

The Wadjemup bike stay

Concept Validation



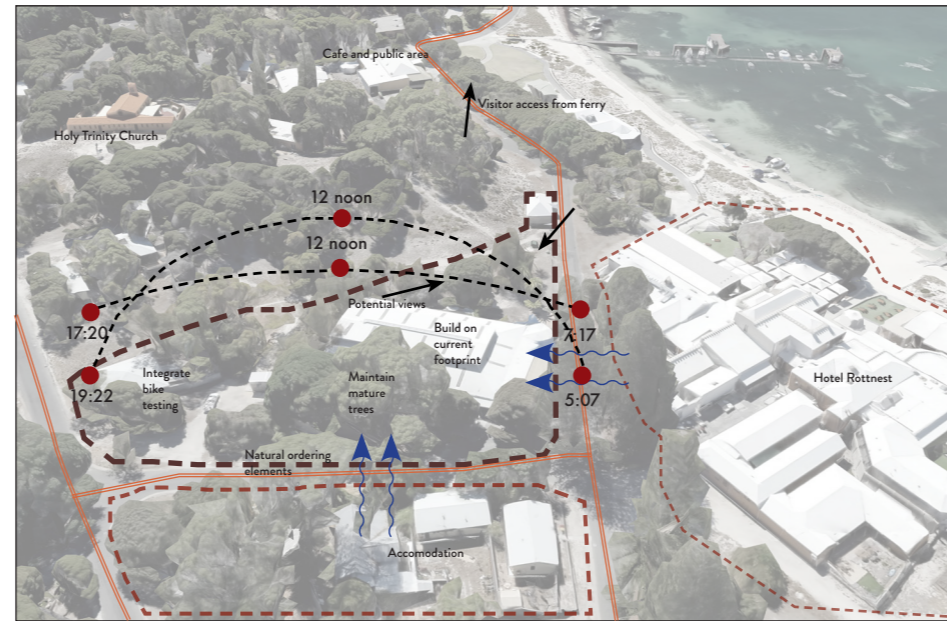
1 Site and main concept

Site opportunities

There are a plethora of opportunities that will enable the design to provide a richness to the community and deliver client value.

Indigenous history

The island was separated from the mainland around 6,500 years ago. This event resulted in an isolation of the flora and fauna and prevented human inhabitation until the onset of the colonial era. The place, Wadjemup, holds significance for the Whadjuk Nyoongar People as even though it was uninhabited for a while, there were oral histories and the island remained in view from places on the continent such as Walyalup (Fremantle).



Design drivers

Environmental sustainability

Environmental sustainability is considered throughout the design, construction and life of the project(s).

Indigenous perspectives

The indigenous perspectives of the Whadjuk Nyoongar were considered by maintaining a sensitivity to the history of colonisation as well as the relationship to land and respect for place.

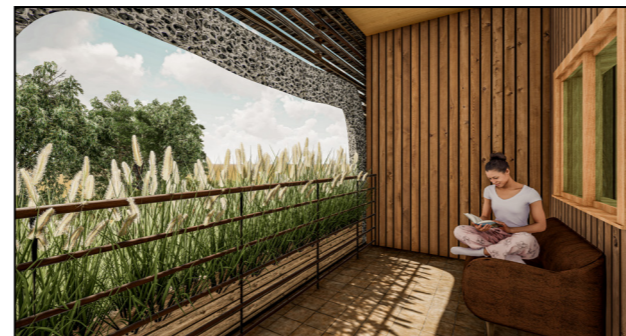
Natural character of the island

The natural character of the island has been well considered with a non-disruptive modular construction and choice of materiality as well as massing and impact on the streetscape.

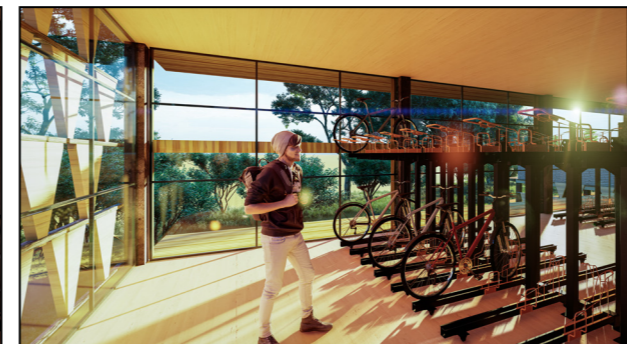
Expression of bike culture

The bike culture is expressed by integrating the testing track and maintaining transparency to support the active lifestyle of those on Rottneest Island.

The residential programme functions as a retreat to the people accommodating with emphasis on the outdoor living areas within the units.



The experience of collecting a bike is a collection of spatial experiences that bring together the senses and creates a unique memory since most visitors are infrequent visitors and oftentimes families or groups of friends.



