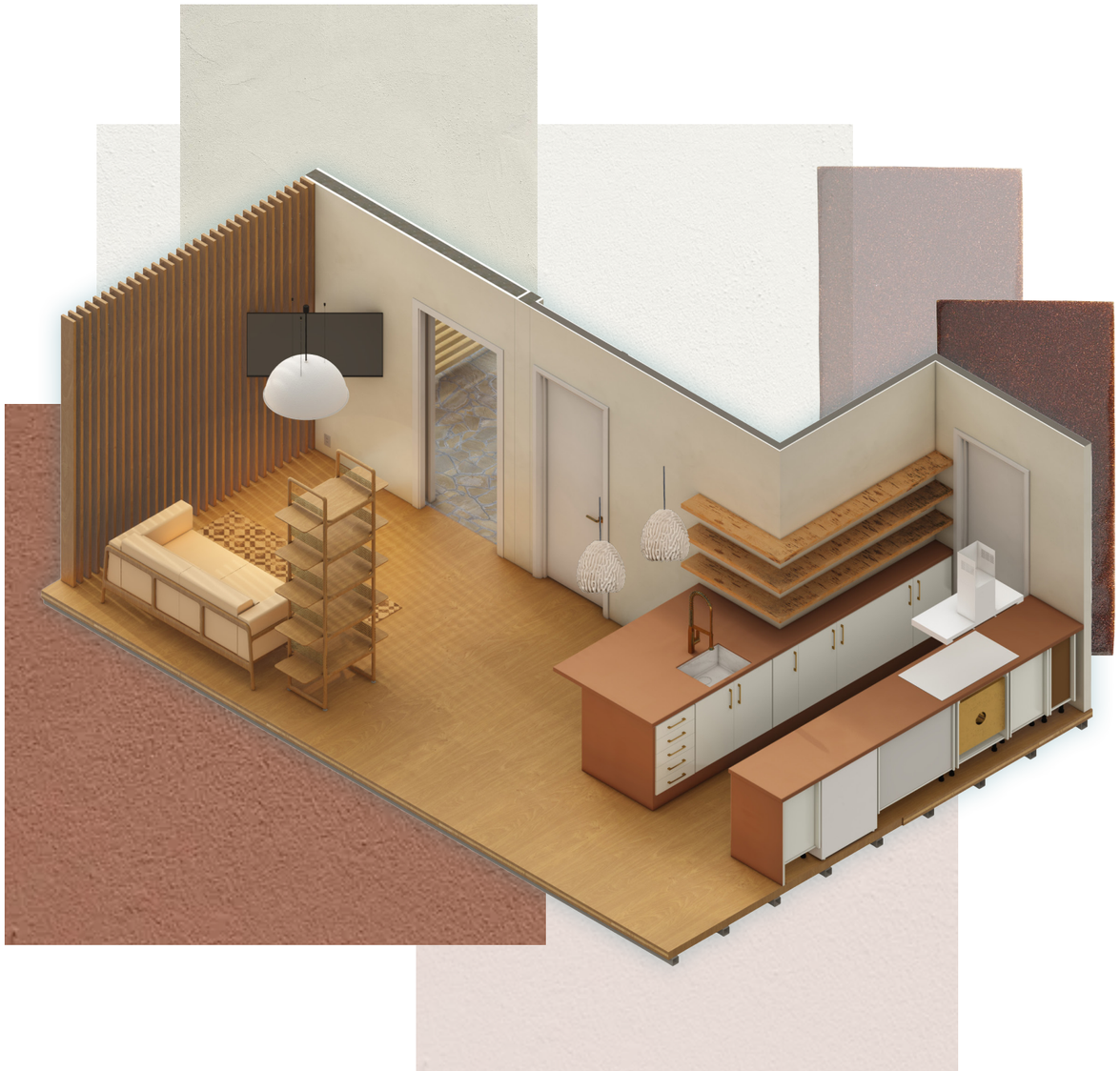
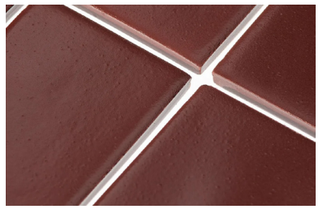
A NEW HEART

RE-IMAGINATION OF WADJEMUP'S PEDAL AND FLIPPER

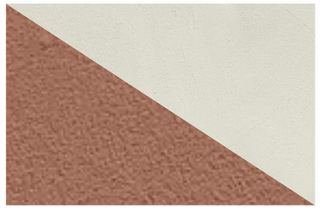
FLEETWOOD CHALLENGE CUP 2023

MATERIAL INNOVATION
MODULE TYPE A: KITCHEN AND LIVING





IGNORANCE IS BLISS IRON WASTE GLAZED TILES
Ignorance is Bliss is a research-based project utilises industrial waste and secondary materials and converts them into interior and exterior products of higher value. Drinking water supply and soil remediation industries, which produce thousands of tonnes of residue per year and are the main suppliers of metal waste for Ignorance is Bliss ceramic tiles. Their Iron Waste Tile is comprised of 20% waste product.



TERRATON WALL
Finishing plaster based on natural pozzolans clay, cement and fine-grained mineral binders. The colour of the plaster comes from the mineral powder itself and is not artificially enhanced. As a mineral wall finishing plaster TerraTon Wall is suitable for indoor and/or outdoor vertical surfaces. It can be applied directly on walls, finished rough plaster and panels.

SILESTONE SUNLIT DAYS: ARCILLA RED
Silestone is a high-performance blend of premium minerals and recycled materials produced through a more sustainable manufacturing process, with 99% recycled water and 100% electric energy from renewable sources.

Sunlit Days is the first carbon neutral collection from Silestone, using a minimum of 20% recycled glass in composition.

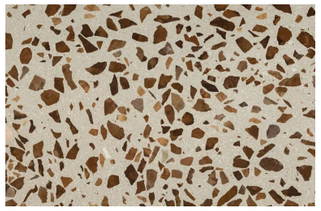
TRANSNATURAL LABEL CORAL HANGING LIGHT
The Coral Light is produced using an experiental printing process. Waste powders like granite and marble from the stone industry are used to 3D print unique objects. The powder is mixed to load the self-made inkjet 3D printer. The printer deposits thin layers of the powder and prints an ink on top of each layer, solidifying the powder to each other. No glue, resin or plastic is used and zero waste is produced.

MUSHLUME HEMI PENDANT LIGHT
The MushLume dome is fully biodegradable and is made of mycelium. Over the period of a couple of days, the mycelium binds together the natural fibers. Your lampshade will thus literally be grown on demand and will entirely unique.

SCHOCK KIRUNA N-100 CRISTADUR GREEN
Cristadur Green is the world's first quartz composite sinks which are ~ 99% made from natural, renewable or recycled raw materials and shine with intense colours. Additionally, manufacturing is carbon neutral.

MATERIAL INNOVATION
MODULE TYPE A: BATHROOM

IGNORANCE IS BLISS METAL WASTE MIX GLAZED TILES
Ignorance is Bliss is a research-based project utilises industrial waste and secondary materials and converts them into interior and exterior products of higher value. Drinking water supply and soil remediation industries, which produce thousands of tonnes of residue per year and are the main suppliers of metal waste for Ignorance is Bliss ceramic tiles. Their Metal Waste Mix Tile is comprised of 0.5% waste product.



