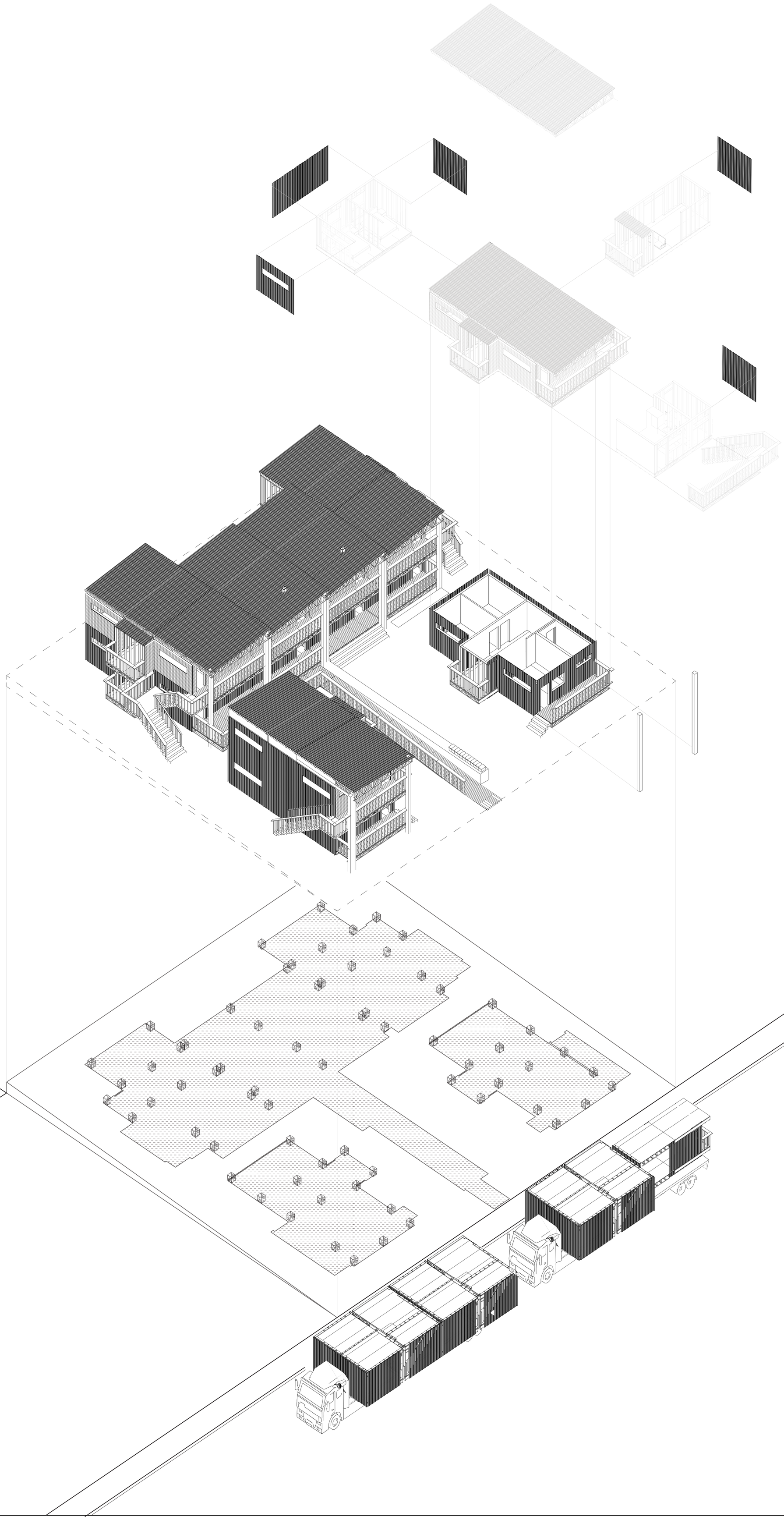
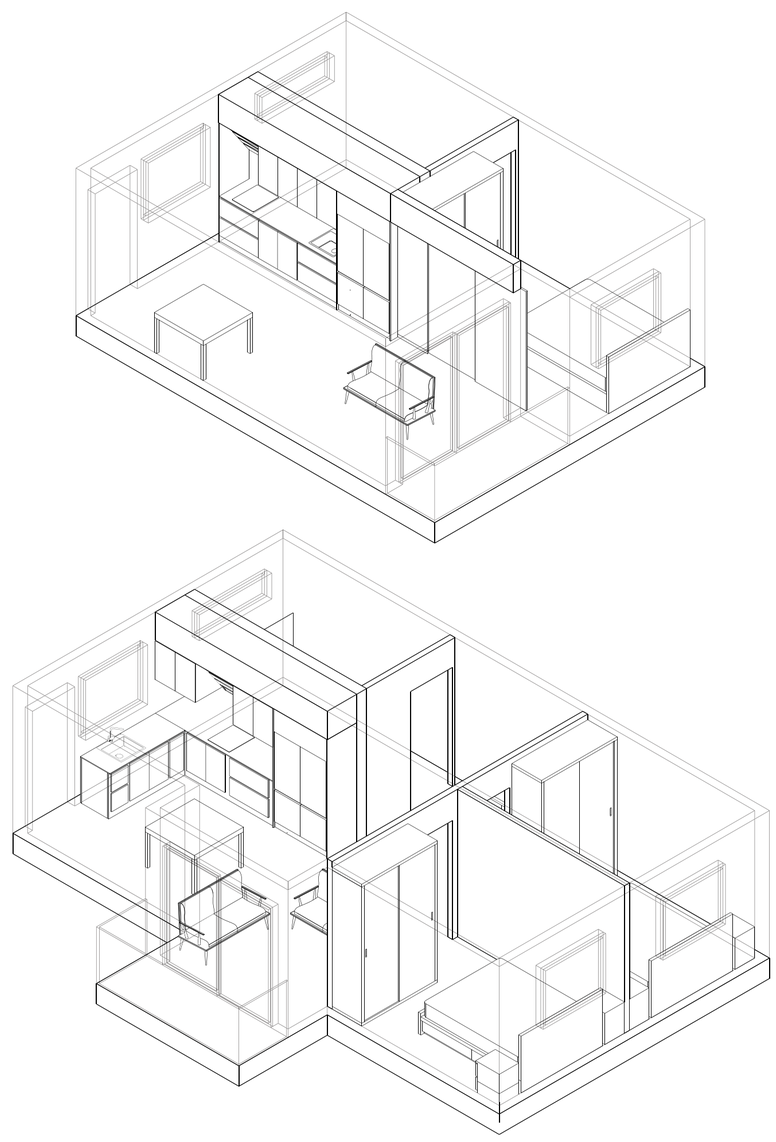
EXPLOADED AXO
Site Assemmbly