2 Design approach



- 1. Main entrance**

The main entrance is celebrated by the elevated shading and integration with the cafe and outdoor seating area. The open space also enables pop-ups or events to take place there.
- 2. Integration with bike path**

The integrated bike path is part of a strategy to immerse the building and improve permeability with its context.
- 3. Transparent frontage**

A visual connection between interior and exterior is established and enhances the status of Pedal&Flipper as the premiere bike renting facility on the island.
- 4. Integration of greenery**

The integration of greenery provides the benefits of vegetative cooling, support of biodiversity and enables the biophilic effects on health and wellbeing.
- 5. Conservation areas**

Much of the site is preserved and mature trees are kept in order to support avian and terrestrial life as well as part of a cultural and urban perspective on maintaining the natural ordering elements on the streetscape.
- 6. Roof**

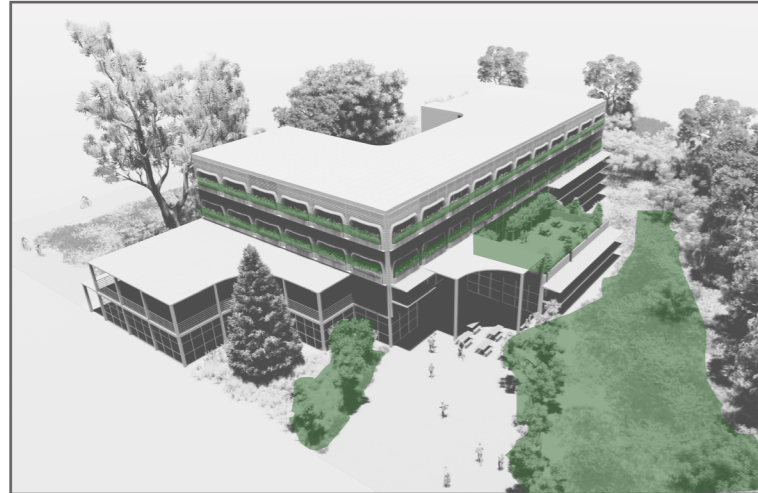
The large roof presents a significant opportunity for the generation of renewable electricity from solar and possibly wind sources. Also, the roof provides a catchment area to recycle rainwater.
- 7. Facade integration of greenery**

The integration of greenery on the facade is a significant strategy in the thermal performance as it uses the flora to provide screening and an incorporation of biophilia to create an immersive natural environment.
- 8. Use of recycled materials**

The roof for the undercover events space can be made out of reclaimed materials. The timber cladding can also reduce the reliance on new materials and lower the embodied carbon value of the building.

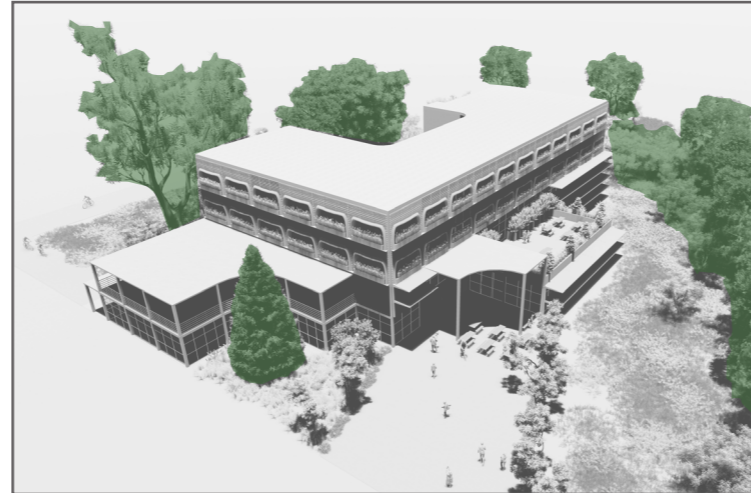
3 Design strategies

Thermal comfort



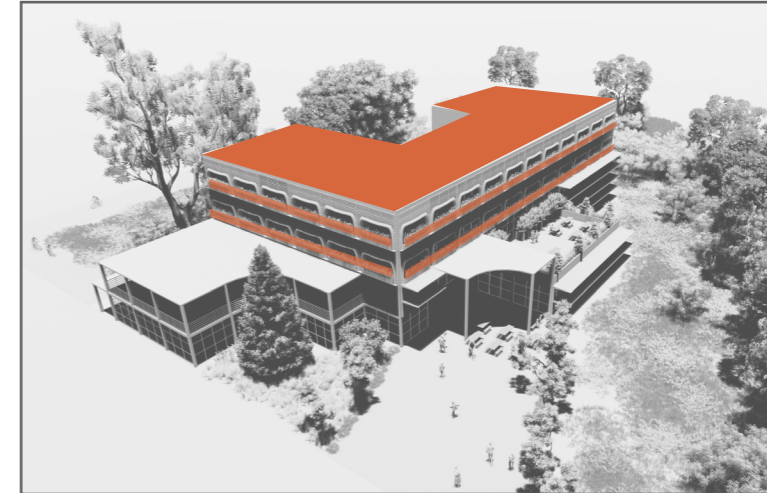
The RIA asks for a continuation of the Rottenest aesthetics and a low impact built form that priorities and complements the natural character of the island.

Minimal site disturbance



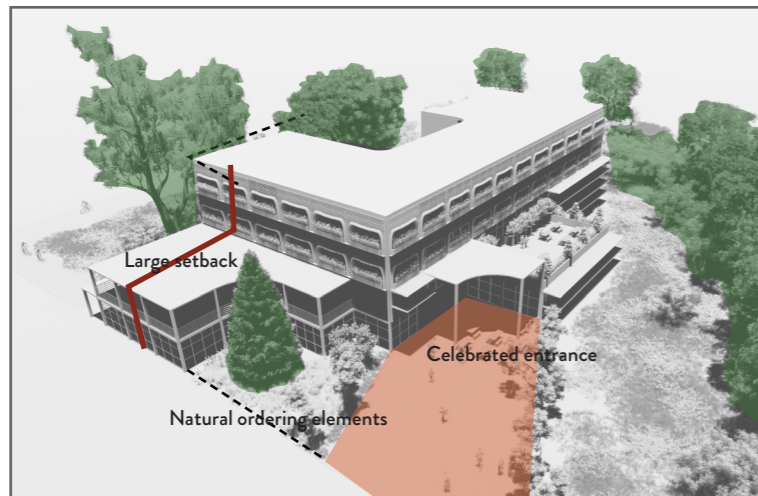
Protection of existing greenery is important in keeping the soil intact and root structure as well as shared resources between plants and its relation to fauna including avian and mammal inhabitants. Additionally, the mature trees are important in providing a wind break from the south and establishing a suitable micro climate for the residential programme.

