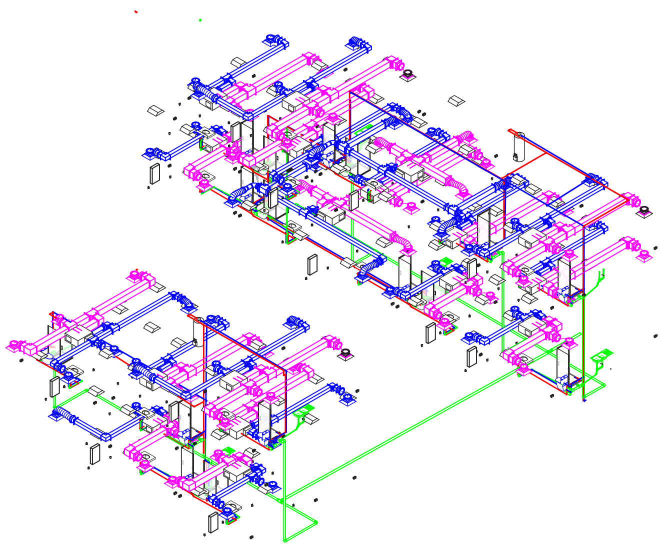


Figure 15: MEP Drawing

The services are shown to connect vertically to the unit above or below with the same riser and also connected to the kitchen pipe and sinks in one central location for efficiency. This also allows us to use prefab services for this apartment as they are the same size and within the same location of the apartment.

The project utilises a solar powered hot water system and electrical system in order to be more energy efficient. Each unit also has central air conditioning which connects to the riser. All services can be accessed via the roof for spatial efficiency and convinience.