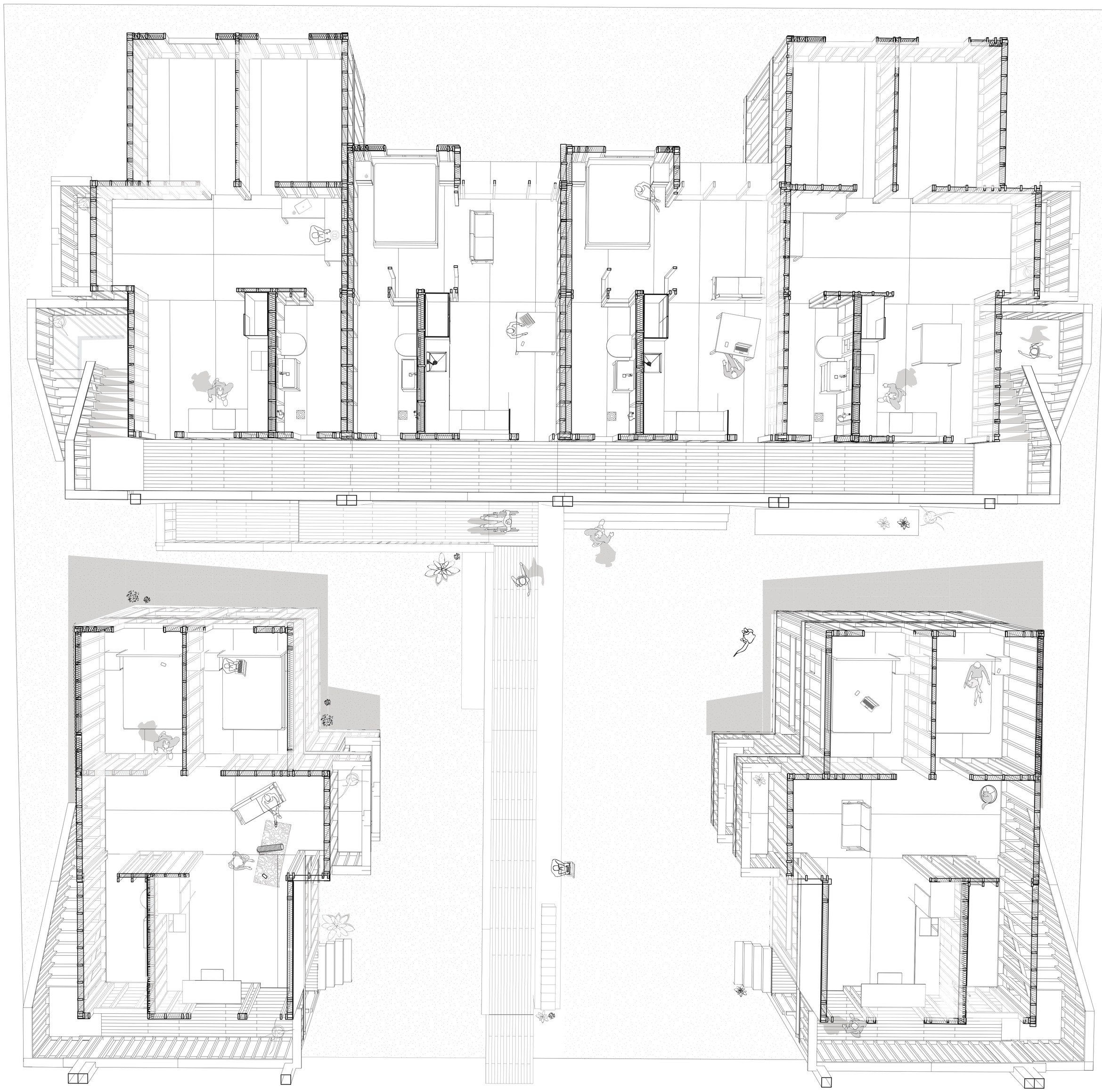
PERSPECTIVE VIEWS
Communal spaces

DWELLING AXONOMETRICS
Interior programming and layout

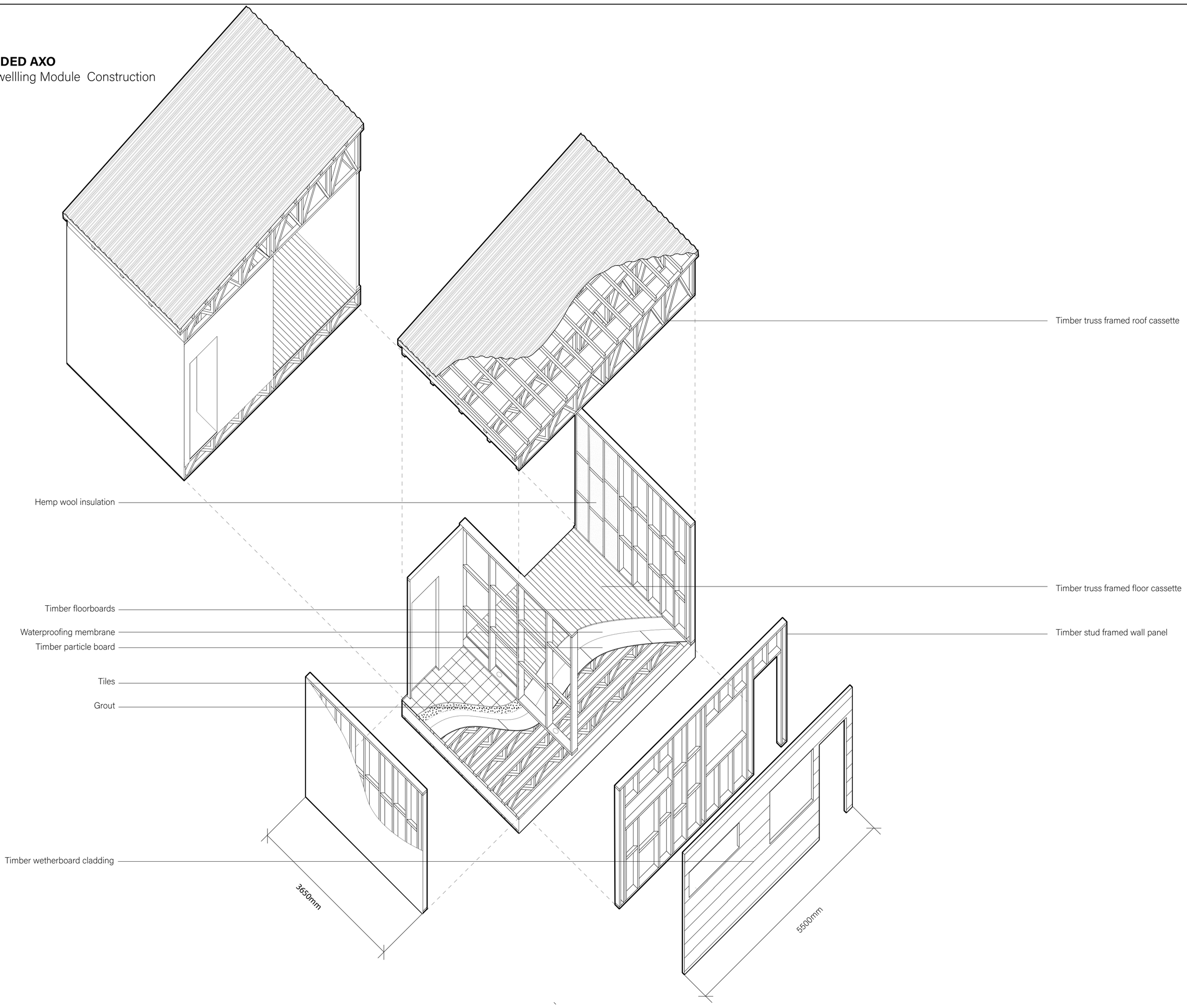


SITE SECTION