Renewable energy and environmental sustainability



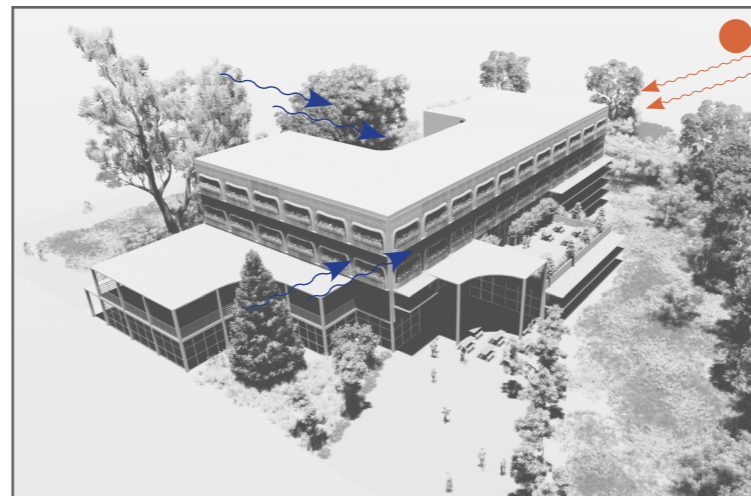
Building integrated photovoltaic cells will be included and recycled materials will be used where possible. Energy will be stored and contribute to the Rottenest Island grid.

Context and character



The frontages are carefully considered to make the built form visible but not dominating. The use of materials in terms of an aesthetic outcome towards complementing the cultural heritage and natural ordering elements on the macro scale have been carefully considered. The extensive use of timber and integrated greenery complement the forested parts of Wadjemup. The foamed aluminium on the facade provides a contrasting element and mimics the hard qualities of the island such as the reef and numerous rocky bays.

Ventilation and solar strategies



Natural ventilation and using vegetation to screen provides numerous benefits that enhance the health and well-being of inhabitants as well as the wider community.

Pedal and Flipper strategy



The visibility of bike and integrated bike testing, as well as the large entrance activate the frontages and create a community feel that is established around bike and active culture.

4 Innovation

Consideration in design

A myriad of innovations were incorporated in terms of the design of the building. This contributes to the design goals of a holistic response to the site, end user, and client requests.

WA Guidelines

The 10 principles of WA cover best practice guidelines to create a built environment that meets a minimum quality outcome. Additionally, the State Planning Policy 7.0 Design of the Built Environment (SPP 7.0) has been considered in the implementation of best practice to ensure each room gets light and ventilation, etc.

General compliance

The AS2890.3 bike storage requirements is adhered to, additionally, the materials will comply with Australian Standards and FRL levels as per the class of construction.

Wolfen waterproofing membrane is used for timber or steel flooring, compliant to AS4654.1 & 4858.

Rottnest Island Authority (RIA)

The RIA asks for a continuation of the Rottenest aesthetics and a low impact built form that priorities and complements the natural character of the island. The design aims to add to the community value and continue to preserve the biodiversity of the island and protect the microclimates in the immediate context.

Energy efficiency

Greenstar or LEED are some organisational bodies that provide certification for meeting guidelines in sustainable construction. Fixtures are compliant to Australian Energy Efficient Standards such as AS 6400 for water efficient products.

Facade types



Facade 1 - West P&F

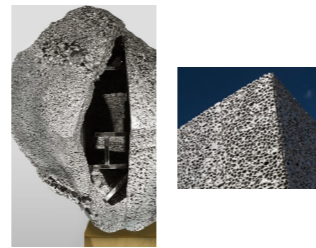
This facade is to serve as a brise soleil and break the glare from the evening sun and provide a pleasant experience during the late afternoon.

Materiality & Innovation



Reclaimed timber

Recycled timber cladding is used for its aesthetic, thermal, and environmental considerations as well as part of a contextual response to the forested area on Rottnest Island.



Recycled foamed Aluminium

Foamed aluminium is a novel material that allows a sculptural foam at a very low density. It provides numerous benefits, especially aesthetic and acoustic benefits.



Solar roof

Solar roof tiles can be incorporated to use the entire surface area in a cost effective solution. Innovative financing can increase the financial viability with leasing and allowing the roof to pay for itself. Volt Australia is a local manufacturer.



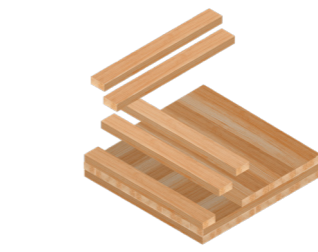
Electrochromatic tinting

Electrochromatic tinting, as from SageGlass, can electrically control the level of tinting to prevent solar heat gain or glare. It is complementary to the facade systems and provides thermal and visual comfort.



