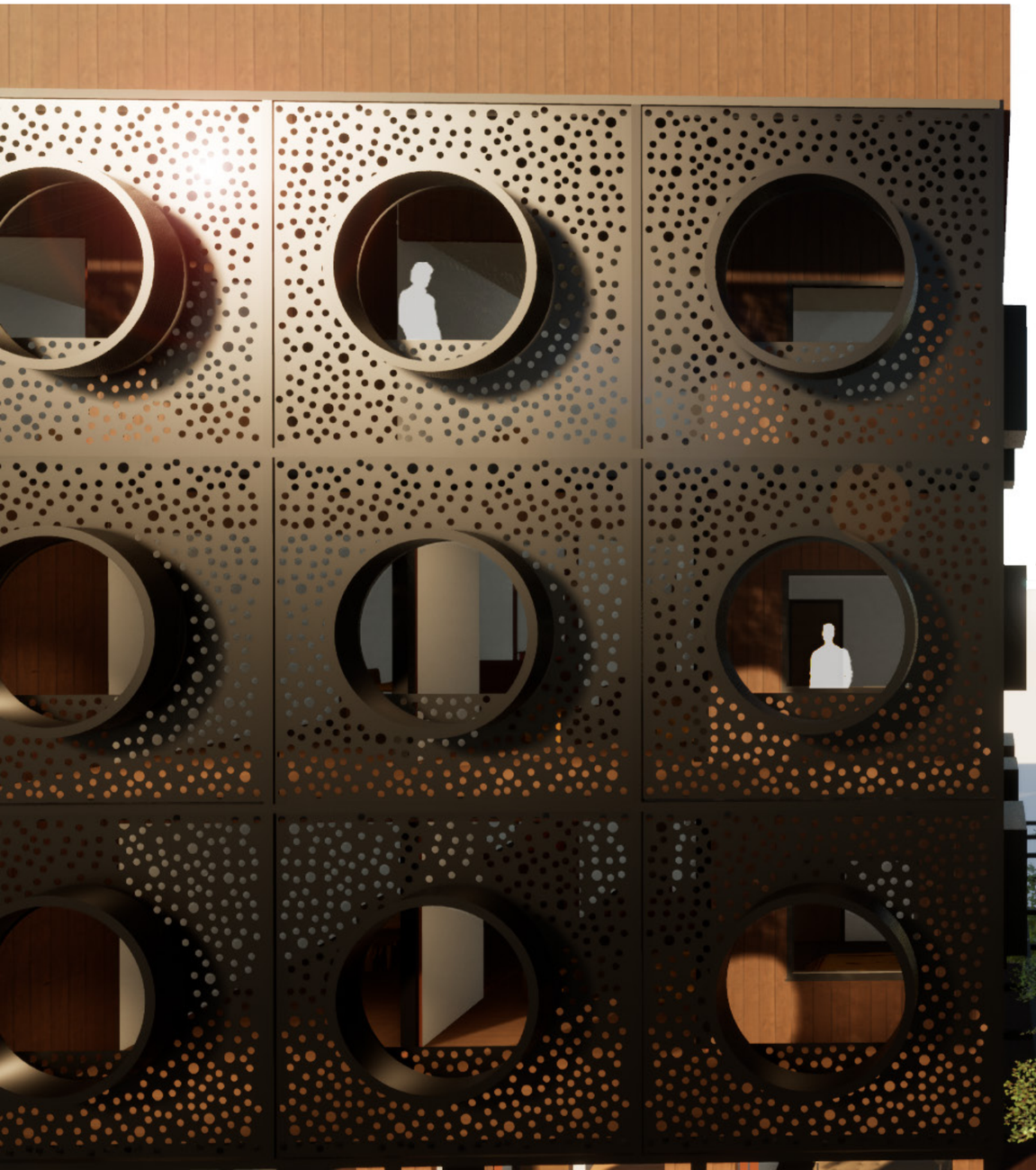
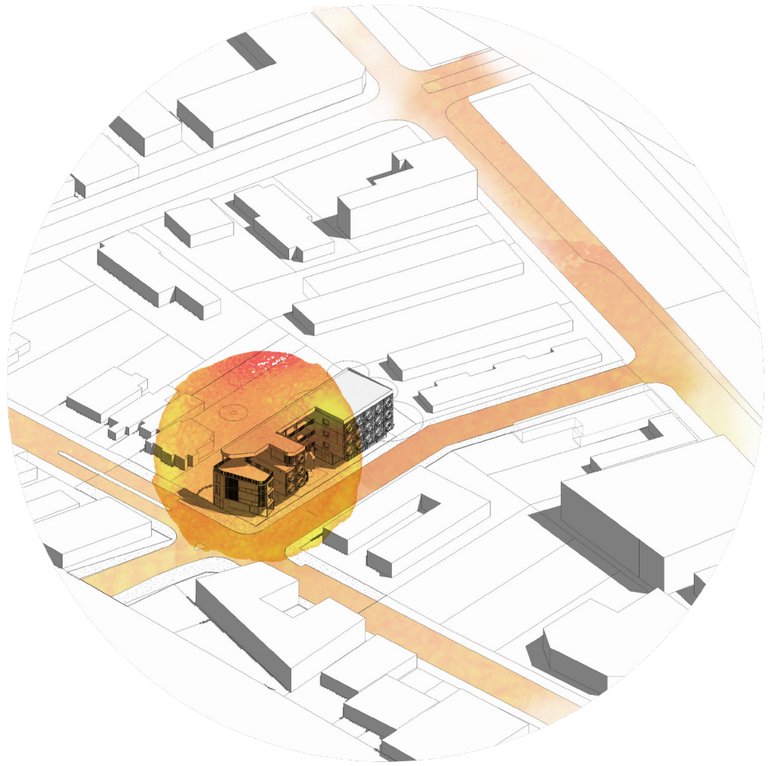
CIRCLES ON VICTORIA