SCALE 1:100

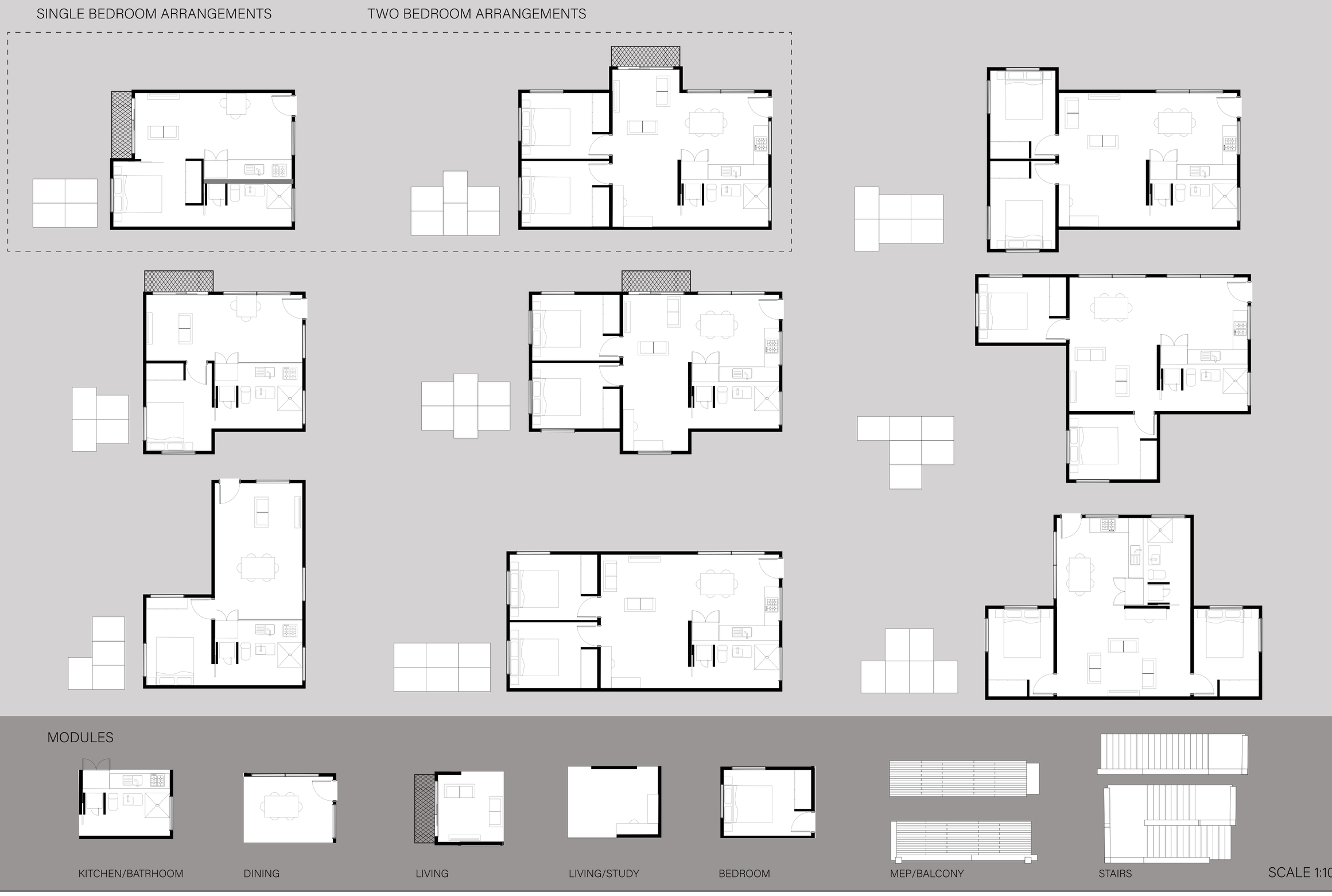
PERSPECTIVE PLAN
Site Plan



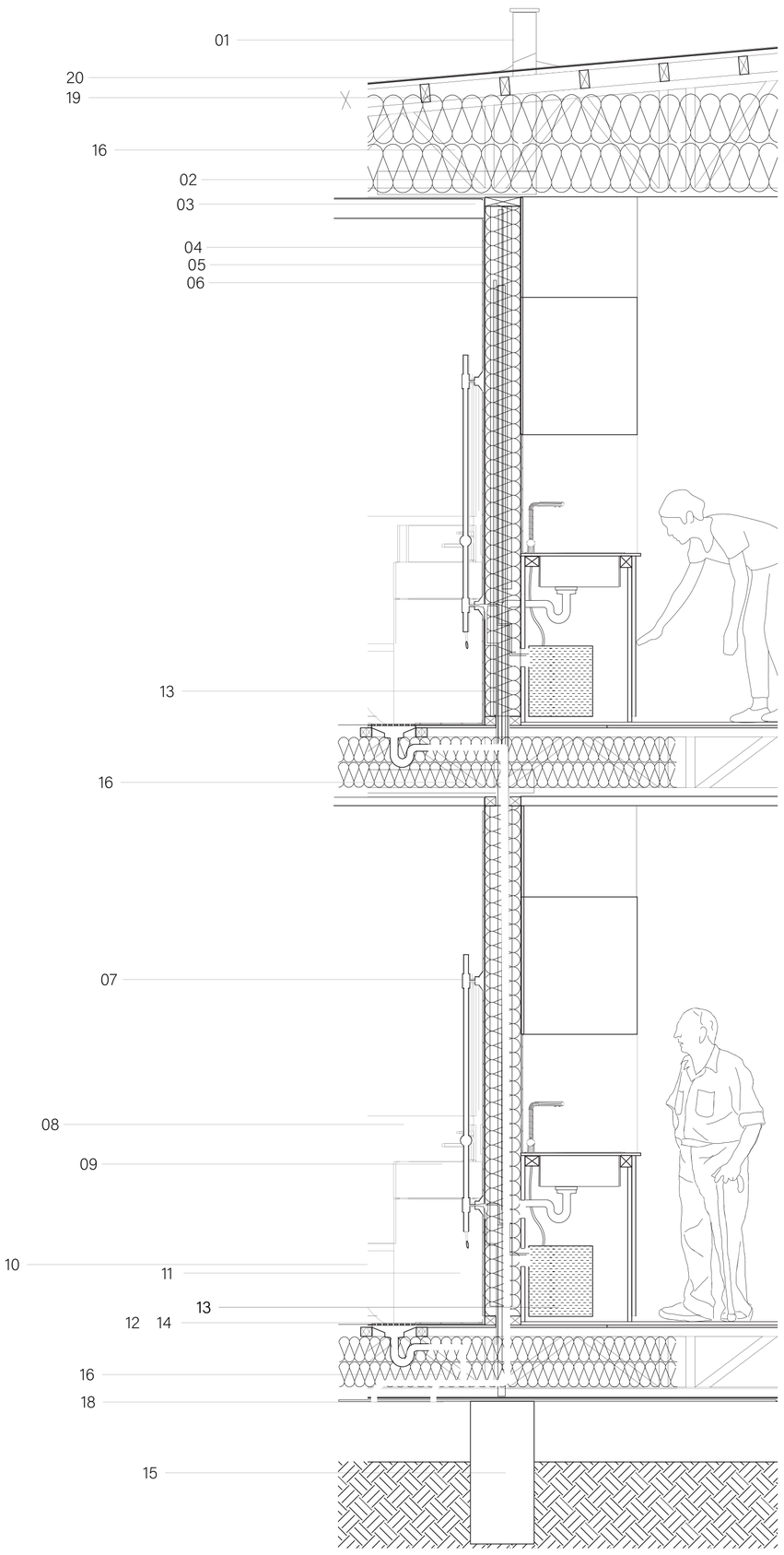
EXPLOADED AXO
Single Dwellling Module Construction