Facade 2 - residential

This facade enhances the connection between the interior of the units to the exterior and create a sense of tranquility and privacy. Additionally, there are biophilic, thermal and acoustic benefits.



Cross Laminated Timber

CLT will be used for floor cassettes and for wall partitions. It provides a solid feel that creates a sense of quality and has good acoustic properties. Importantly, it is safe in the event of a fire as the first layer chars and prevents further damage. It is also a store of carbon.



Recycled steel SHS

Square hollow sections are used for the structural component in the individual modules as they are less bulky than timber and complement in a hybrid structure. Additionally, it is fully recyclable.



CNC milling

CNC milling will be used for the fabrication of timber components. It is a cheap and highly efficient way to get accurate parts.



Battery storage

Battery storage stores the excess energy during peak generation and allows for use during off-peak hours. It improves the resiliency of the grid as it can contribute to the sustainability of the island at a macro scale.



Facade 3 - P&F

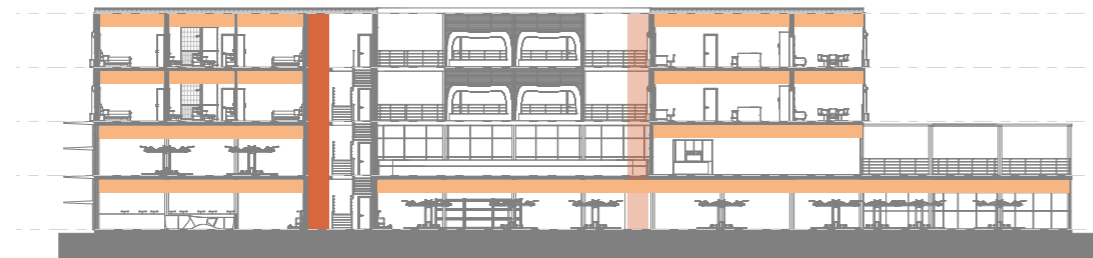
This facade allows for uninterrupted views of trees and nature and creates a unique experience when customers collect their bikes as well as maintaining an exterior-interior visual connection.

5 Building services and planning compliance

Planning compliance

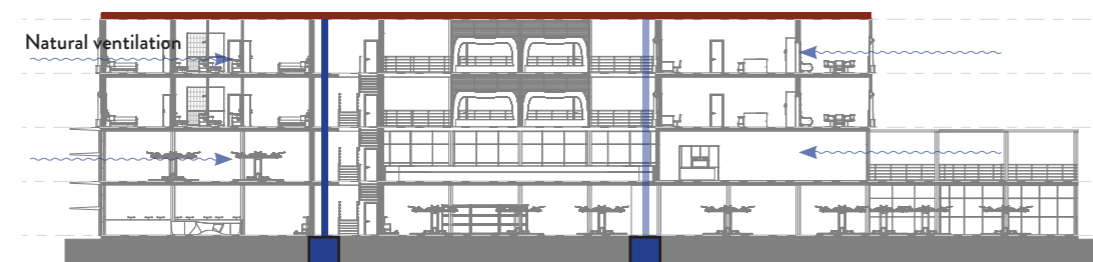


Building services



Service core and planning

The service shaft connects to the service space in the ceiling of the modules to provide a seamless integration of mechanical, plumbing and electrical services.



Solar and water

Water and solar energy are part of sustainability strategies that use the site in a renewable way. Solar energy will be stored in batteries to be used when needed. Water will be stored for reticulation.

The NCC and BCA

The building will need to be certified by the relevant professionals in order to comply with Australian Standards. Additionally, the following sections of the NCC are relevant:

- A.6: Building Classification
- B.1: Structure Classification
- Section C: Fire Resistance
- Section D: Access and Egress
- Section E: Fire fighting equipment
- Section F: F.3 Rooms heights, F.4 light and ventilation, F.5 Sound transmission
- Section J

Fire safety

The fire safety as per the NCC have been adhered to with materials complying to the Australian Standards, i.e. fire isolated steel columns (C1.8), and two fire isolated exits. The relevant sections are Section C: Fire Resistance and Section D: Access and Egress. The facade systems must comply with C1.9, and C2.3. Type A construction (see C1.1) is required as the building is 4 storeys and part of the building is Class 6 since it is a building of multiple classification (See C1.3).