CONTENTS

ABSTRACT

“As revolutionary as architecture and the construction sector appears, it currently accounts for nearly 40% of the worlds carbon emissions, 11% of which are a result of manufacturing building materials such as steel, cement and glass” (Archdaily, 2022). The United Nations are referring to the situation as the **“code red for humanity”**, and the idea of net zero carbon emissions have become increasingly apparent in the application of systems including construction in order to dramatically reduce these emissions (Curtin University, 2022).

Situated in the suburb of Midland, Perth; this project works to address this issue whilst tackling the burgeoning affordable housing crisis facing Australia and Perth in particular.

Due to Covid 19, lower socio-economic and homeless communities are more at risk due to the lack of social awareness and poor healthcare; leaving many individuals and families lacking a safe and protected dwelling as more affordable forms of housing are not readily available. It is these basic principles in conjunction with awareness to a much more sustainable living environment that will ultimately be the key in revitilizing the surrounding Midland community.

01. EXECUTIVE SUMMARY

This project is aimed at delivering a mixed use, flexible, affordable and transportable accommodation design located on 47 Victoria Street, Midland. The core principles of the design are adaptability, sustainability and community living , working as drivers to revitalise the surrounding Midland community.

Through the flexibility of the module design, the site sits 12 self-contained apartments that also focus on its communal spaces in between. The apartment complex contains a community centre with a shared kitchen, lounge and maker space/activity room, public laundromat, café and library space.

The proposal endeavours to express the benefits and adaptability of off-site prefabricated construction. With its proven predictability, efficiency, reduction in costs and worker safety, it creates a great tender for a more economical structure that challenges traditional building methods. Drawing upon the philosophy of circular economy, the modules structure, materials and their sizes are all designed to allow for the buildings end of life reusability.

Overall, this project proposal works to rejuvenate the area through incorporating vibrant community spaces and opportunities for businesses to thrive, as well as providing a housing project that challenges traditional social housing methods by blurring the threshold between public and private living.

NET ZERO 02. INITIATIVES + RESEARCH

The proposal endeavours to express the benefits and adaptability of off-site prefabricated construction. Research was conducted to ensure the optimal efficiency and innovative methods to prove the projects core principles in adaptability and modular construction and its benefits against typical building construction.

INNOVATION

ROBOTICS
Due to Covid-19, many shortages to labour workers have resulted in challenges to the construction process. New technologies such as self driving construction vehicles, drones to view site from other locations, and industrial robots can all aid in reducing the need for construction workers, labouring costs and increase safety in construction.