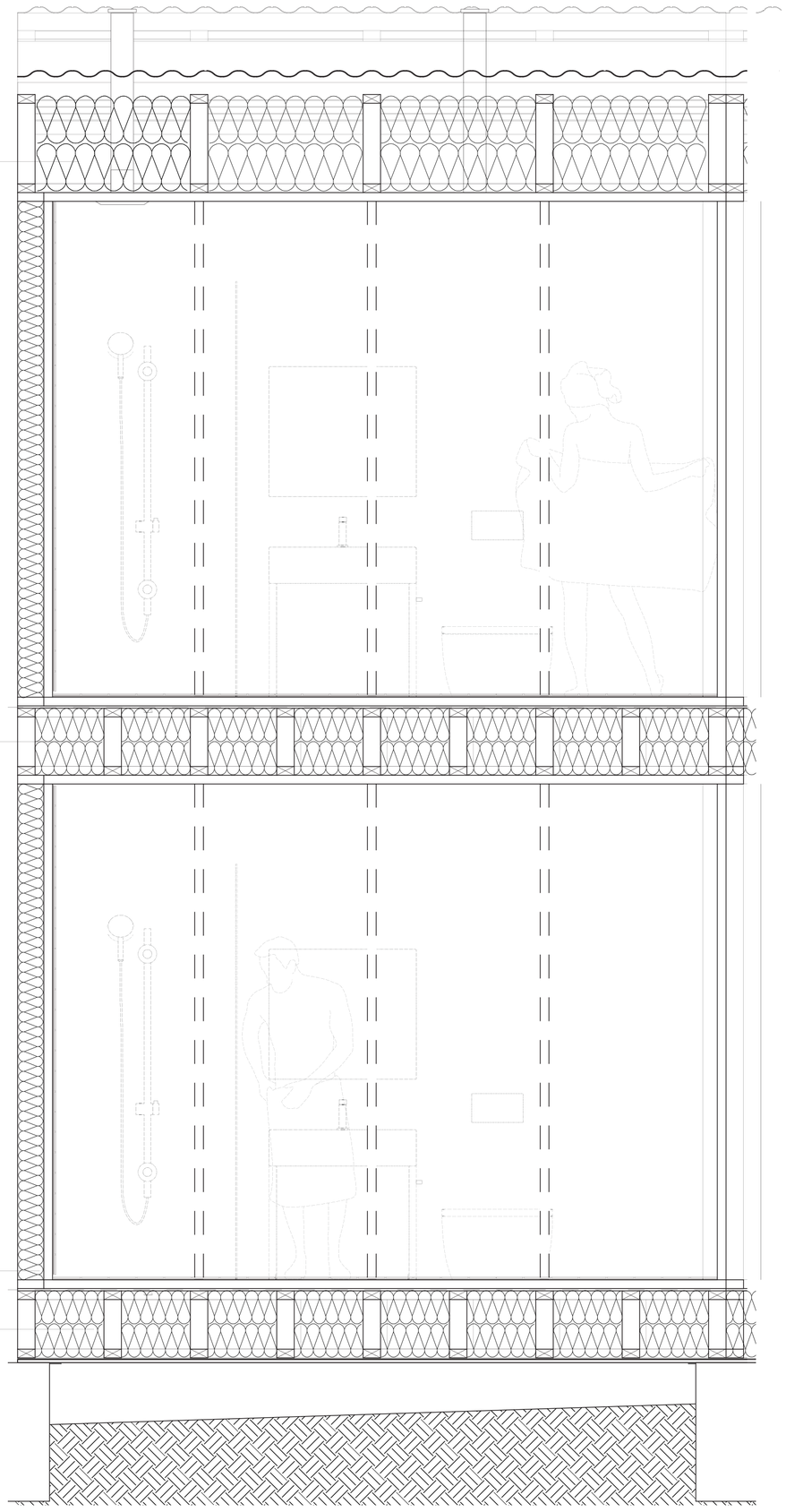
DWELLING PLANS
Possible plan configurations using the modular system