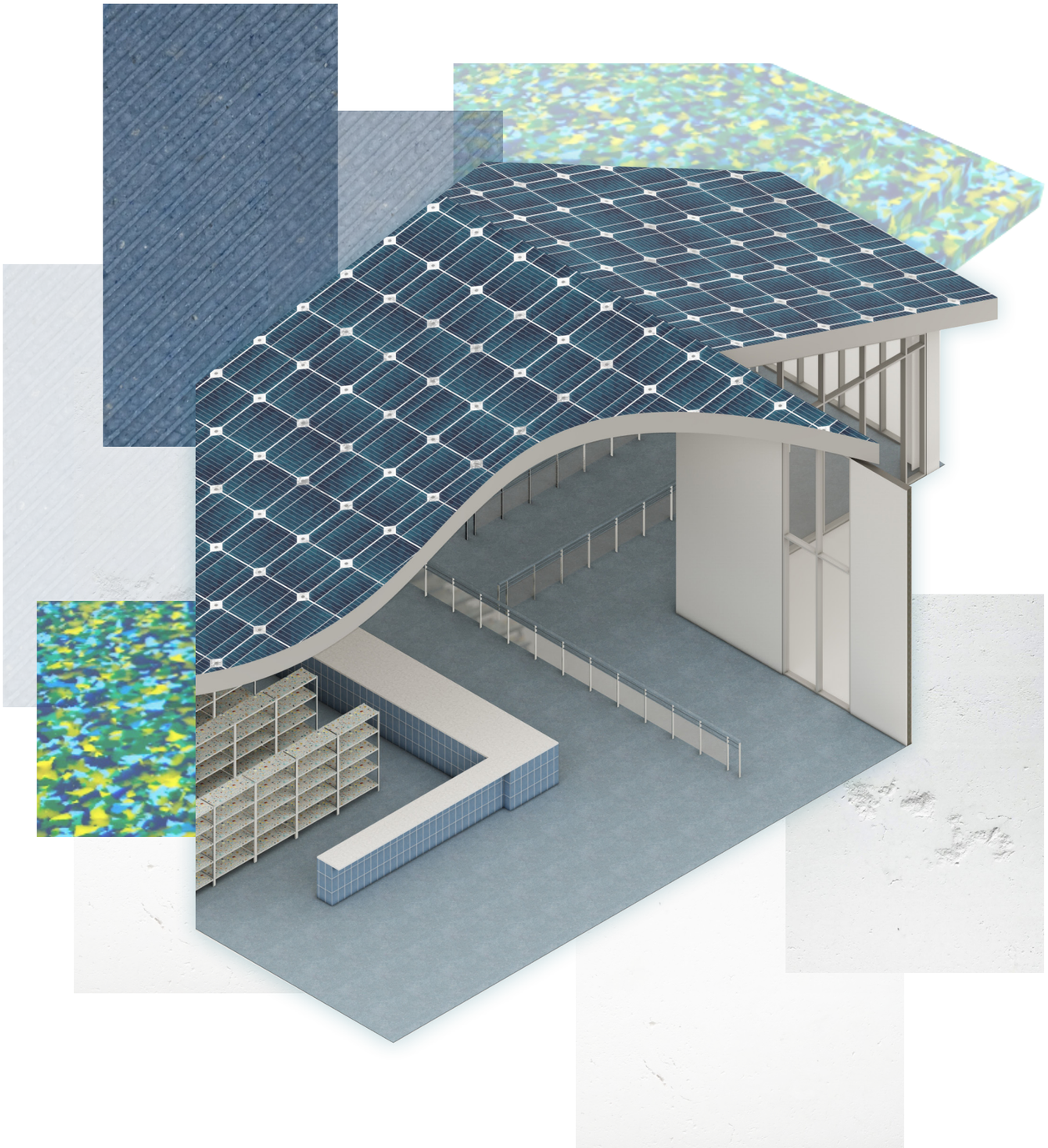
MIPA LENTIL TERRAZZO TILES
This collection of tiles feature up to 80% recycled marble content that is combined with cement to create a durable, eco-friendly, long-lasting and water resistant surface.

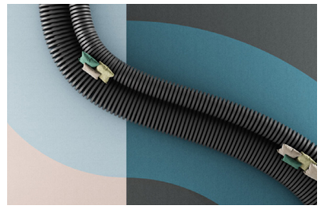
WOOD MELBOURNE
Wood Melbourne creates handmade bathroom finishes in limited batches, reducing waste. Their double towel rail and toilet roll holder use Victorian Ash wood and raw brass to age with time and demonstrates Australian craftsmanship.

ORBITAL SHOWER
Orbital Shower, the world's first circular shower system. Without sacrificing efficiency, cleanliness, or a pleasant shower experience, Orbital Shower is a system with built-in purification and sensor technologies. The Orbital recirculating system is stored within the sink plinth, allowing the bathroom to remain a sleek, minimalist finish while still offering the benefits of water retention and reuse.

ORBITAL TAP
Orbital Tap saves 100% of the water from your tap and reuses it to flush the toilet. Their tech was designed by an industrial designer exploring the possibilities to sustain life on Mars, when he discovered a better way to conserve water that he wanted to bring back down to Earth.

MATERIAL INNOVATION
RECEPTION AND BIKE SHOWROOM



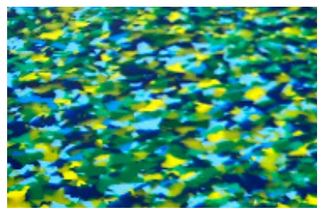


MOGU FLOOR FLEX
Mogu Floor Flexis a collection of resilient flexible floors 67% biobased that come in roll form. They are destined to large and high-traffic areas, such as offices, buildings and hospitality.

The flooring is cultivated mycellium grown on agricultural waste.

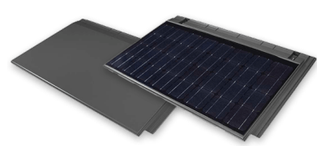
SEA STONE SANDY BLUE TILE - 3D STRIPE
Every year, 7 million tons of Seashells are discarded by the fishing industry and by aquafarming. A part of this waste is then reused to make fertiliser, but the vast majority lies abandoned along shores and coastlines, creating smelly mounds or goes to landfill. Material 'Sea Stone' proposes the use of discarded seashells to create environmentally and economically sustainable material rather than contributing to the world's rubbish problem.

PAPER FACTOR BENCHTOP
Paper Factor was created from the exceptional qualities of a solid surface material made from a new compound of micro-paper: an innovative evolution of papier-mâché, scientifically tested and developed in collaboration with the University of Salento. Paper Factor is strong, durable, and incredibly light.



PRECIOUS PLASTICS INTEGRATION
Precious Plastic is a combination of people, machines, platforms and knowledge to create an alternative global recycling system. Their services will be commissioned to make shelving units, crates and other service items for the bike shop that would ordinarily also be plastic.

There are some small Precious Plastics-affilliated workshops in Perth, however an initiative such as this could see a centre open on Rottnest to bring creative recycling to Perth.



TRACTILE SOLAR ULTIMATE SUITE
Tractile is a versatile, easy to install roof solution suitable for most roof types. Tractile is also compatible with modern home energy systems such as heat exchangers, batteries and car chargers to future proof your roof and enable a modern yet sustainable lifestyle. Generate and store both electrical and thermal energy (heated water) to sustainably power and heat

MATERIAL AND TECHNOLOGICAL INNOVATION

OTHER NOTABLE INNOVATIONS:

GENCORK CORKNATURE CORKGREEN
(Located in the Residential Common Areas)
Corknature is a disruptive pattern that combines cork and plants naturally preserved, with strong flexibility, plasticity and natural vigor without any maintenance. The cork is hypoallergenic and is fire, water and weather resistant. The product is 100% natural and sustainable, with 95% energy self-suficient production.