TIMELINE

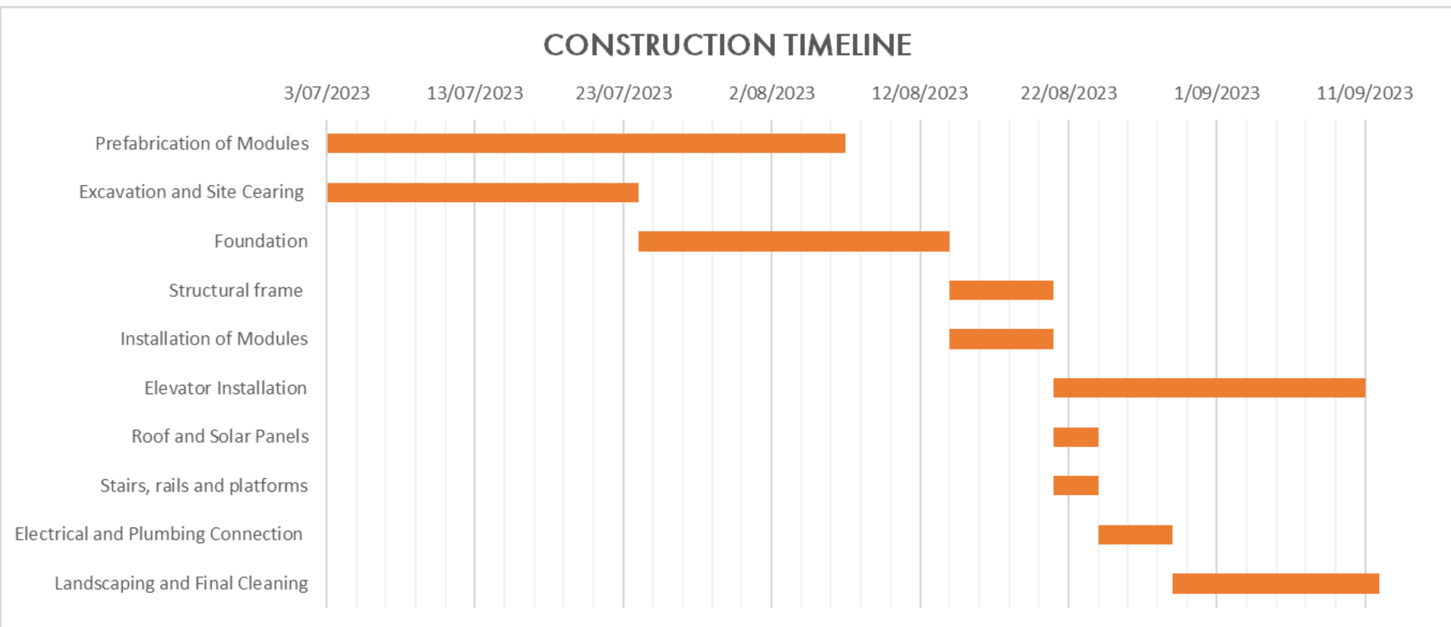


Figure 16: Construction Timeline

BUDGET

LABOUR COST BREAKDOWN

ONE BATHROOM INSTALLATION

Task	days	hrs	wage	labour cost
plumbing	2	16	$73.75	$1,180.00
electrical fitting	2	16	$72.75	$1,164.00
plaster	3	24	$45.00	$1,080.00
tiling and waterproofing	2	16	$97.50	$1,560.00
cabinet, shower, sink	3	24	$73.75	$1,770.00
TOTAL				$6,754.00

ONE KITCHEN INSTALLATION

Task	days	hrs	wage	labour cost
plumbing - outlets	1	8	$73.75	$590.00
electrical - outlets	1	8	$72.75	$582.00
installing the module	3	24	$61.00	$1,464.00
fitting new services - plumbing	44928	4	$73.75	$295.00
fitting new services - electric	44928	4	$72.75	$291.00
TOTAL				$3,222.00

SERVICE MODULES, CLADDING & STRUCTURE

per unit	1b1b	2b1b 1 storey	2b1b 2 storey	2b2b 2storey	3b2b 1 storey	TOTAL
bathroom module	$6,164.00	$6,164.00	$6,164.00	$12,328.00	$12,328.00	$43,148.00
kitchen module	$3,222.00	$3,222.00	$3,222.00	$3,222.00	$3,222.00	$16,110.00
plasterboard	$789.42	$1,079.87	$1,236.96	$786.68	$1,049.29	$4,152.80
AS A WHOLE						
cladding						$12,973.00
structural components						$54,240.00
TOTAL						$130,623.80

ONE UNIT MODULE

Skill	days	hrs	wage	1 person fee	no. of people	labour cost
Carpenter	2	16	$61.00	$976.00	5	$4,880.00
crane operator	2	16	$43.00	$688.00	1	$688.00
TOTAL						$5,568.00

12 UNITS

labour cost per unit	$5,568.00
number of units	12
TOTAL	$66,816.00

MATERIAL COST BREAKDOWN

KITCHEN

Items	qty	cost	total
Module	12	$700	$8,400.00
sinks	12	$319.45	$3,833.40
Stove	12	$1,016.00	$12,192.00
RangeHood	12	$132.00	$1,584.00
TOTAL			$26,009.40

BATHROOM

Items	qty	cost	total
showerheads	16	$50.00	$800.00
sinks	16	$300.00	$4,800.00
vanity	16	$327.00	$5,232.00
toilet	16	$290.00	$4,640.00
showerscreen	16	$275.00	$4,400.00
showerbase	16	$149.00	$2,384.00
TOTAL			$22,256.00

STRUCTURAL

item	qty	Cost	total
100x100x10 (3000) L Beam	14	$328.53	$4,599.42
100x100x10 (3600) L Beam	22	$657.06	$14,455.32
100x100x10 (2400) L Beam	8	$262.82	$2,102.56
PFC	28	$482.06	$13,497.68
SHS	4	$369.36	$1,477.44
Metal Grates	38	$700.00	$26,600.00
Glulam (336x110x3500)	101	$693.00	$69,993.00
Glulam (336x110x2000)	68	$396.00	$26,928.00
Glulam (336x110x5700)	44	$1,128.60	$49,658.40
Glulam Beam	160	$299.20	$47,872.00
TOTAL			$257,183.82