CONSTRUCTION DETAILS
Wall sections scale 1:20



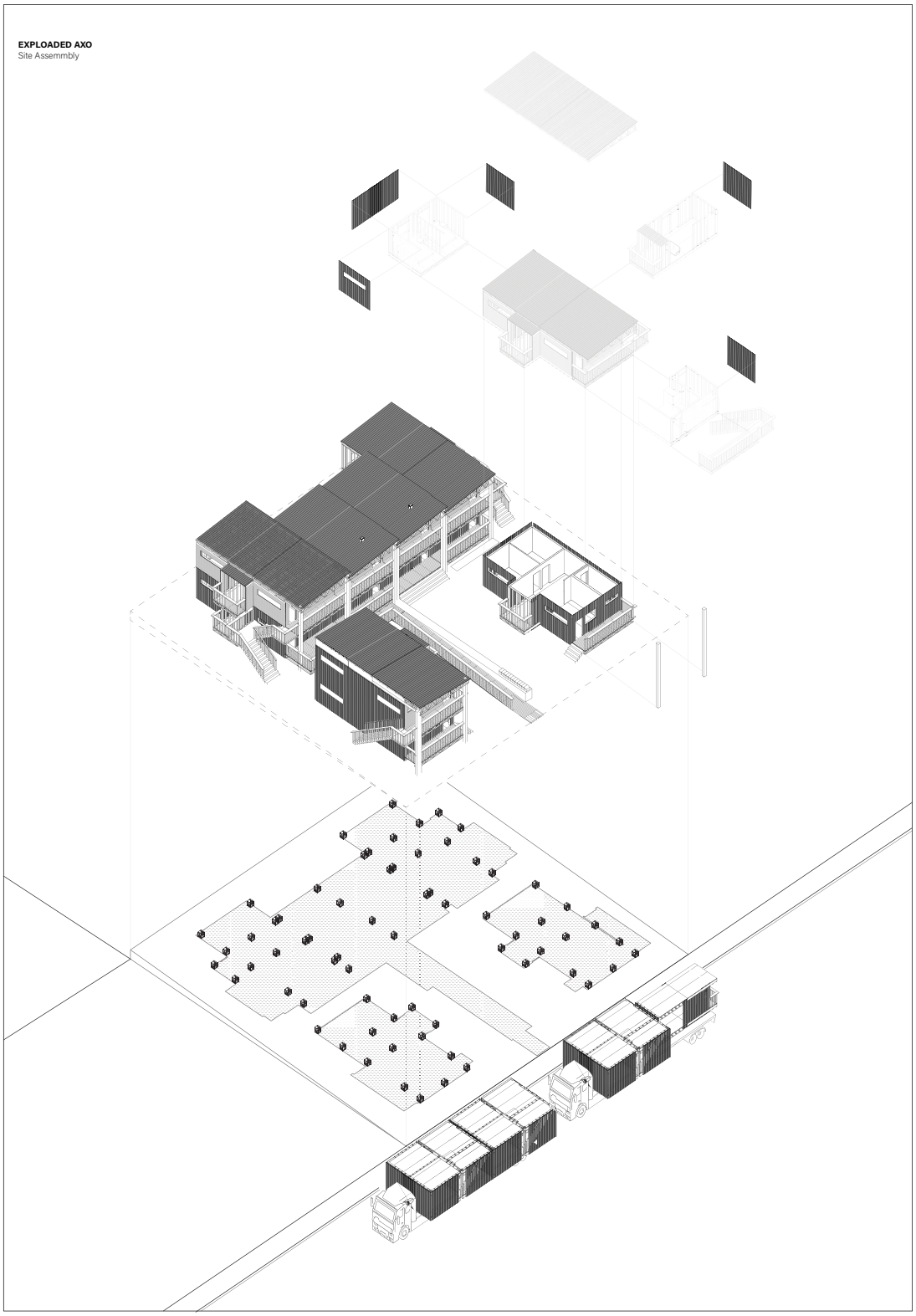
Main MEP Wall_Detailed Section 1:20



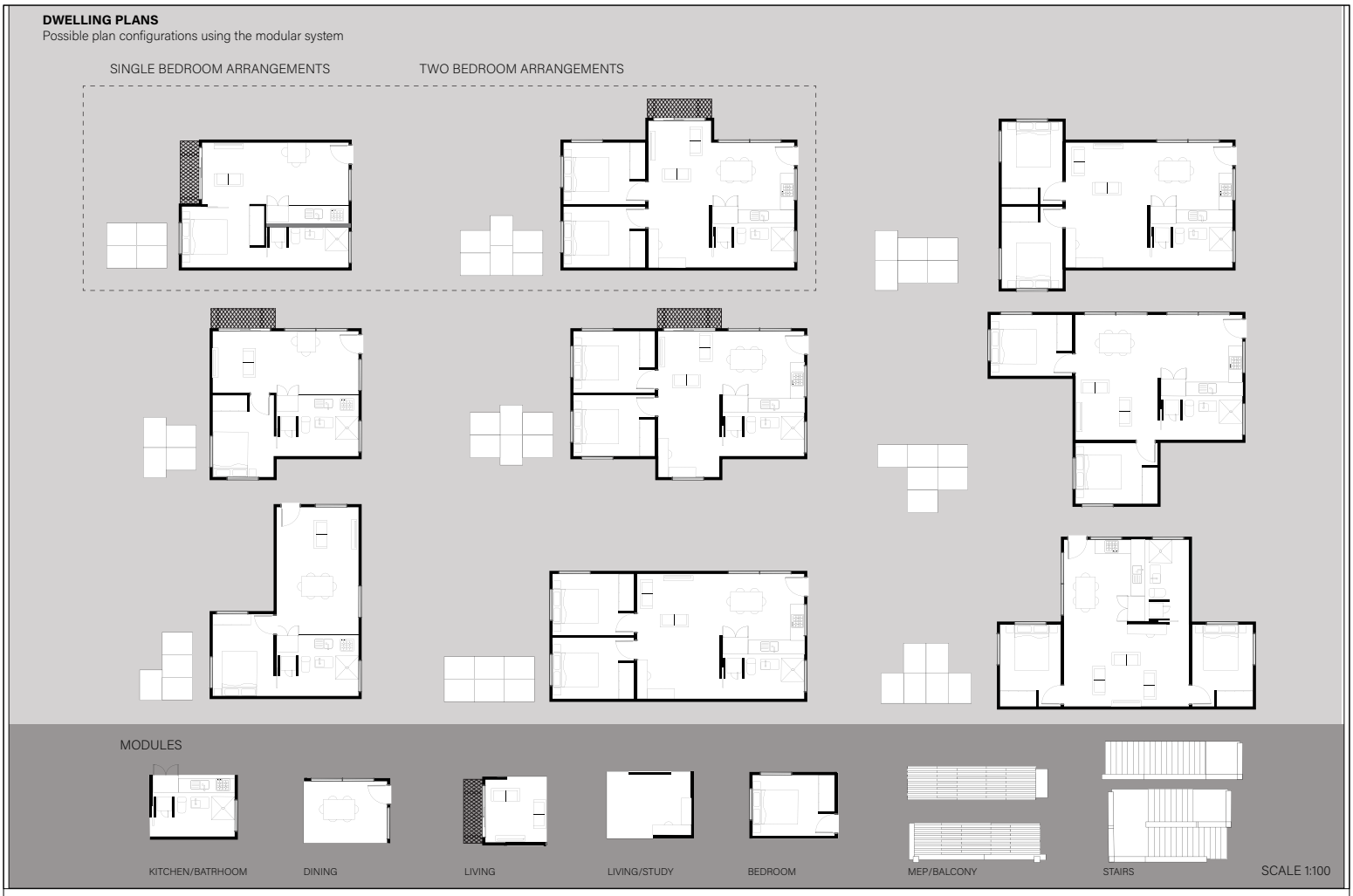
Main MEP Wall_Detailed Section_1:20

01_Exhaust Chimney Aluminium
02_Hemp Wool Insulation
03_180mm Timber Stud
04_2 x Vapour Barriers
05_100mm Ceramic Tiles
06_Timber Panels
07_Shower
08_Washing Machine
09_Sink
10_Toilet
11_Vertically Stacked Plumbing and Electrical Systems
12_CNC Routed Holes for Piping and Electrical Wiring
13_ Shower, Bathroom Sink, Kitchen Sink Hot Water System
14_90mmx 45mm Timber Truss Joist
15_Isolated Concrete Fittings
16 Hemp Wool Isulation
17_135mm x 45mm Exterior Stud Wall
18_ Exterior Vapour Barriers
19_45mm x 90mm Timber Battons
20_ Corrigated Steel Roofing
21_Structural Trusses 345mm x 90mm

PERSPECTIVE DIAGRAM
Services path



Contents



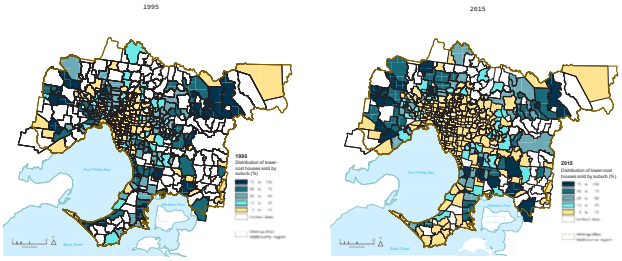
Executive Summary

This project is an affordable, prefabricated housing solution for the Australian Market. Using DfMA, off-site construction and plug & play, this concept uniquely develops an afforable housing solution that can be cost-effectively relocated with minimal cost and stress.

The design employs a volumetric construction system. The dwellings are made up of a series of prefabricated modules constructed off site in a factory and delivered to site 85% completed. These modules are designed so they can be taken apart and rearranged in multiple configurations depending on the site. The single bedroom dwelling is broken down into four areas and constructed as two modules. One module contains the bathroom/kitchen and dining and the other module contains bedroom and living. In the two bedroom dwelling an additional two smaller modules are added to form a living space. These smaller modules are half the width of the main module and are configured along the short edge. These smaller modules are perfect size for an individual bedroom or can be stacked together to create larger living spaces. This allows for more flexibility in the arrangement of the plan.

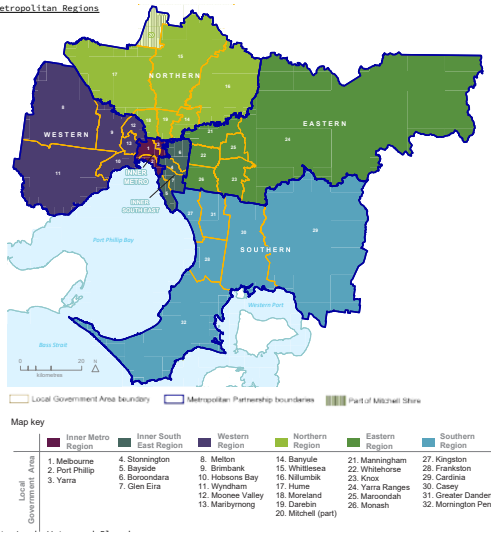
By David Wallace - https://www.flickr.com/photos/wallyonwater54/9756929044/, CC BY 2.0, https://commons.wikimedia.org/w/index.php?curid=30529192

Lower-cost Housing in Metropolitan Melbourne 1995 and 2015



*Lower-cost housing for the purpose of this illustration is defined as the cheapest 25% of all houses sold in Melbourne in the relevant year. In 1995 this was houses that sold for less than $100,000. In 2015 it was houses that sold for less than $415,000." - **Plan Melbourne**