CLIENT + COMMUNITY

The design honours the client bried by delivering a project that is modular, pre-fabricated and transportable. The flexibility of the module design provides the ability for the facade to change and adapt where there is potential expansion to occur. The essense of the design revolves around community engagement, incorporating multi-use building with circulation wells to encourage interaction.

DFMA DIS-ASSEMBLY

The demountable design utilises typical structural member sizes and material spans to ensure re-usability for when the building reaches its 'end of life' and needs to be repurposed.

ENGINEERING

The design was iterated with the co-ordination of enthusiastic structural engineers. Obstacles such as minimal usage of steel construction, weight of modules, and cantilevered elements were resolved to produce a final structurally efficient design.

MINIMAL WASTE

Off site prefabrication allows processes like circular economy approaches to replace onsite construction. All elements of the project except for fire proofing measures are all to be constructed off site. This ensures there is no wastage of building elements, safer working conditions, and reduction in construction time on-site. All prefabricated elements will be constructed as close to the site as possible to limit the amount of carbon emmisions from the transport of these elements.

SMART MATERIALS + REUSE

The structure will repurpose as much elements as possible, this includes the reuse of steel members, timber cladding etc. If unable to reuse items, the elements that are required to be newly made will have the properties to be recycled after the buildings lifespan ends.

CLIMATE RESPONSIVE

Good passive design that limits the need for mechanical systems to maintain a comfortable livng environment not only emits less carbon, but achieves a higher level of satisfaction and interaction between the user and the building. Due to the sites west facing manner, measures such as north facing windows where possible, sunshading devices, and high thermal mass flooring allows for a much more efficient method of monitoring internal temperature within the buildings interior.

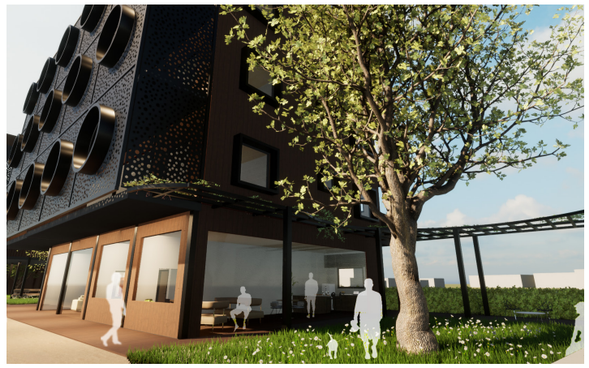
ONSITE-RENEWABLES

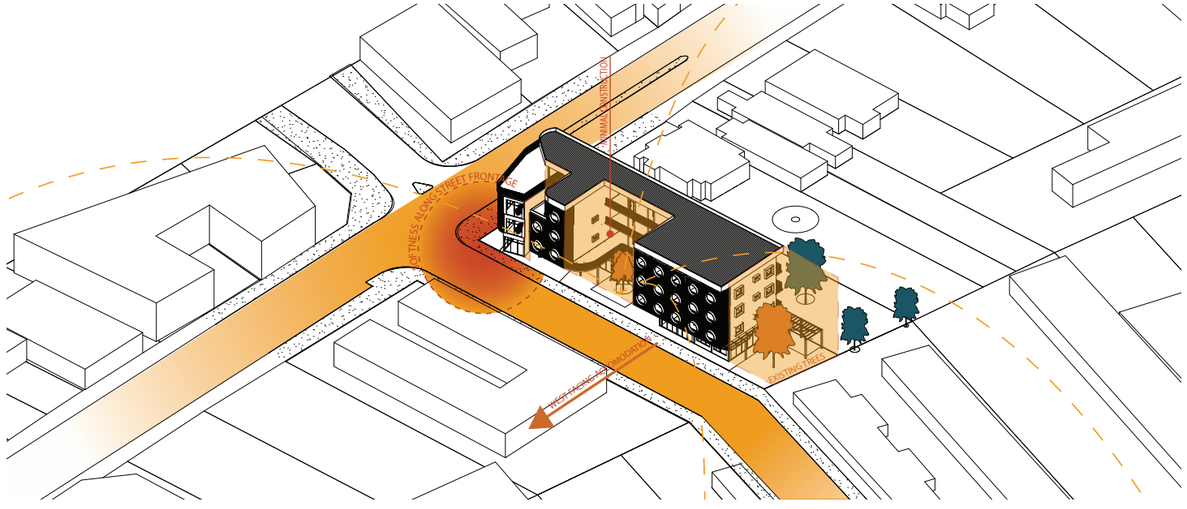
Photovoltain panels will be incorporated on the roof to harvest sun energy throughout the day. Through onsite renewable generation, the building will minimise the need for mains power supply.