TOTAL LABOUR COST

Labour	Cost
All Unit - carpentry and crane operator	$66,816.00
All bathrooms	$43,148.00
All kitchen	$16,110.00
Structural and module installation	$59,258.00
FCS installation	$12,973.70
Bamboo Flooring	$51,037.00
Fixed GlazingUnfixed Glazing	$294,912.00
Bricks	$6,448.00
Ground slab	$130,764.78
Foundation	$573,688.00
Electrical	$163,200.00
Plumbing - Laundry	$1,260.00
Plumbing - Electric Hot Water (315L)	$1,850.00
Lift Installation & Transportation	$105,000.00
TOTAL	$1,526,465.48

TOTAL SITE PREPARATION COST

Description	Unit	Rate	Column2	Total
Preliminaries / Site Preparations				
Temporary Fencing	m	10.45	70	$731.50
Site Clearing	item	960.53	1	$960.53
Substructure				
Geotechnical Report	item	1750	1	$1,750.00
Level and Compaction	m2	3.35	919	$3,078.65
Ground slab	m2	107.95	535	$57,753.25
Finishing works				
Landscaping	m2	112.49	1226	$137,887.99
TOTAL				$202,161.92

TOTAL MATERIAL COST

ALL MODULE COMPONENTS	$729,110.54
STRUCTURAL	$257,183.82
BATHROOM MODULE	$22,256.00
KITCHEN MODULE	$26,009.40
TOTAL	$1,034,559.76

TOTAL COST OF THE PROJECT

Material Cost	$1,034,559.76
Labour Cost	$1,526,465.48
Permit Application Fees	$724.00
Transport	$213.40
Site Clearing	$202,161.92
TOTAL	$2,764,124.56

COST OF A TRADITIONAL BUILDING

Construction Cost per unit	$250,000 - $300,000
No. of Units	12
TOTAL	$3,000,000 to $3,600,000

Soure: https://www.localsearch.com.au/guides/builders/how-much-does-it-cost-to-build-a-unit-in-australia

In comparison to a 12-unit traditional apartment, the construction cost of the prefabricated 3-storey apartment complex with the same number of units will cost cheaper. This is because less labour is required as the individual units are transported to the lacation as a prefab module instead of individually building it on site. In addition to that, the materials utilised such as CLT, fiber cement sheets as well as the kitchen and bathroom modules are also prefabricated. Thus, since the construction process is shorter and less labour intensive, the overall construction cost is also lower.