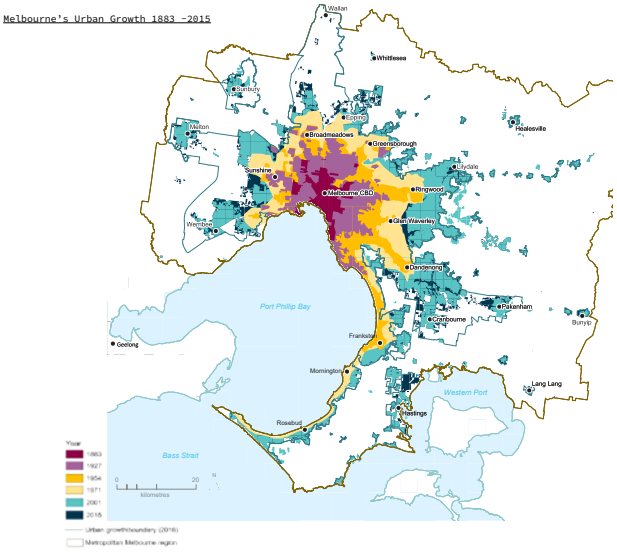
Melbourne Metropolitan Regions



Map key

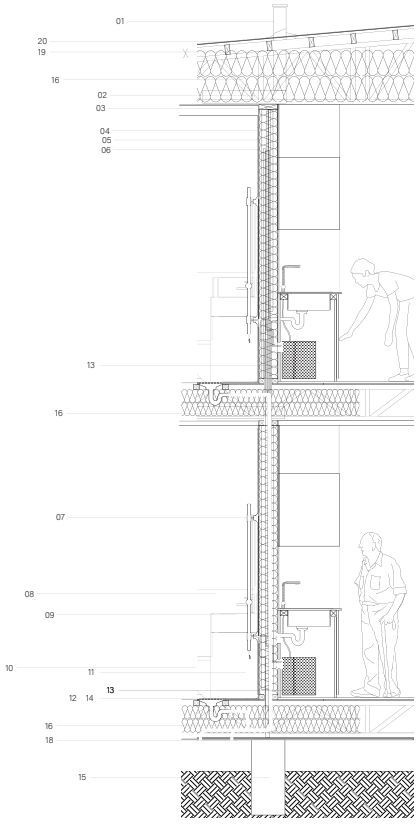
	Inner Metro Region	Inner South East Region	Western Region	Northern Region	Eastern Region	Southern Region
Local Government Area	1. Melbourne 2. Port Phillip 3. Yarra	4. Stonnington 5. Bayside 6. Boroondara 7. Glen Eira	8. Melton 9. Brimbank 10. Hobsons Bay 11. Wyndham 12. Moonee Valley 13. Maribyrnong	14. Banyule 15. Whittlesea 16. Nillumbik 17. Hume 18. Moreland 19. Darebin 20. Mitchell (part)	21. Manningham 22. Whitehorse 23. Knox 24. Yarra Ranges 25. Maroondah 26. Monash	27. Kingston 28. Frankston 29. Cardinia 30. Casey 31. Greater Dandenong 32. Mornington Peninsula

Melbourne's Urban Growth 1883 -2015

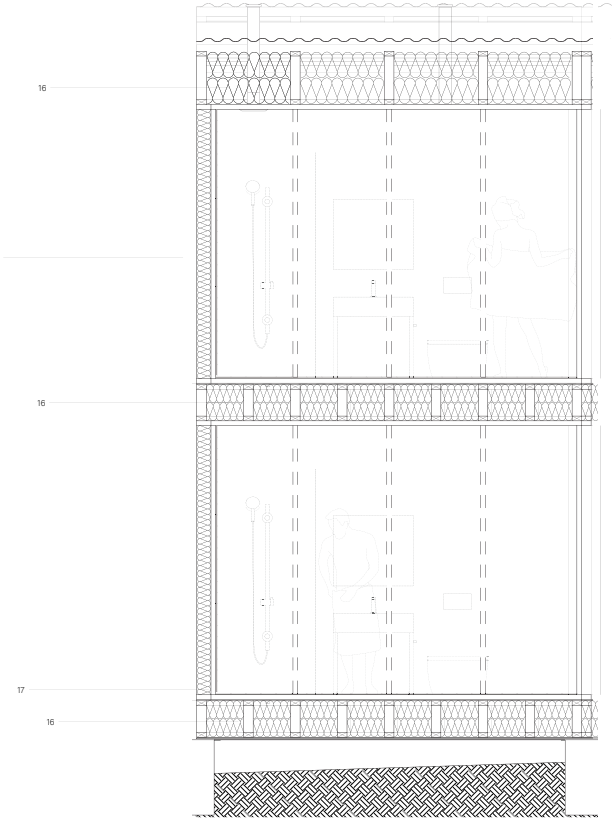


Source: Department of Environment, Land, Water and Planning

CONSTRUCTION DETAILS
Wall sections scale 1:20



Main MEP Wall_Detailed Section 1:20



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21_Structural Trusses 345mm x 90mm

Structural System

Each module is constructed using a series of 2D elements: the floor cassette, the wall panel and the roof cassette. These three systems are individually manufactured on a production line, before being assembled together in the factory.

The floor cassette is made up of a series of timber truss joists using 90x45mm hardwood timber members. These joists span between LVN (laminated veneer lumber) beams that are framed on all four sides of the chassis to create a ring beam. This provides a solid base for the dwellings, with the cassette system being stiffer than typical floor construction methods and therefore will hold up well when transporting and lifting onto site. This base can be easily fixed to the pre-constructed isolated footings on the site, reducing the amount of excavation needed and impact on the site. The timber truss joists allow for plumbing and service connections to easily run underneath the building with minimal need for additional structure.

The wall panels are constructed using a timber stud frame with 135x45mm hardwood timber members. The vertical members follow the spacing of the floor joists at 445mm centres. The frame is reinforced in the corners by an additional timber member spaced 135mm apart to create a column that can support and transfer the load through the stacked dwellings.
The roof cassette is constructed in the same way as the floor cassette however with the top plate of the truss running at a 5 degree angle. This is constructed as a module on its own and only fixed to the modules that are stacked on top.

MEP Panels

A unique design feature to our dwellings is the use of horizontal MEP Risers. These risers are prefabricated and planned using BIM systems and allow for 'plug and play' connections in-situ.
The MEP works to connect the dwellings externally and optimise shared Mechanical, Electrical and Plumbing systems. This reduces significant costs, materials and use of on-site professionals.
This allows for ease of connectivity between units and standardised systems that are easily reproducible.
This also flows into the MEP Wall system, in which all water systems and electrical systems run off within each dwelling. A thicker wall between each Bathroom and Kitchen is hooked into from the MEP horizontal riser and provides connection from the mains on the north side of the plot, but can be rerouted when these houses are moved to another.
This flexibility allows for cost effective movement between sites, as one does not have to extract many pipes from the ground, saving on excavation and further embodied energy.
In optimising the use of these MEP Panels, their form provides additional programs above. These programs include:

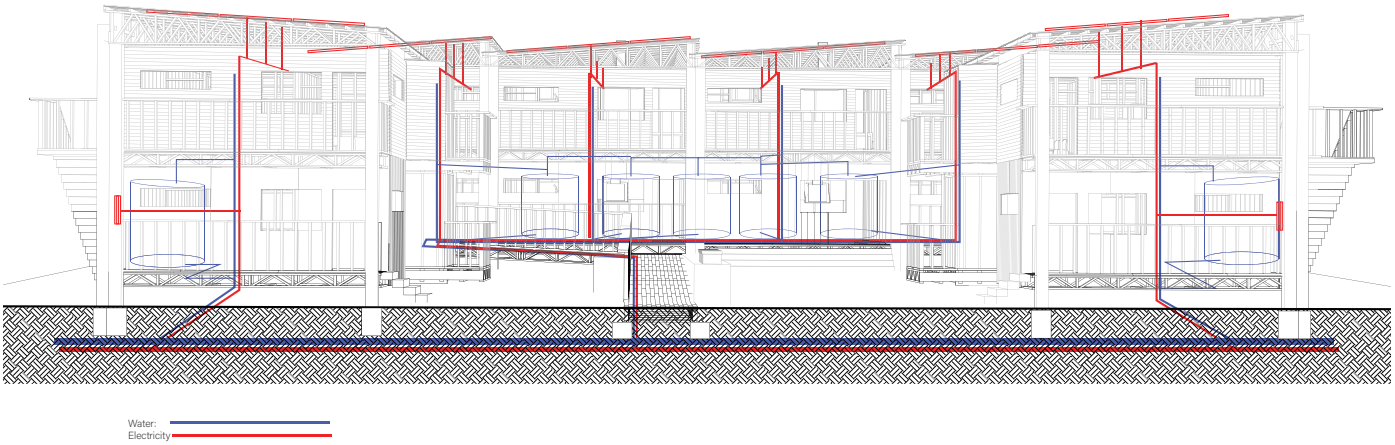
Wheelchair access

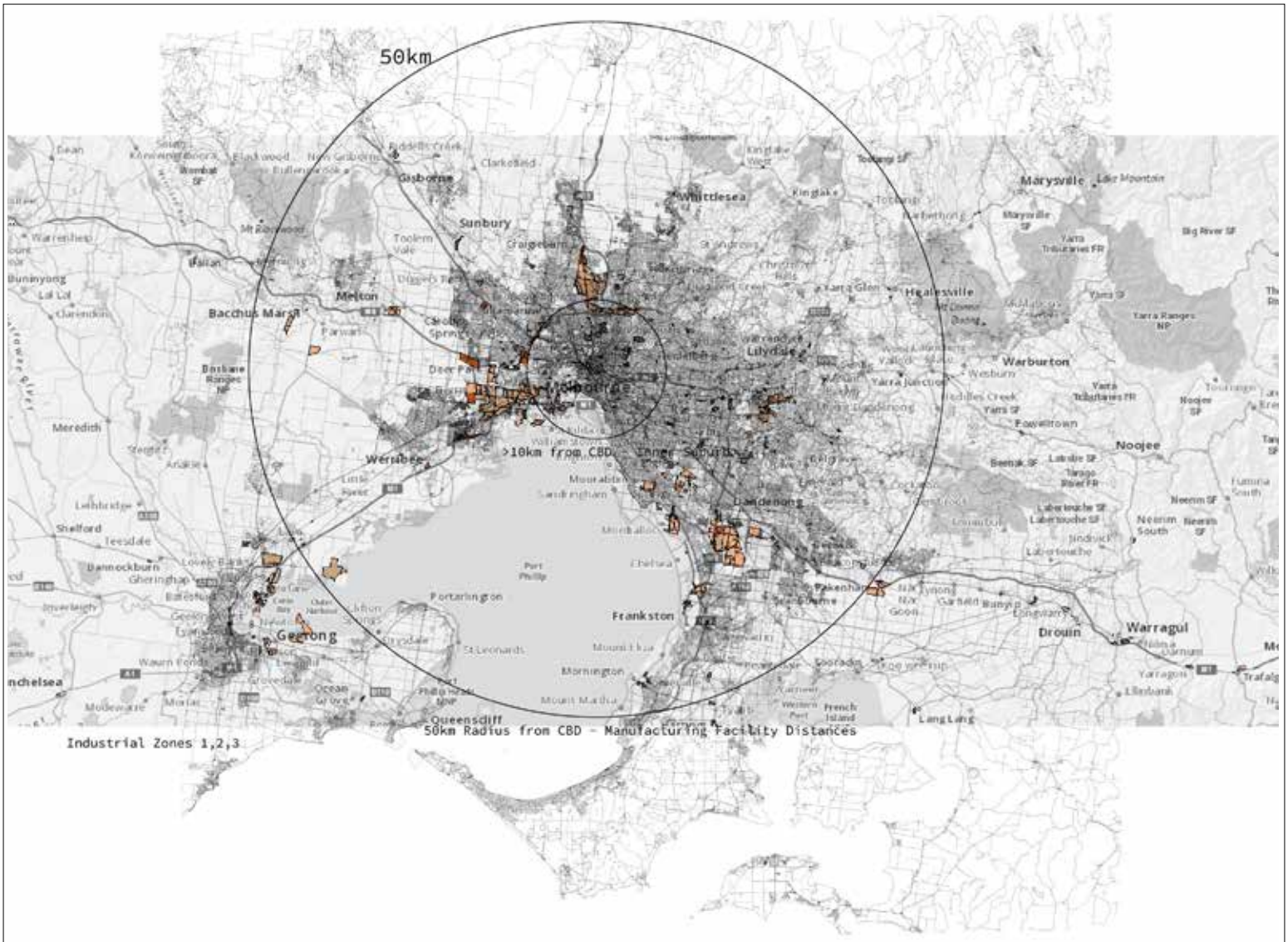
Verandas

Walkways

Balconies (structure only)

PERSPECTIVE DIAGRAM
Services path





Delivery

The modules are designed to be transported to site on a 5.5x18m bed truck. We designed the modules to these dimensions with the aim to optimise the number of modules that could be transported at a time. Our design allows for the four single dwellings to only require two trucks. The other dwellings can subsequently be transported on six trucks with room on all of these for the additional balcony, stairs and MEP modules. Once arrived on site the dwellings will be craned into position via 4 points on the floor cassette structure.

Environmental Optimisation

The design implements environmental aspects including materials, water rank, grey and black water system, and solar system. We have eliminated the need for gas by specifying electric appliances for cooking and water heating.

Materiality - Mass Timber

Timber itself is the most sustainable among all the other materials being used for construction such as concrete and steel. It is due to its ability to lower embodied energy in production and through transportation (it weighs 20% of concrete, so that the deliveries can be reduced to up to 5 times). Timber is also suitable for off-site construction which reduces the risk of project delay.

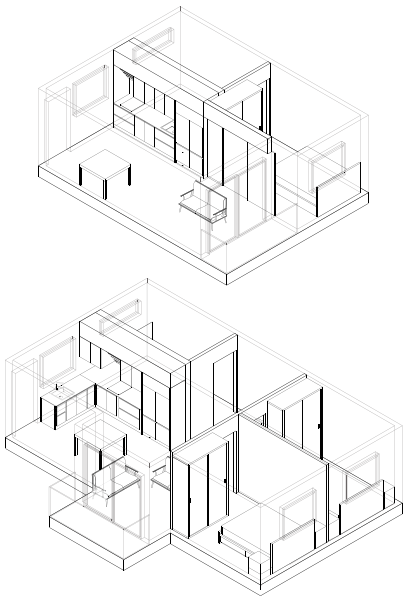
Water Tank + Black and Grey Water Recycling

The development includes the collection and recycling to serve sustainability. Rainwater is harvested into the tanks to be used within the apartment, and the grey water is separated from black water to be purified and used for the veggie garden or plants.

Solar Panelling System

Upon the arrival of the residents, the housing provider can negotiate with the residents to have solar panels installed. On behalf of the residents, the provider will apply for the rebate from the government of up to $1,850 while being able to apply for the interest-free loan for a period of four years.