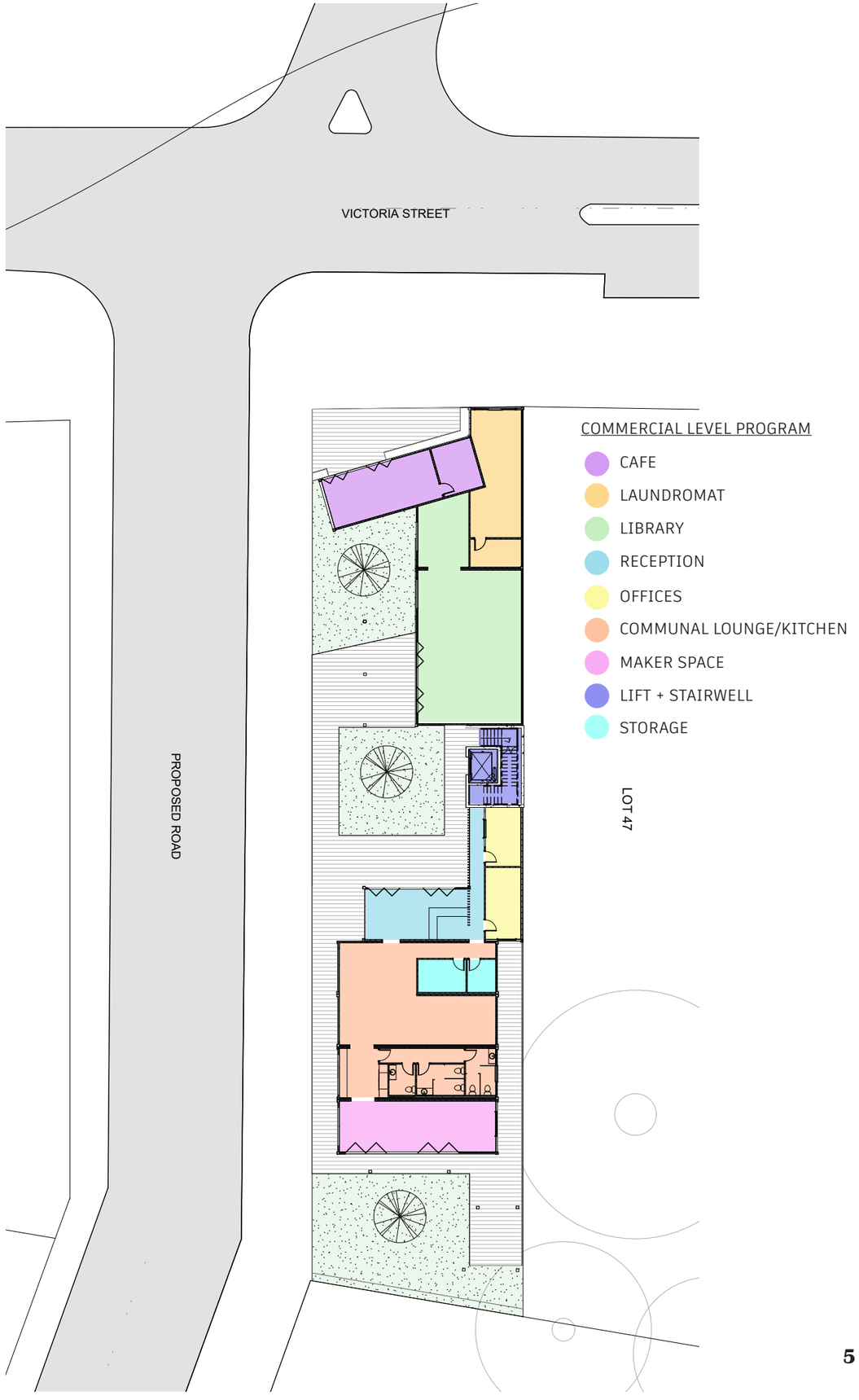
03. DESIGN CONCEPT

URBAN STRATEGY.