REGULATORY COMPLIANCE

Section B - Structure	
B1 - Structural Provisions	**VIC B1D6 Construction of buildings in flood hazard area*s*** (1) A building in a flood hazard area must comply with the ABCB Standard for Construction of Buildings in Flood Hazard Areas.
Section D - Access and egress	
D2 - Provision for Escape	**D2D5 Exit travel distances** (1) Class 2 buildings — The entrance doorway of any unit must be no more than: (i) 6 m from a point with access to two exits in different directions; or (ii) 20 m from a single exit leading to a road or open space at the same level. **D2D7 Height of exits, paths of travel to exits and doorways** In a required exit or path of travel to an exit the unobstructed height throughout must be not less than 2 m **D2D8 Width of exits and paths of travel to exits** The unobstructed width of each required exit or path of travel to an exit must be not less than 1 m **D2D13 External stairways or ramps in lieu of fire-isolated exits** (1) An external stairway may serve as an exit instead of a fire-isolated exit if the stairway is— (a) non-combustible throughout; and (b) protected in accordance with (3) if it is within 6 m of, and exposed to, any part of the external wall of the building it serves. **D2D14 Travel by non-fire-isolated stairways or ramps** (6) If 2 or more non-fire-isolated are provided, each exit must— (a) provide separate egress to an open space; and (b) be suitably smoke-separated from each other at the level of discharge
D4 Access for people with a disability	**D4D2 General building access requirements** For a Class 2 building, at least 1 floor containing sole-occupancy units are to be accessible from a pedestrian entrance and a doorway on that level
Section E - Services and Equipment	
E2 Smoke Hazard Management	**E2D8 Buildings not more than 25 m in effective height in Class 2 buildings and Class 4 part of a building** Building must be provided with an automatic smoke detection and alarm system complying with Specification 20
E3 Lift Installations	**E3P4 Lift access for people with a disability** When a passenger lift is provided in a building required to be accessible, it must be suitable for use by people with a disability. **E3D4 Warning against use of lifts in fire** -A warning sign must be displayed where it can be readily seen near every call button - Each warning sign must comply with the details and dimensions of Figure E3D4 and consist of— (a) incised, inlaid or embossed letters on a metal, wood, plastic or similar plate securely and permanently attached to the wall; or (b) letters incised or inlaid directly into the surface of the material forming the wall. **E3D8 Accessible features required for passenger lifts** In an accessible building, every passenger lift must have: (a) A handrail complying with the provisions for a mandatory handrail in AS 1735.12 (c) Lift floor dimensions of not less than 1100 mm wide x 1400 mm deep
Specification 18 Class 2 and 3 buildings not more than 25 m in effective height	**S18C3 System requirements** (1) A required automatic fire sprinkler system installed in a Class 2 or 3 building with an effective height of not more than 25 m and a rise in storeys of 4 or more must comply with— (a) AS 2118.1 except clause 5.9.10 of AS 2118.1 does not apply and is replaced with 'Covered balconies shall be sprinkler protected'; or (b) AS 2118.4, as applicable; or (c) FPAA101D or (d) FPAA101H
Specification 20 Smoke detection and alarm systems	**VIC S20C8 System monitoring** The installation must be connected to a fire alarm monitoring system connected to a fire station or a fire station dispatch centre in accordance with AS 1670.3

Figure 17: Page 1 of the compiled NCC Report

Specification 22 Smoke-and-heat vents	**S22C2 Adoption of AS 2665** Automatic smoke-and-heat vents must be installed as a system complying with AS 2665 except that permanently open vents may form part of the smoke/heat venting system provided they comply with the relevant criteria for automatic smokeand-heat vents in AS 2665.
Section F Health & Amenity	
F3 - Roof and wall cladding	**F3P1 Weatherproofing** A roof and external wall (including openings around windows and doors) must prevent the penetration of water that could cause: (a) unhealthy or dangerous conditions, or loss of amenity for occupants; and (b) undue dampness or deterioration of building elements. **F3D2 Roof coverings** A roof must be covered with— metal sheet roofing complying with AS 1562.1 **F3D3 Sarking** Sarking-type material used for waterproofing of roofs and walls must comply with AS 4200.1 and AS 4200.2 **F3D4 Glazed assemblies** Glazed assemblies in an external wall, must comply with AS 2047 for resistance to water penetration
F4 - Sanitary and other facilities	**VIC F4P2 Laundry facilities** Laundering facilities must be provided in a convenient location within or associated with a building appropriate to the function or use of the building.
F5 Room heights	**F5P1 Room or space heights** A habitable room or space must have sufficient size to enable the room or space to fulfil its intended function.
F6 Light and ventilation	**F6P1 Natural lighting** Sufficient openings must be provided and distributed in a building, appropriate to the function or use of that part of the building so that natural light. It must provide an average daylight factor of not less than 2% **F6P2 Artificial lighting** Artificial lighting must be installed to provide an illuminance of not less than 20 lux appropriate to the function or use of the building to enable safe movement by occupants. **F6P3 Outdoor air supply** A habitable space in a building must be provided with means of ventilation with outdoor air to sustain adequate air quality. **F6D5 Artificial lighting** (1) Artificial lighting must be provided— (a) in required stairways, passageways, and ramps; and **F6D7 Natural ventilation** (1) Natural ventilation provided in accordance with F6D6(a) must consist of openings, windows, doors or other devices which can be opened— (a) with a ventilating area not less than 5% of the floor area of the room required to be ventilated; and (b) open to— (i) a suitably sized court, or space open to the sky; or (ii) an open verandah, carport, or the like; or (iii) an adjoining room in accordance with F6D8
F7 Sound transmission and insulation	**F7P1 Sound transmission through floors** A floor separating sole-occupancy units or a sole-occupancy unit from a plant room, lift shaft, stairway, public corridor,must minimise the transmission of airborne and impact generated sound.
	F7P2 Sound transmission through walls A wall must minimise the transmission of sound using sound insulation to prevent illness or loss of amenity to the occupants if the wall separates— (i) a bathroom, sanitary compartment, laundry or kitchen in one unit from a habitable room (other than a kitchen) in an adjoining sole-occupancy unit.
Section G Ancillary provisions	
G7 Livable housing design	**G7F1 Livable housing design** A Class 2 sole-occupancy unit is to be designed such that it is: - easy to enter and to navigate in - capable of easy and cost effective adaptation; and - responsive to the changing needs of occupants.