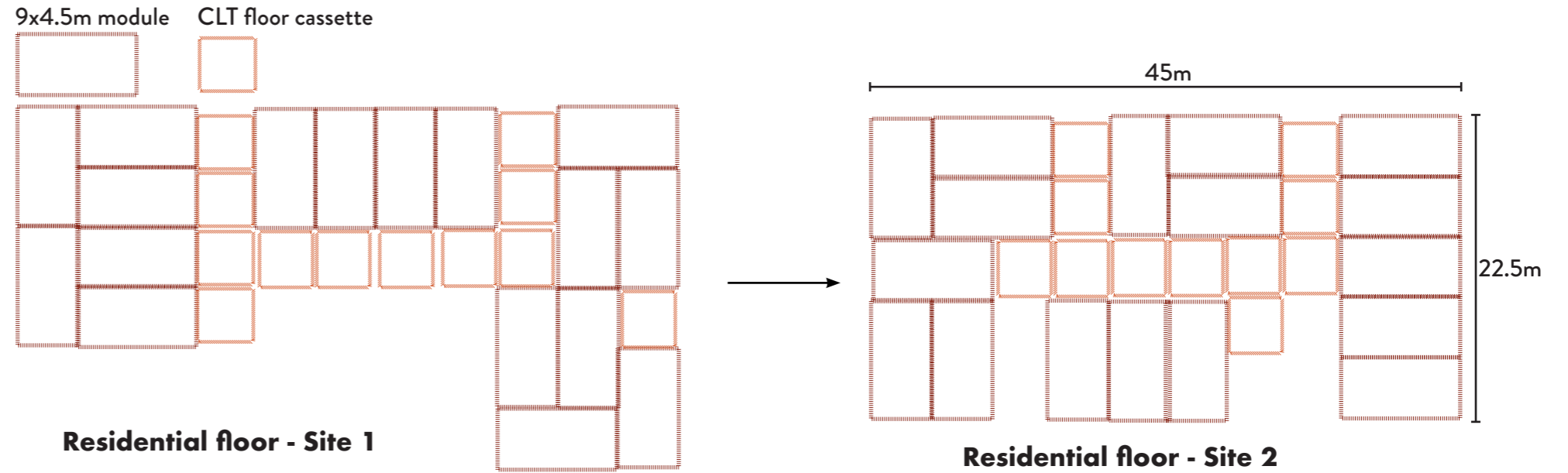
The specific parts (non-exhaustive) are as follows:

- C1.1: Fire resistance and stability
- C1.3: Buildings of multiple classification
- C1.8: Lightweight construction
- C1.9: Non-combustible building elements
- C1.10: Fire hazard properties
- C2.3: Openings in external walls
- C2.6: Vertical separation of openings in external walls
- C3.2: Protection of Openings, Section D1.3: provisions for early warning fire detection and alarm systems
- D2.2: Provisions for emergency lighting

6 Construction

Reconfiguration

The modular construction will allow for disassembly and different uses as modules can be reconfigured as per the new site needs. Facade systems and cladding can be removed or changed depending on orientation and programmatic or site requirements. Additionally, the modules sit within a framework of circulation which uses CLT floor cassettes to adapt the circulation around the modules and maintain flexibility. The male-female connections allow for fast deconstruction and reassembly and the non-structural internal partitions make it easy to adapt to a new programme.



Dfma

Integrated design approach

Different professionals come together for a collaborative process from the start. This produces better outcomes and creates efficiencies in the process.

Production

Prefab and volumetric modular construction is used to manufacture the building offsite for timely and a less disruptive construction process.

Off-site assembly

The volumetric construction contributes to the circular economy by allowing for rapid deconstruction and reassembly on another site.

Transportation

The modular units are manufactured with 150km and are transported by trucks run with renewable energy to reduce embodied carbon, i.e. electric trucks if available or biofuels.

Construction

Construction uses mechanical connections and avoids glue or welding to allow for easy disassembly and reconfiguration.

Life

The life of the building has been considered in order to reduce energy usage and generate energy from renewable sources such as solar pv cells.

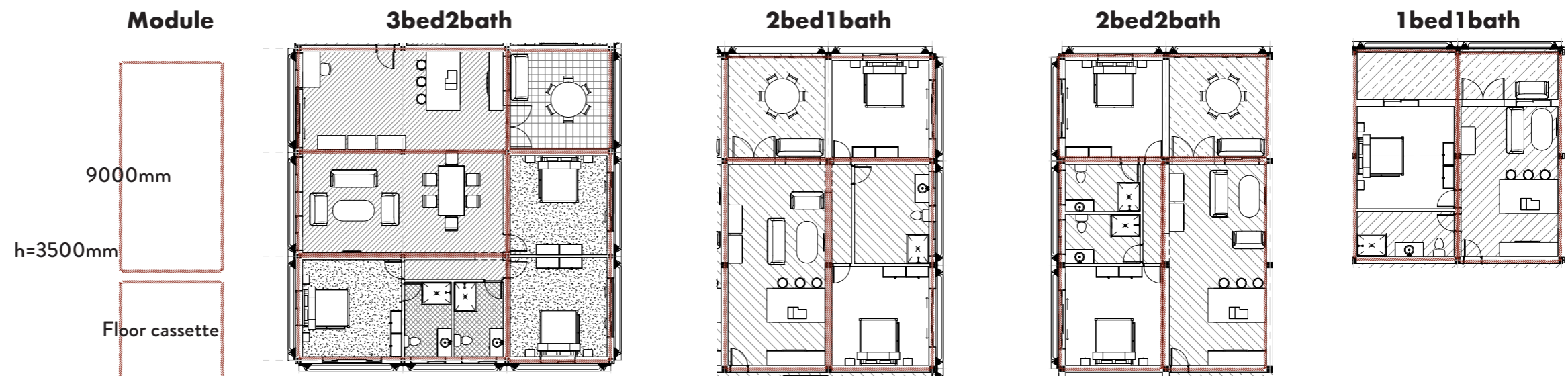
Disassembly

The disassembly methods uses steel connectors that allow the modules to be detached from each other. Additionally, the internal partitions use CLT, this can be reconfigured to maintain flexibility in the floor plan.