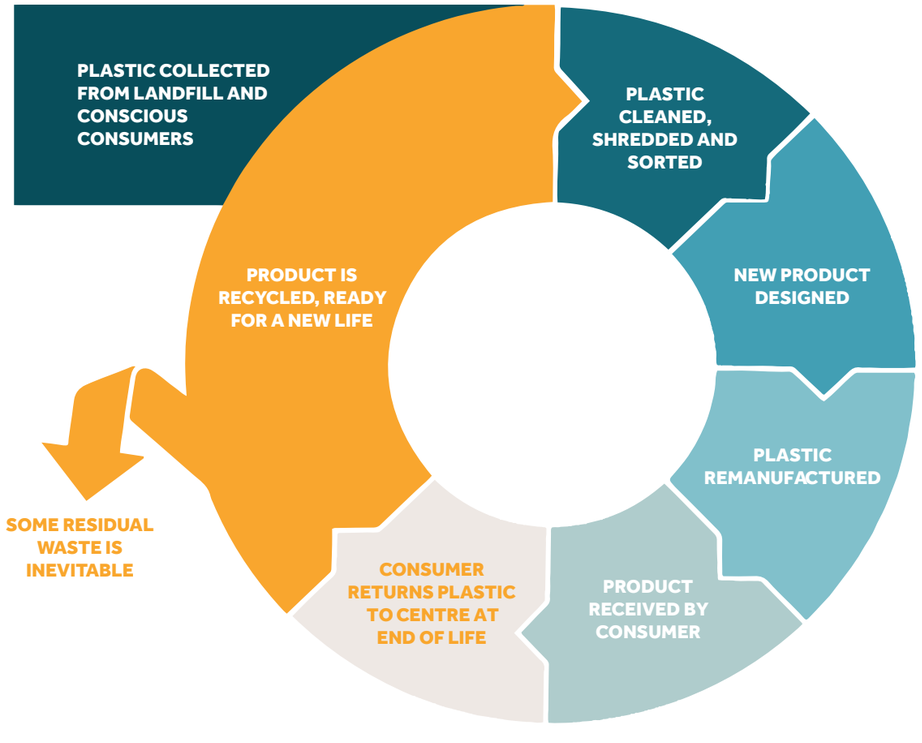
KISI READER PRO
(Located at the entryway to each apartment and other key access points throughout the building)
The Kisi Reader Pro, designed for commercial office access control, will perfectly integrate into the apartment complex, allowing access to be easily granted and revoked in line with employee swings. NFC readers within employee phones or smart watches quickly allow access without the need for a key, and access can be monitored by staff.

CIRCULAR ECONOMY

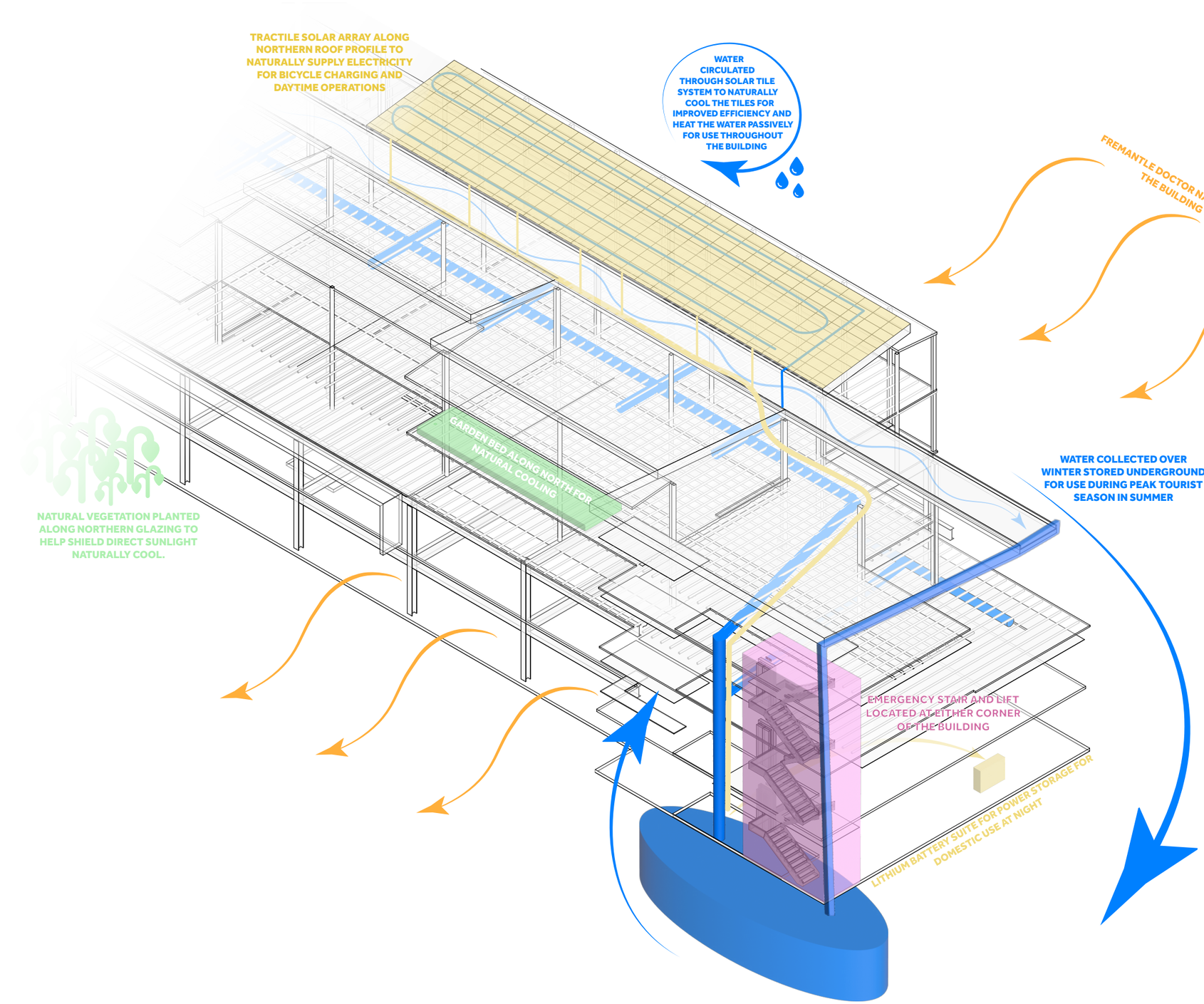
In an attempt to create a circular economy, material waste will be reduce wherever possible by sourcing a manufacturer that uses robots to create module with precision so resource need can be carefully predicted.

Materials selected throughout the building, including structural, are already circular in production or provide opportunities for circularity.

Additionally, partnering with plastic remanufacturing companies such as Precious Plastics, an Australian initiative seeking to reuse plastic meaningfully, could help to manufacture crates, containers and other plastic needs out of recycled plastic that can then be melted down and given another life if the future. The project provides an opportunity for a manufacturing plant to open within the Settlement precinct, offering remanufactured goods to the buisinesses on the island and creating unique souvenir opportunities for tourists to take home and help fund the project.



SERVICE INTEGRATION



PARTIAL DIAGRAM OF BUILDING SERVICES (NOT TO SCALE)

SERVICE CORE

In compliance with Section D of the NCC, a service core has been located at either corner of the building, offering both stairs and a fire lift to provide universal escape options for building occupants. Furthermore, firefighting equipment can also be found at these exits in compliance with section E.

VENTILATION

The building prioritises natural means of ventilation, allowing residents to comfortably inhabit the building without the need for artificial HVAC systems. Linear apartments optimise opportunity for wind to cool, with louvre systems in place to reduce the impact of direct sunlight.