Figure 18: Page 2 of the compiled NCC Report

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The following sections, with which the project complies, were extracted from Sections B to Section J of the National Construction Code (NCC) Report.

	G7P1 Livable housing design Each sole-occupancy unit in a Class 2 building must be provided with— (a) at least one level and step-free entrance door into the sole-occupancy unit from an accessible part of the floor on which it is located; and (b) internal doors and corridors which facilitate unimpeded movement between spaces; and (c) a sanitary compartment that facilitates independent access and use, and is located on the entry level of the unit (d) a shower that facilitates independent access and use; and (e) the walls of a sanitary compartment referred to in (c), the shower referred to in (d) and a bath are able to facilitate future installation of grab rails
Section J Energy Efficiency	
J1 Building Fabric	**J1.2 Thermal Construction** -All insulation used in the building fabric must not overlap with any other materials and must form continuous barriers with ceilings and walls and floors. -All insulation should not cover any building services (e.g electrical piping, vents and fixtures). **J1.3 Roof and Ceiling Construction** Roof and ceiling must be equal or greater than the total R value of 3.2 **J1.5 Walls and Glazing** All insulation must comply with AS/NZS 4859.2 and have a total R value of 1.4 **J1.6 Floors** The minimum total r value should be 2.0 for a concrete slab without an in slab heating or cooling system
J3 Building Sealing	**J3.4 Windows and Doors** -Doors and openable windows that is a part of the envelope of the building must be sealed -For the bottom edge of a door or the sides of an openable window, there must be a foam or rubber compression strip to restrict air infiltration **J3.5 Exhaust fans (Energy)** Exhaust fans to be fitted with a sealing device in a conditioned space or a habitable room **J3.6 Construction of ceilings, walls and floors** Ceiling, walls, floors and any opening must be enclosed by internal lining systems or sealed at junctions to minimise air leakage.
J5 Air Conditioning & Ventilation	**J5.2 Air conditioning system control** -Air conditioning must be able to be deactivated when not occupied -AC system must be zoned and be able to operate independently and not mix the temperature by heating and cooling simultaneously -AC system must be able to stop the flow of water to those not operating **J5.5 Ductwork insulation** Minimum insulation r value for ductwork within a conditioned space is 1.2, where exposed to sunlight should be 3 and other locations is 2.0 for climate zone 6 as specified in table J5.5.
J6 Artificial light and power	**J6.2 Artificial lighting** The maximum illumination power density for a single unit should be 5W/m2, and in an attached balcony veranda, 4W/m2 **J6.3 Interior artificial lighting and power control** All artificial lighting must be operated by a switch or device that can turn it off **J6.5 Exterior artificial lighting** -Exterior artificial lighting on the facade of the building must be controlled by a daylight sensor or a control that can turn it off at a predetermined time **J6.6 Boiling water and chilled water storage units** Must be controlled by a time switch **J6.7 Lifts** Ensure artificial lighting and ventilation are turned off when it is unused for 15 minutes

Figure 19: Page 3 of the compiled NCC Report