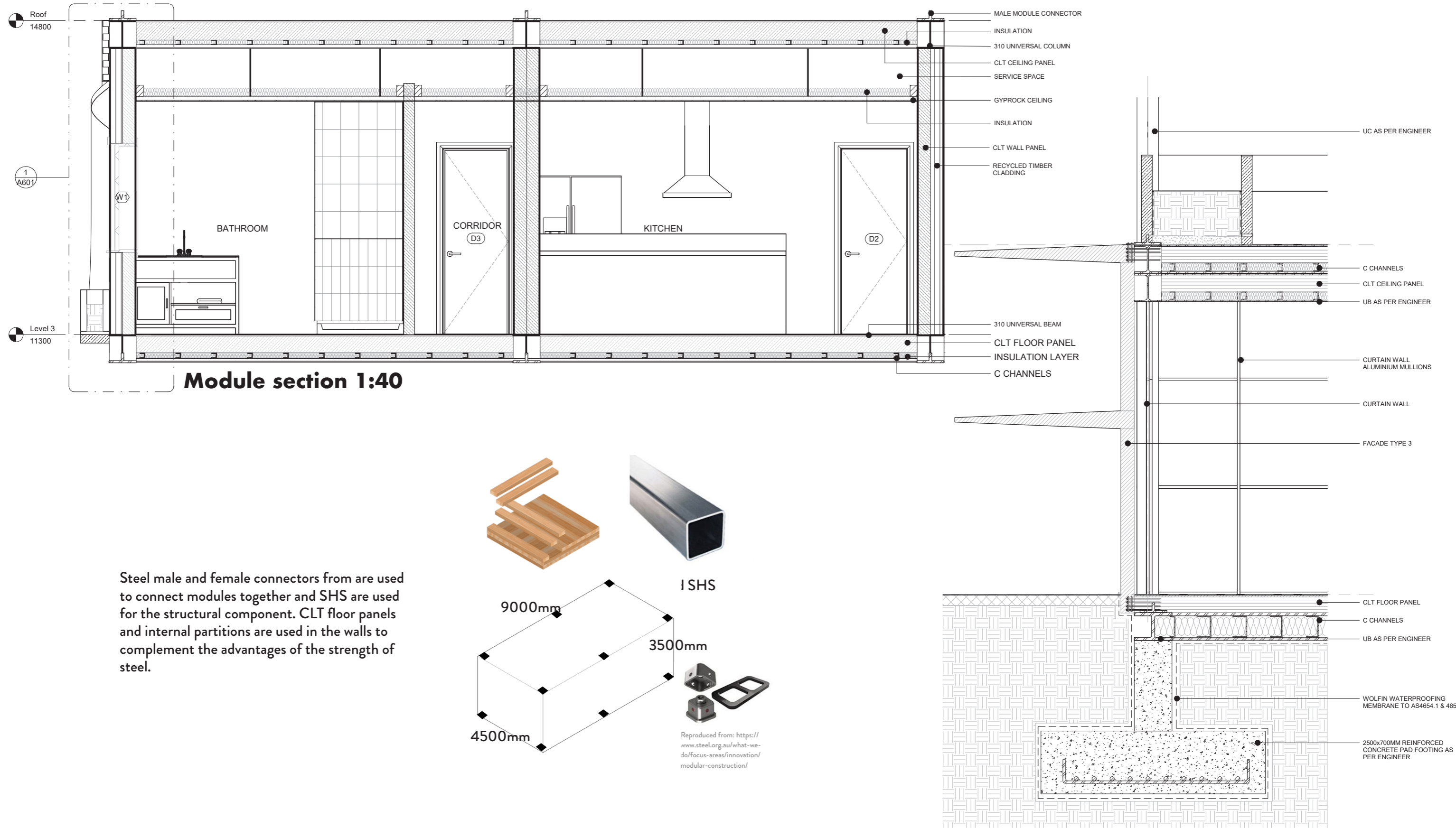
Reassembly

The reassembly method involves deconstruction and reconfiguration as per the needs of the new site. The discarded material will be reused as part of a circular economy and waste will be kept to a minimum.