SOLAR AND ELECTRICAL STORAGE

Integrated into the roof system is the Tractile PV system, offering an in-line solution to maximise opportunity to harness the sun's power. This power is then used during the day to power Pedal and Flipper's opperations and to ensure that the e-bikes remain charged. Any additional power is stored within the buildings battery system, providing naturally generated power to the building's inhabitants.

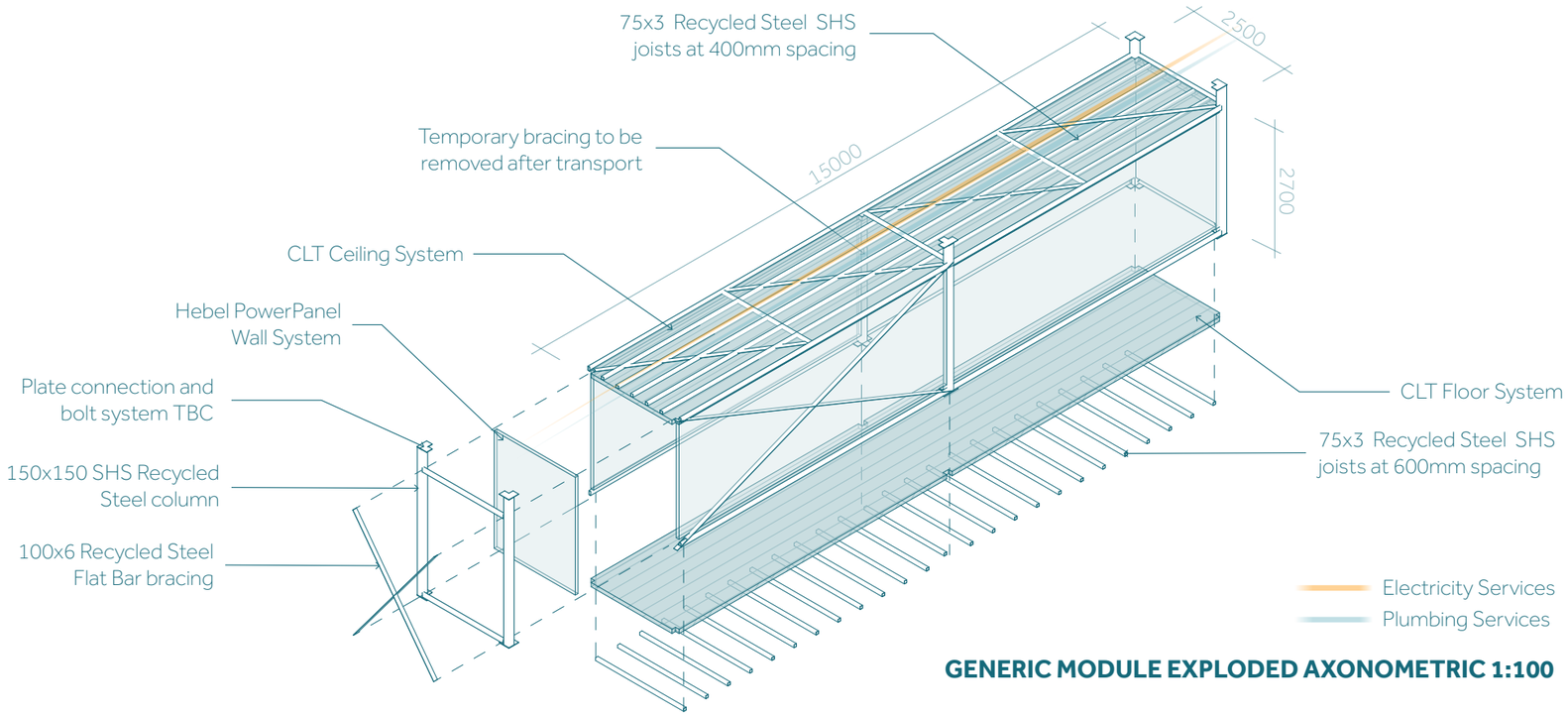
VEGETATION

To assist in cooling the building and to rehabilitate the developed soil, the Pedal and Flipper precinct will be extensively replanted with locally sourced species in line with the guides outlined by the RIA.

WATER STORAGE AND DISTRIBUTION

Water is a key resource required both commercially and residentially within the precinct, therefore it was essential to ensure that generous water storage has been considered. Water is collected from the building's feature gutter, demonstrating the importance of water as a resource. This water is then cycled through the Tractile system to naturally cool the tiles and heat the water, or directly to the water tank for storage.

DESIGN FOR ASSEMBLY, DISSASSEMBLY AND REASSEMBLY

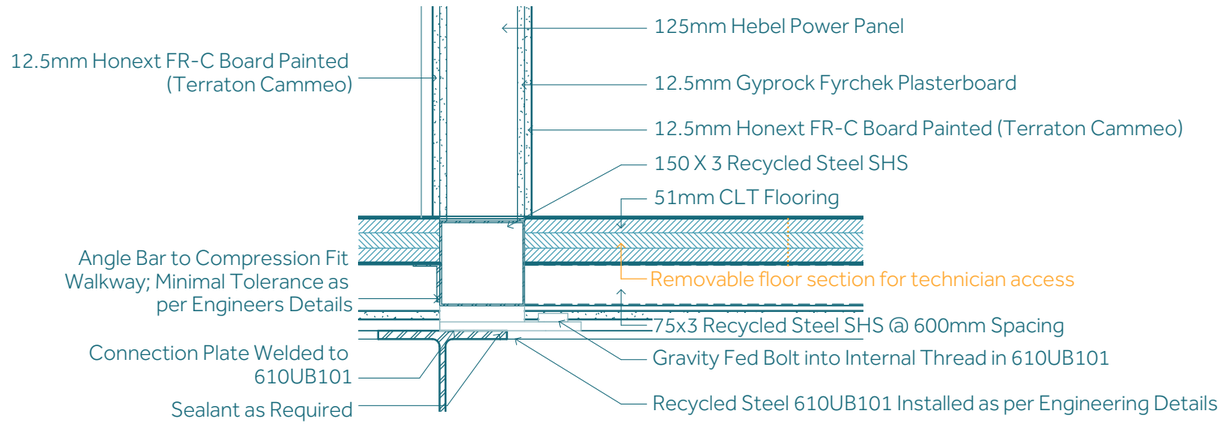


GENERIC MODULE EXPLODED AXONOMETRIC 1:100

DFMA DESIGN METHODOLOGY

Working closely alongside the engineers has assisted the design process and simplified the transition from one site to another. By omitting the use of welding and instead designing using bolts that technicians can easily access and manage allows the modules to be moved from one site to another without too much impact on the structural or physical properties of the module.

To make this possible, the module was designed early in the design process and the schematic of the precinct was created with the dimensions of the module creating the grid. The module's design is lightweight, using hollow recycled steel members and CLT panels to shape the frame of the module. This module can then be clad appropriately and internal finishes adapted to the design. By intelligently placing bracing sporatically along the system, it is able to endure long spans. Temporary columns and bracing will be used for transport, keeping the frame rigid and simplifying construction and assembly on-site.



GENERIC MODULE TO PORTAL FRAME FOOTING DETAIL 1:10

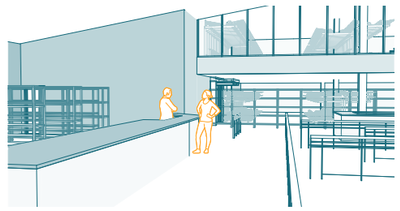
MANUFACTURE, DIGITISATION AND ROBOTICS

Robotics can play a key role in manufacture, especially if the warehouse were to engage with a system that can assist in the assembly of materials.