DWELLING AXONOMETRICS
Interior programming and layout

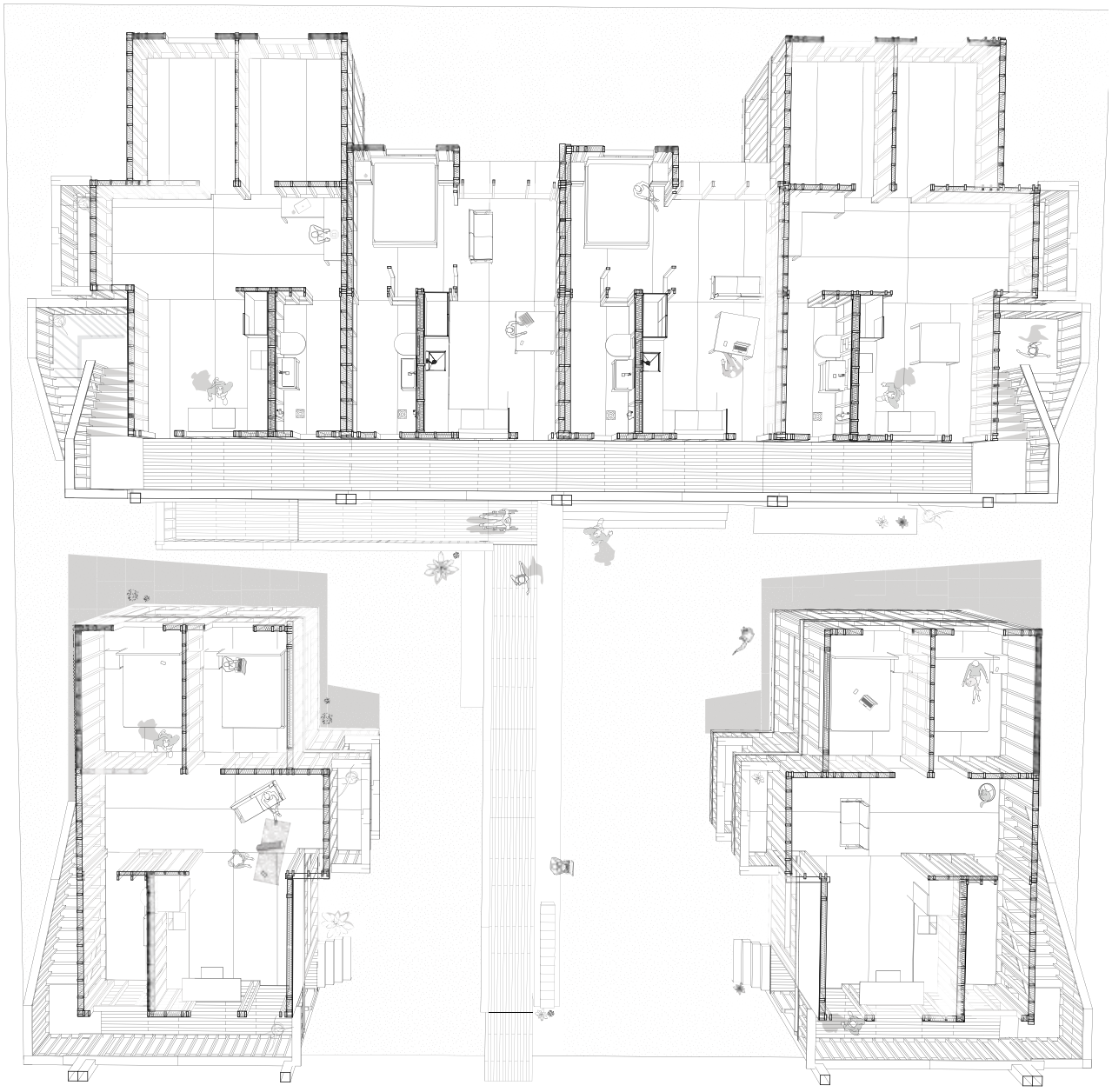


DfMA

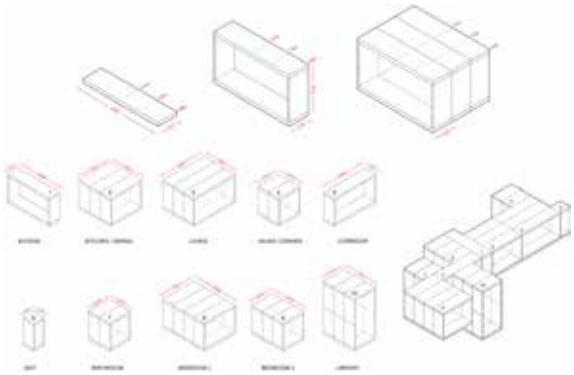
Our design employs principles of DfMA, Design for Manufacturing and Assembly. Throughout each phase of design, our team would consider the implications of the design on its fabrication, environmental impacts and ease of assembly. These considerations drove the design and helped optimising cost, efficiency and significant reduction in the number of materials necessary.

Using only timber for the primary structure of the building provides an optimised use of material when manufacturing. Reusing off-cuts and excess sawdust reused for particle boards provides a drastic reduction of waste relative to in-situ work.

Use of standardised dimensions of particle board has also been employed, only requiring an additional cut to fit the flooring cassette. This optimises the amount of energy used in the creation of our modules.



Community Programs



The Yellow House is a series of prefab modules, covered in bright yellow corrugated panels to form a prefabricated woodland residence in Pucón, Chile.

SIP {[structural insulated panels] Panels are lightweight structural panels.
8mm OSB(Oriented Strand Board) has been used for the stressed skin (metal, cement firbe can also be used). Insulation can vary from vegetal fibres, mushroom mycelia to polystyrine/polyurethane).

Structural System:
SIP Panels

Cost:
1,513AUD (from Chilean UF) per square metre. [average lower range Victorian cost per square metre :1,720AUD, ABS 2018]

Yellow House - Alejandro Soffia 2019

"Using always 8 mm thick OSB, you can change the thickness of the isolating polystyrene due to structural matters. Then for use as a structural wall, the panel must be at least 116 mm thick. And for use as a structural slab, the panel must be at least 160 mm thick. In this case, I use 116 mm thick panels for walls, and 210 mm thick panels for slabs. Most of SIP systems required joint components that usually represent structural reinforcement of the system too. In this case then, I use 2×4" wood board for walls joints; and 2×8" wood board for

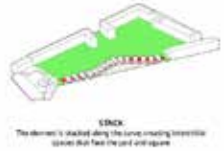
Source: Alejandro Soffia, Arquitecto , AECCafe , ArchDaily:Yellow House
https://www10.aeccafe.com/blogs/arch-showcase/2019/05/03/yellow-house-in-pucon-chile-by-alejandro-soffia-arquitecto/

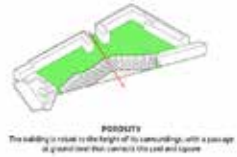
Dortheavej Residence fulfills the "Homes for All" mission for non-profit affordable housing association Lejerbo in Copenhagen. Dortheavej was honored with the Danish Association of Architects' Lille Arne Award for prioritizing the spatial qualities of the residences and the building strategy on a strict affordable housing budget.

Structural System:
SIP Panels

Cost:
2,255 AUD per square metre. {lower range Victorian cost per square metre :1,720AUD, ABS 2018]

Dortheavej Residence - Bjarke Ingels Group 2018





66 Apartments (60-115sqm)

Source: Bjarke Engels Group, Eumiesaward Website @ https://miesarch.com/work/3924

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Bike storage https://www.homecrux.com/bike-storage-ideas-tiny-apartment/34738/