Unit types



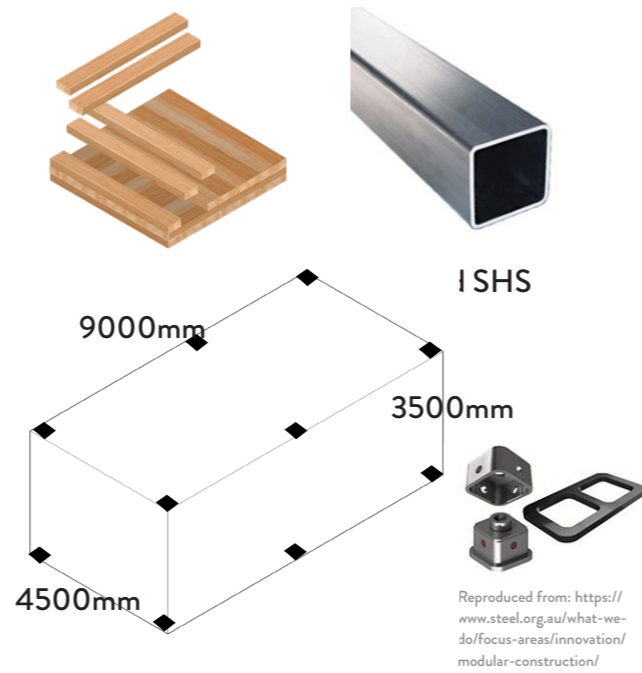
7 Construction



Module section 1:40

Wall section 1:40

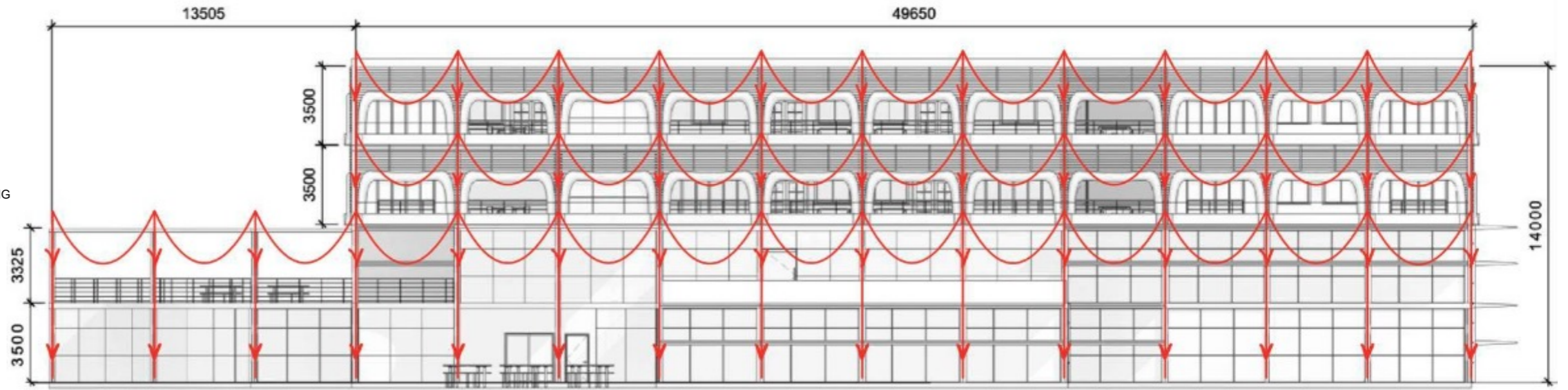
Steel male and female connectors from are used to connect modules together and SHS are used for the structural component. CLT floor panels and internal partitions are used in the walls to complement the advantages of the strength of steel.