They are already being introduced to the Australian market, with Modscape, a prominent Australian modular builder, integrating a robot into their production line to help support workers by lifting heavier items and automating out menial tasks.

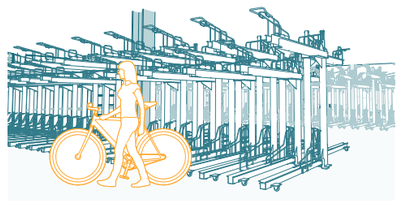
The continued digitisation of design communication simplifies discussions across disciplines. When considering the proposal itself, the robust online check-in system is an excellent example of digitisation in motion.

INTEGRATION OF NEW TECHNOLOGIES: BIKE HIRE PROCESS

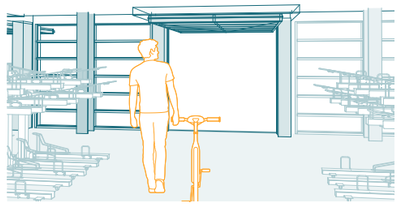


Pre-hire a bike(s) online prior to arrival to attain a digital bike card. Once you have arrived, walk straight though reception and scan your card at the gate and enter the warehouse.

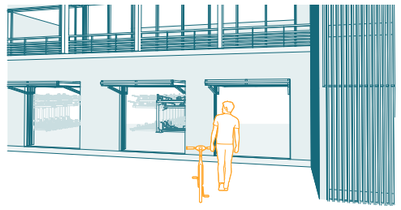
Once inside, grab a helmet from the helmet hub and continue to the bike racks. Tap your digital card onto a rack with the bike type you requested to rent (ie. a push bike or e-bike).



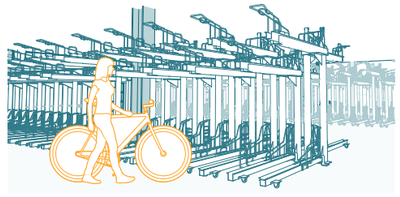
If you attempt to take a bike you have not hired, the lock will not release. Once the lock releases on the correct bike, that bike's RFID is now linked with your digital card via IoT.



To exit, simply walk your bike through the gates at the south of the warehouse. The gate detects the bike's unique RFID, triggering it to open and takes photos to docoument its condition as you leave.

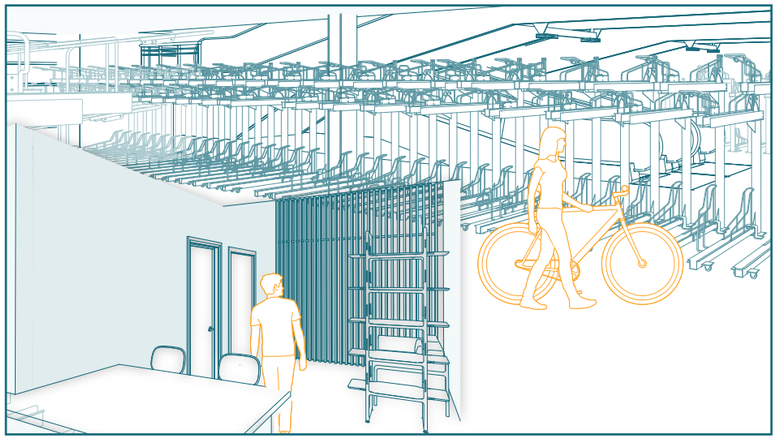


The bike is returned through gates at the north east and it is photographed again. If its condition is worse than on departure, the customer will be asked to take the bike to maintenance.



If the bike is okay, the gates will open and the customer can place the bike in the area that they found it. The customer can tap their digital card to exit from the south gates.

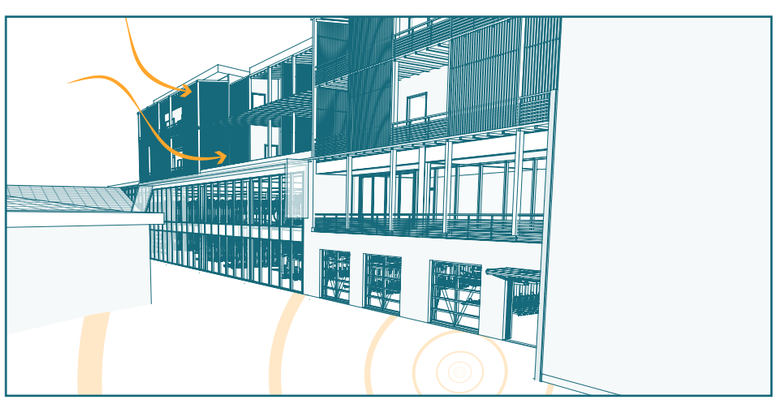
INDUSTRY CODES AND PLANNING REGULATIONS



SECTION A
A6 BUILDING CLASSIFICATION
Due to the multiple uses of the building, it can be classed as both classes 2 and 6. The residential units (ie. The class 2 portion of the structure) is intended to house transient workers operating on a FIFO (ferry-in, ferry-out) basis, however it could potentially house more long-term tenants. The apartments are class 2, and therefore have stricter requirements to consider for emergency egress in case of fire. When considering the secondary site, the modular units will remain class 2 as they are being used as hotel accommodation, but could again house longer term tenants.

While the class 6 bike store and warehouse has less severe requirements for fire egress, the building has been over specified to ensure that fire compliance is met for the class 2 portion of the building.

SECTION B
B1 STRUCTURE CLASSIFICATION
Table B1.2a – Building classed as Importance Level 2 by engineers. It has been designed to exceed an annual probability of 1:500 for non-cyclonic wind, cyclonic wind and earthquake, and for a snow probability exceeding 1:150.

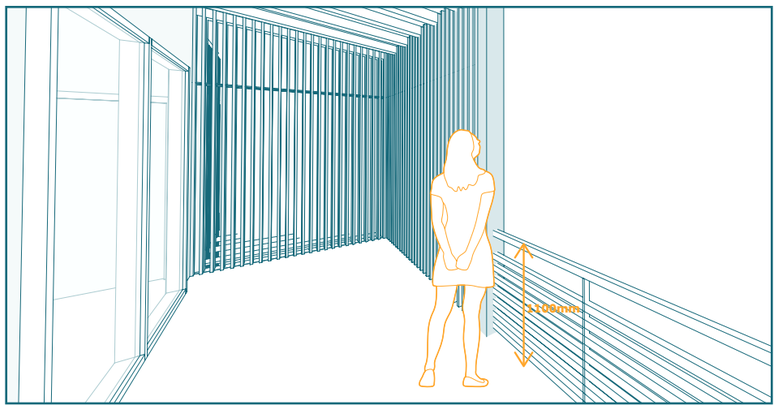


SECTION C
FIRE RESISTANCE
Please note that a certified professional is required to ensure the structure is meeting fire resistance compliance to an adequate standard, and to confirm the below classification.

C2D2 – Due to the building being 4 storeys high, for both the class 3 and 6 portions of the building the construction can be defined as Type A.

CV3 – The building is of Type B construction, meaning it is appropriate for the Class 6 portion of the building, and for the Class 3 portion, all openings in the external wall are separated by a slab that complies with C2.6(a)(iv). This means that the slab extends at least 1100mm from the wall, and that it extends at least 450mm from either side of the opening. Additionally, this slab needs to be non-combustible and of an FRL not less than 60/60/60.

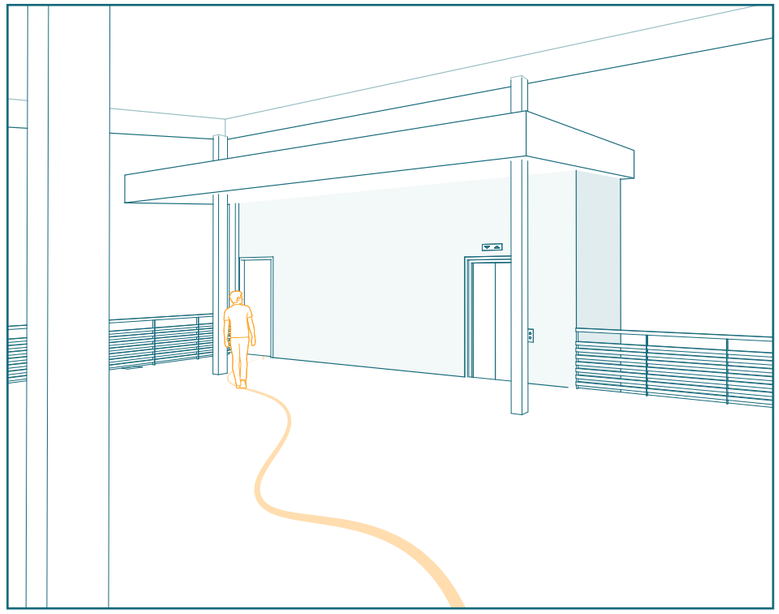
Fire resistant glazing will be required for and provided to the southern emergency stairwell. Additionally, the lining within the ceiling needs to be fire resistant to an appropriate level. For this project, Fyrchek Gyprock will be used to separate levels, and thus modules, vertically, ensuring that fire within one floor or module will not spread vertically.



SECTION D
ACCESS AND EGRESS
To comply with DP2 and DP3, egress routes of compliant widths are provided throughout the building, and balustrades on each class 3 balcony are at least 1100mm high and extend the entire width.

The travellator is compliant with DV3, meaning it is at an appropriate slope and has compliant slip resistance.

CONSTRUCTION OF EXITS
The lining, material or assembly of an outdoor area is required be deemed appropriate as per the specifications outlined in C1.10 to ensure appropriate fire consideration has been made.



PROVISION FOR ESCAPE
D1P5 – Exit requirements are calculated with reference to the number of floors and the use of each floor. Two emergency access points have been provided to streamline the ascension and descension from the building. Access to a point where unit inhabitants can choose between two exits is directly available outside of each residential unit, well within the required 6 meter travel maximum. For a class 6 building, the travel distance from an exit selection point to an exit can be no more than 40m, which has been considered and designed for within the proposed building.

Two emergency access points have been provided to streamline the ascension and descension from the building, with no more than 20m of travel required to access an exit. In addition to space for disabled refuge in the stairwell, both exits are fitted with emergency lifts, aiding in offering a quick ascent for patrons.

ACCESS FOR PEOPLE WITH DISABILITY
For a Class 3 building of 12 sole-occupancy units, D3.1 requires that a minimum of 2 accessible units is required. Additionally, the common areas are accessible to all, with access to each floor due to the two passenger lifts provided in the building.

To comply with D3.2, every main point of pedestrian entry is accessible. Disabled people must be able to access all areas of the building. Lifts are to comply with specifications outlined within E3.6.

Additionally, slip-resistant tiles and floor materials are required, with the level of resistance considered based on the level of traffic through each area.

INDUSTRY CODES AND PLANNING REGULATIONS

SECTION E
FIREFIGHTING EQUIPMENT
A firehose is supplied by each exit, whether in a cupboard or purpose-built wall mount to comply with section E.

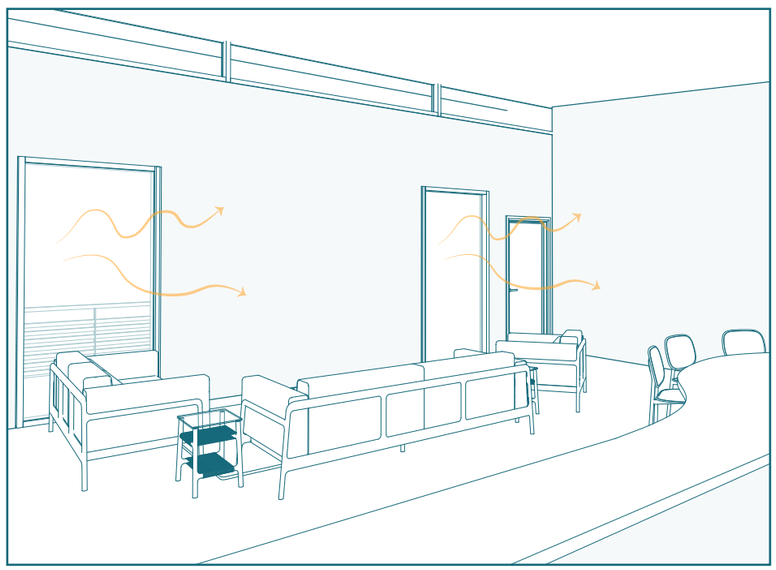
SECTION F
SANITARY AND OTHER FACILITIES
Needs for a unisex accessible adult change facility are not met for F4D12 as the building, despite being a class 6 building, is not a shopping centre nor designed to host more than 3500 people.

Within each sole occupancy unit, a kitchen sink, cooking facilities, shower, closet pan and wash basin have been provided as per F4D4(1)(a). In compliance with F4D4(1)(b), each floor is provided a laundering facility, including a wash tub, washing machines and dryers.

Sanitary compartments have doors and partitioning that extend 1.8m above the floor in compliance with F4D8.

ROOMS HEIGHTS
Room heights comply with those outlined in F5D2(1) for the class 2 portion of the building, and F5D2(3) for the class 6 portion of the building. Furthermore, the building aligns wuth general height requirements outlined in F5D2(8).

LIGHT AND VENTILLATION
In compliance with F6D2, natural light is provided to every habitable room within the class 2 portion of the building. Where necessary, such as for the unit bathrooms which don't have windows, artificial lighting is used in compliance with F6D5.



SOUND TRANSMISSION
CLT floors in the class 2 portion of the building are to be dampened to have an Rw and Ctr (airborne) of not less than 50 and an Ln,w (impact) of not more than 2 where separating units from another unit or public lobby as per F7D5.

CLT walls for the class 2 portion of the building, the Rw and Ctr (airborne) will not be less than 50 where it separates units, and doors to the circulation hallway have an Rw of not less than 30.

SECTION J
In alignment with J1V2, the building will seek to acquire an appropriate GreenStar rating or NABHERS rating. To best understand the appropriate glazing, an energy efficiency professional will need to be hired to ensure the glazing U-value complies with AS 4859.2 (as outlined in specification 37).

J3D9 requires glazing within climate zone 5 to have a U-value of no more than U2.2. J3D9(4) requires solar admittance to be no more than 0.13.

J3D14 requires net energy to comply with their provided calculation, considering how floor area and energy usage correlates to power generated by the PV system.