WOLFIN WATERPROOFING MEMBRANE TO AS4654.1 & 4854.1
2500x700MM REINFORCED CONCRETE PAD FOOTING AS PER ENGINEER

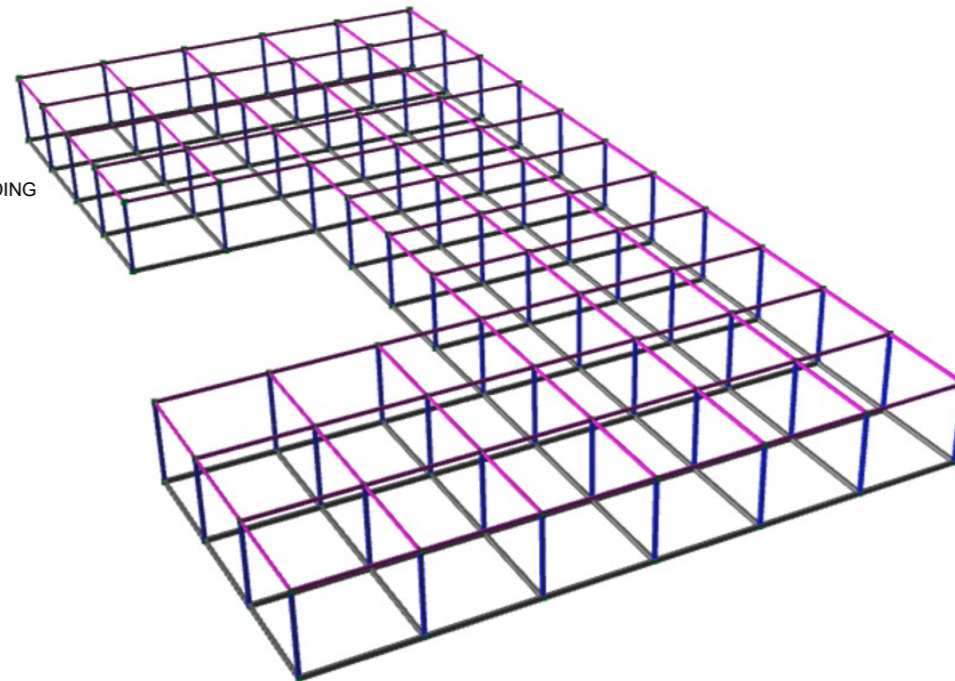
8 Engineering diagrams

Load path diagram

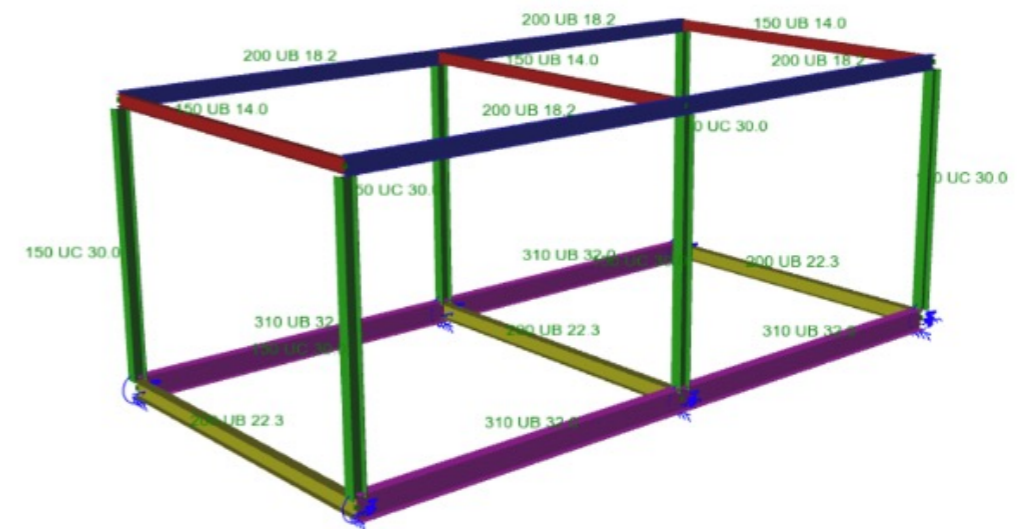


NORTH ELEVATION

Structural diagram of residential floor



Structural diagram of module



MALE MODULE CONNECTOR

CLT CEILING PANEL

GYPROCK CEILING

TIMBER LINTEL

RECYCLED TIMBER CLADDING

CLT WALL PANEL

BATHROOM FLOOR TILES

310 UNIVERSAL BEAM

CLT FLOOR PANEL

C CHANNELS

MODULE CONNECTOR

200 UNIVERSAL BEAM

INSULATION

Wall section 1:20

9 Engineering costing

Material costs

4. Cost

4.1. First Principals Bill of Quantities Take-Off

The first principles bill of quantities take-off is attached in Appendix B.

4.2. Detailed Estimate

The detailed estimate used unit rates obtained from Rawlinson's and Cordell's that already factored in the costs of labour, plant, and materials. The table was created based on the Civil Engineering Standard Method of Measurement (CESMM4), with quantities based on the Bill of Quantities (BoQ) takeoff draft found in Appendix B. A 10% contingency was added to the total cost to account for unforeseen risks, in addition to 10% GST and 7.5% for overheads and profit. Assumptions made include a total contract value (TCV) of \$5M and the absence of a site investigation, with ground condition data obtained from nearby previous works.

A summary table of the results is provided below with the full detailed estimate on the following pages.

Table 4: BoQ results

Final detailed estimate	\$3,406,230
7.5% overheads and profit	\$255,467
10% contingency	\$366,170
10% GST	\$402,787
TOTAL	\$4,430,653

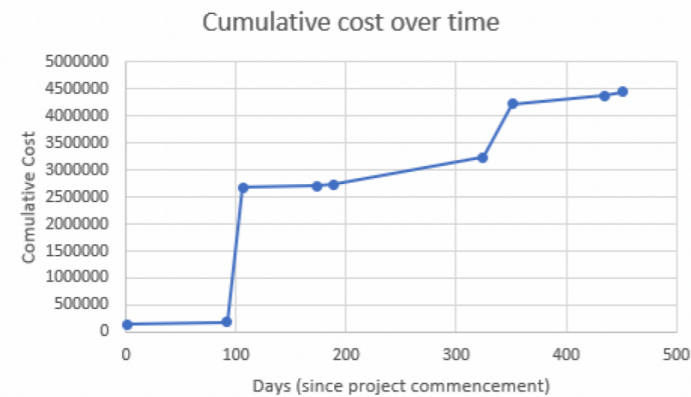


Table 9: Data used to create S-curve

Activity	Cost (\$)	Cumulative cost	Start Date	Day
Tendering	135000	135000	10/05/2023	1
Planning	45000	180000	09/08/2023	92
Design and Procurement	2500000	2680000	23/08/2023	106
Pre-construction	20000	2700000	30/10/2023	174
Earthworks	30000	2730000	14/11/2023	189
Ground floor	500000	3230000	28/03/2024	324
Top floors	1000000	4230000	24/04/2024	351
Roof and fixings	150000	4380000	17/07/2024	435
Commissioning	70000	4450000	02/08/2024	451

As detailed in the costing, the cost of the CLT is around \$60-\$65/m². The concrete is three times the price, with it being approximately \$180/m². Due to a lack of information, the price of concrete considered is that of in Perth, doing a similar flooring system in Rottneest will result in a higher price due to the location being remote and offshore.

The maintenance cost though, differs for both materials as the concrete requires little to no maintenance while the CLT has to be regularly maintained to protect it from moisture and pests. The floor has to be sealed and finished and must be followed through with periodic inspections. This is necessary to maintain both its appearance and performance.

While the additional maintenance cost of CLT makes concrete look better, the overall pros of CLT outweigh this one con.

Table 7: Concrete vs CLT costs

Cost (\$/m ²)	CLT	Concrete
Initial Setup	65	180
Renovation	50	110
Maintenance	15	5
Demolition	14	65
Rank	1	2

Impact	Material		
	Steel	Concrete (in-situ)	CrossLam Timber
Initial Construction Cost	\$335/m ²	\$206/m ²	\$269/m ²
Maintenance Cost	\$20/m ²	\$15/m ²	\$17/m ²
Replacement Cost	\$200/m ²	\$150/m ²	\$50/m ²
Total Lifecycle NVP	\$602/m²	\$568/m²	\$344/m²
Rank	3	2	1

Timber is found to be the most cost-effective material to use. This is why it has been chosen as the primary material for flooring and wall cladding. Although it would be preferred to make the modules out of CLT, for structural purposes, steel is required as it has a better strength-to-density ratio, meaning less material is required.