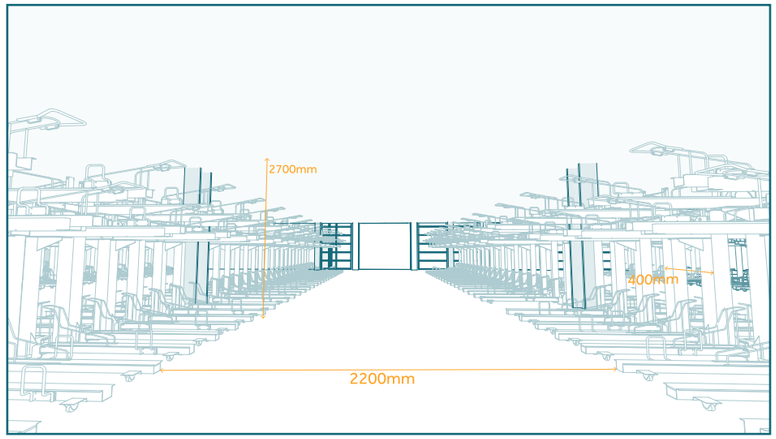
J3D6's need for a thermal break is satisfied by the installation of Hebel Power Panels throughout the building.

In compliance with J7D4, all artificial lighting is controlled by light switches, accessed from within the room being switched.To comply with J7D3, artificial lighting is not to exceed the allowance of 5W/m^2

10 DESIGN PRINCIPLES
To remain ahead of the upcoming updates to the NCC, and to aknowledge the changes already made to apartment compliance, the design places focus on the 10 good design principles, including consideration of ventillation and with strong focus on context and character.

While ventillation is not required within the R-Codes for Rottnest, exercising best practise should include natural ventillation as it is contextually appropriate and capitalises on the naturally windy site.

The design of the residential suites is intentionally reminiscent of other accommodation on the island, connecting to the inherant character of the island and its history. By drawing on the forms already existing on the island, it will assist in helping this building to connect with the rest of the Rottnest precinct, showing consideration of the 'context' considerations of good design.

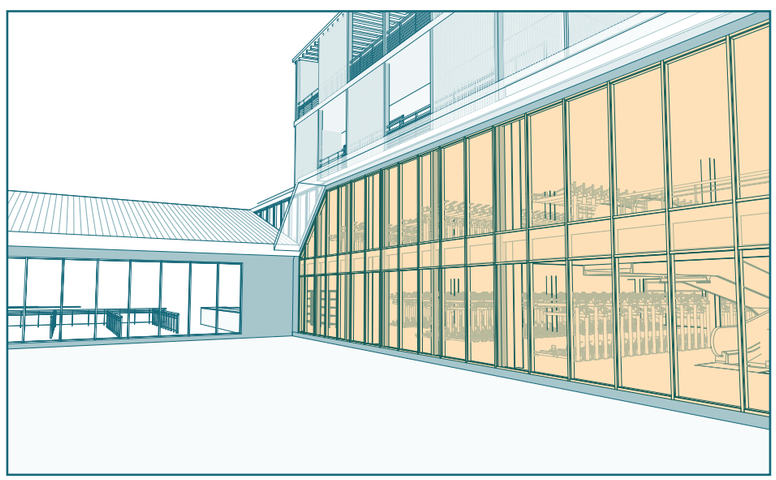


AS 2890.3 - BICYCLE PARKING
Bicycle layout for Pedal and Flipper was completed with reference and adherence to AS2890.3 (2015). Bicycle stands are spaced no closer than 400mm apart, with bikes staggered at 300mm vertical offsets from one another, allowing the reduced spacing.

A passageway of at least 2000mm has been provided as per the standards. AS2890.3 was developed alongside Cora, the bikestand manufacturer selected for this proposal.

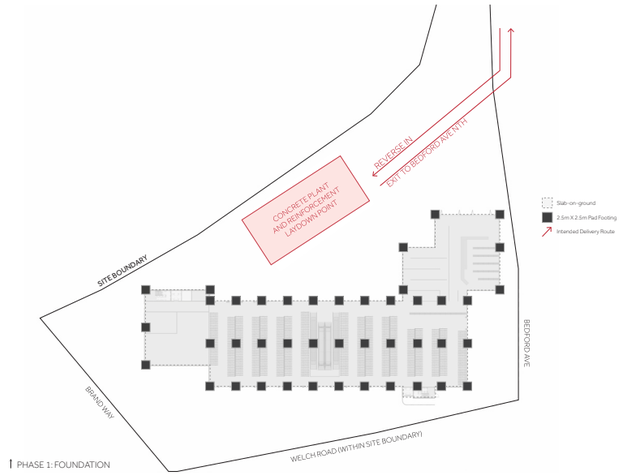
ROTTNEST ISLAND AUTHORITY
Choosing materials and aesthetics that match the Island's existing infrastructure was key for complying with the Rottnest Island Authority's guidelines. They emphasise the design respecting the landscape and considering the economical, environmental and social sustainability of the precinct.

Orienting the building north was also key, with the Authority requesting northern light maximised and east and western facades with minimal fenestrations. Additionally, plants on-site are to be native to Rottnest.



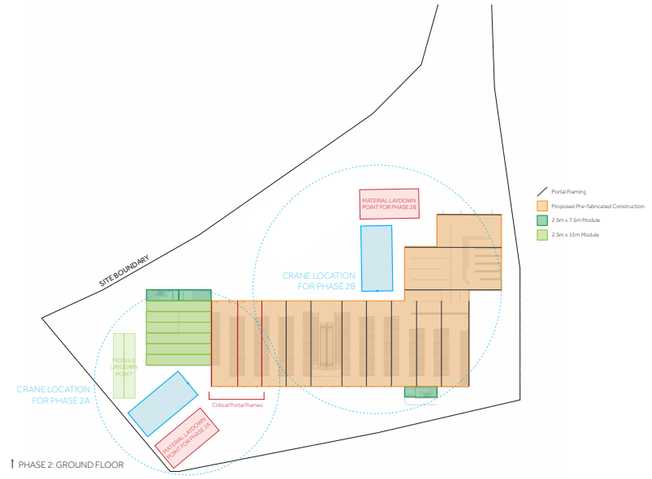
CONSTRUCTION PROGRAM (ADAPTED FROM ENGINEER'S REPORT)

The construction procedure is broken up into 6 main phases and sub-phases dependent on the selected crane location for what needs to be installed.



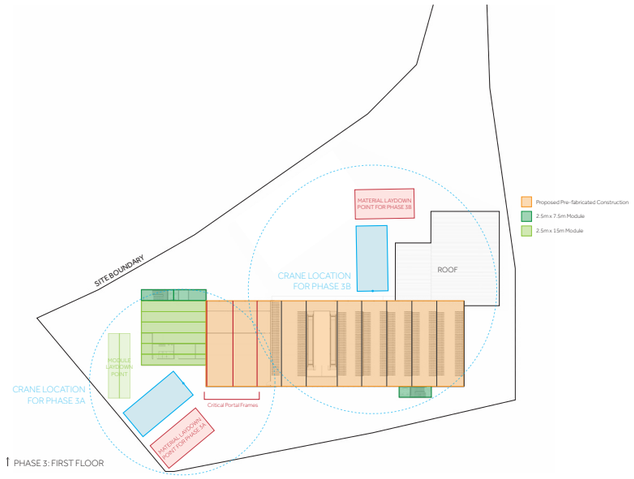
Phase 1: Foundation

The site will be excavated to the Reduced Levels (RLs) as specified by engineers, mixed with grout to reduce settlement and compacted to 100% OMC & 95% MMDD as specified by engineers. The mobile concrete plant is to produce concrete Slab-on-ground (108 cubic m per day) and pad footing (57 cubic m per day) concrete. Reinforcement delivery trucks (with cranes to offload material cages) to follow route specified.



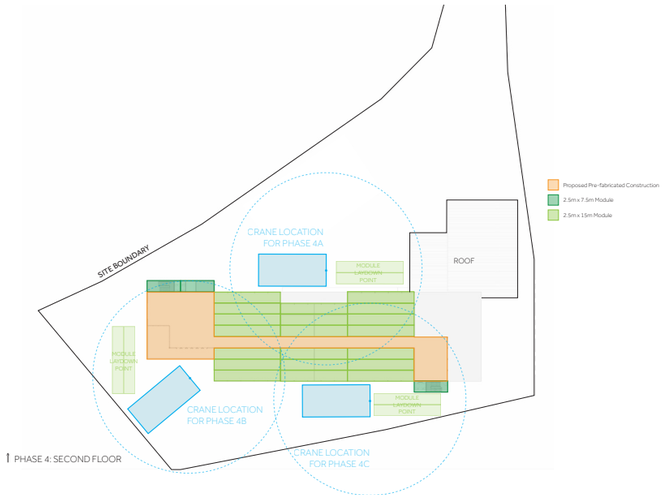
Phase 2: Ground Floor

Phase 2 begins when the foundation is finished as specified. Phase 2A shall begin by installing the critical portal frames and bracing accordingly. Note that temporary supports for the portal frames column will be required until bracing is connected as specified. Phase 2B begins when the modules have been installed as specified. Beginning with the portal frames closest to the critical portal frames, construction of the ground floor will continue East, then to the entrance portal frames and bracing from South to North.



Phase 3: First Floor

The crane placements, general site layout and construction procedures for Phase 3A and Phase 3B are identical to Phase 2A and Phase 2B; the only difference being the standard method of entrance roofing installation.

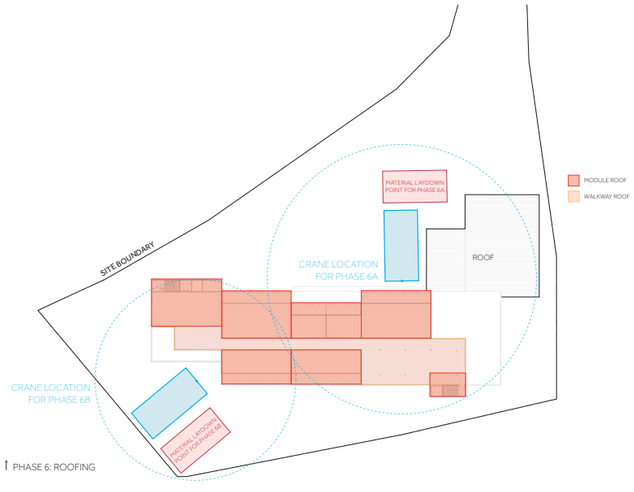


Phase 4: Second Floor

Once Phase 3B is completed to the specifications in the report Phase 4 may begin. Phases 4A, 4B, 4C have been specified to ensure that the modules are lifted within the safe working distance and height of the modules.

Phase 5: Third Floor

Phase 5 can begin once Phase 4C has been completed to the specifications within the report. The sequence of the crane locations is in reverse order of Phase 4 to reduce the distance travelled by the crane.



Phase 6: Roofing

Phase 6 can begin while the crane is in position for Phase 5C, noting the different laydown points for the modules and structural material.

TRANSDICIPLINARY DESIGN APPROACH

Working closely with the engineering team has allowed for design decisions to quickly be omitted if they would not be suitable structurally. It allows for useful discourse and concurrent design and engineering to reach a resolved solution faster and with greater acccuracy.

A collaborative approach has also assisted in shaping how the building functions aesthetically. By considering how columns and other bracing will appear, they can become beautiful features of the design and add to the overall success of the building.

COST PLANNING (ADAPTED FROM ENGINEER'S REPORT)

The following was produced by the engineering team, referencing Rawlinson's Cost Guide 2022, their drawing set and the Civil Engineering Standard Methods of Measurement 4.

BILLABLE ITEM	TOTAL ($)
GENERAL ITEMS	3,529,716
GROUND INVESTIGATION	15,985
DEMOLITION AND SITE CLEARANCE	679,056
EARTHWORKS	80,287
IN-SITU CONCRETE	1,035,668
CONCRETE ANCILLARIES	85,433
STRUCTURAL METALWORK	6,171,950
TIMBER	668,250
SIMPLE BUILDING WORKS INCIDENTAL TO CIVIL ENGINEERING	1,500,000
TOTAL (EX. GST)	**13,826,312**

Additionally, the contingency, markup, GST and stamp duty breakdown is presented below in Table 5. While GST and stamp duty are applied as per industry standards, a contingency of 5% accounts for unforeseen circumstances that have not been mitigated for, such as supply issues. A markup of 7.5% covers overheads during works on-site, and nominal profit for a construction market already inflated in Perth but empty on Rottnest Island.

TOTAL ESTIMATED COST	$13,826,312
5% CONTINGENCY	$691,316
7.5% OVERHEADS AND PROFIT	$1,036,973
SUBTOTAL (EX. GST)	$15,554,601
SUBTOTAL (INC. GST)	$17,110,061
TOTAL CONTRACT VALUE (TCV)	$17,190,061
10% STAMP DUTY	$1,719,006
GRAND TOTAL	**$18,909,067**

BUILDING PERFORMANCE ACROSS LIFE CYCLE (ADAPTED FROM ENGINEER'S REPORT)

The engineers conducted an life cycle analysis on the core considered materials to determine which material would be best for the modules and for the portal frame structure. For the purpose of the table below, embodied energy was defined as the approximate total energy which goes into the production of each of the materials, this includes extraction, processing and manufacture dependant on the material. Embodied carbon was defined as This is the CO2 emissions from the material across its entire life cycle including the transportation, installation and practical use of the material Their results can be seen in the table below;

ITEM	UNIT	STEEL	CLT	HEBEL	CONCRETE
EMBODIED ENERGY	MJ/KG	38.8	34.3	3.6	1.1
EMBODIED CARBON	kgC/KG	1.55	0.437	0.139	0.9
RECYCLABILITY	%	100%	100%	100%	65%

MODULE AND PORTAL FRAME STRUCTURE

Based on the above analysis, concrete has the lowest embodied energy and steel has the highest. However, steel was chosen as it was deemed a more desirable strength to weight ratio, being 8x stronger than concrete in stress, so it is the more appropriate choice for the modules for the same reasons as noted in the flooring selection. Furthermore, steel is able to be recycled at end of life, improving its life cycle. Concrete cannot be completly recycled, leaving at least 35% of the material destined for landfill.

Recycled steel is known to require 73% less CO2 emissions, 64% less primary energy required and 90% less iron ore required when compared to new steel production, helping to create a circular material economy. Steel that has been previously recycled at least once will be the only kind considered for this project.

FLOORING

Based on the above analysis, the chosen material for the module flooring is **CLT** due to its lower density compared to a Hebel Power Panel (480kg/m3 and 653kg/m3 respectively). This change in density would result in a considerably lighter module, lowering emissions exerted during the assembly, dissassembly and reassembly processes.

CLT is quite a new construction material for Australia, only significantly joining the market in the last 10 years. Across a variety of scholarly sources noted by Cadorel and Crawford (2018), CLT has a predicted lifetime horison of 50 years. Due to its novelty, CLT's Global Warming Potential is still heavily contested, with value estimates ranging from +15% to -278% impact.

WALL

In regards to the walls, Hebel Power Panels and CLT were considered. **Hebel Power Panels** were selected due to their excellent fire and acoustic ratings. Furthermore, they have a significantly lower embodied energy when compared to CLT as seen in the table above. Choosing the external walls as Hebel and not CLT has reduced the total embodied energy by approximately 9.5x. Additionally for the external walls, CLT has an embodied carbon of 0.437 kgC/kg compared to Hebel which is 0.139 kgC/kg, this represents a 3x reduction in embodied carbon.