The proposal works to revitalise the urban fabric of Victoria Street through utilizing the councils addition of a proposed road that runs adjacent to the lot boundary. Consisting of a cafe, library space, public laundromat and new community centre, the ground floor plane adapts and manipulates the modular concept to create a more welcoming and integrated public atmosphere.

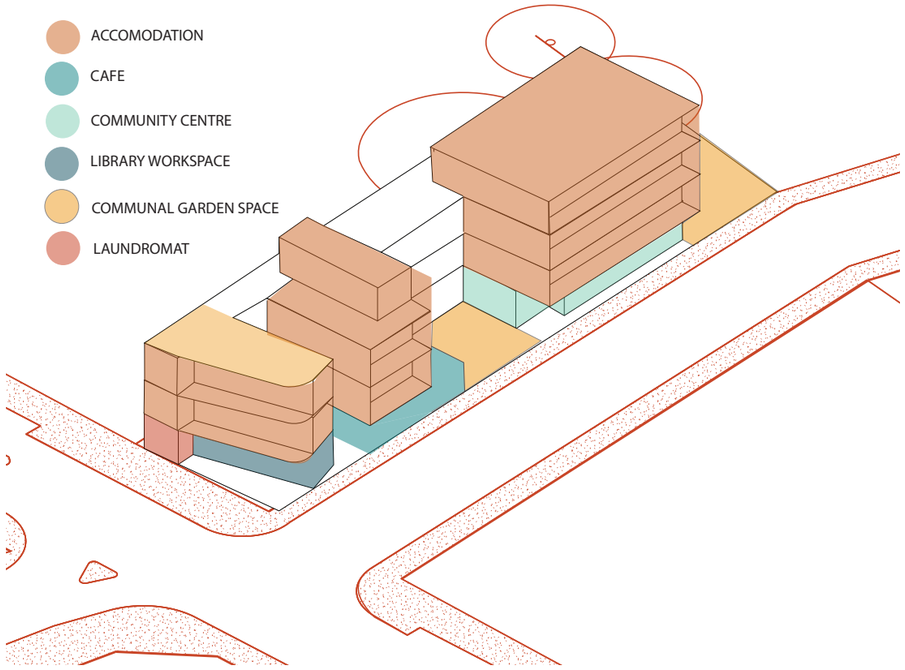




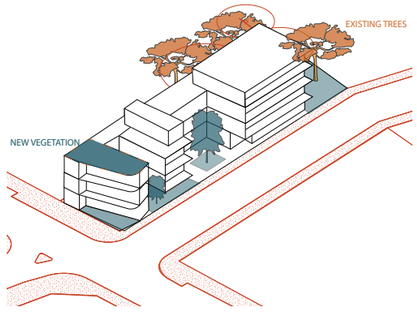


03. DESIGN CONCEPT

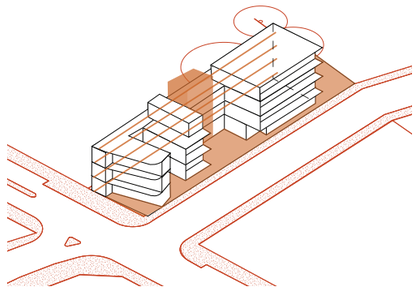
DESIGN FOR LIVING



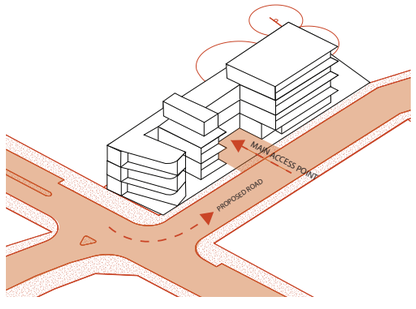
PROGRAM



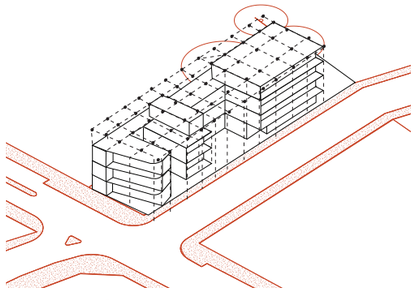
VEGETATION



CIRCULATION



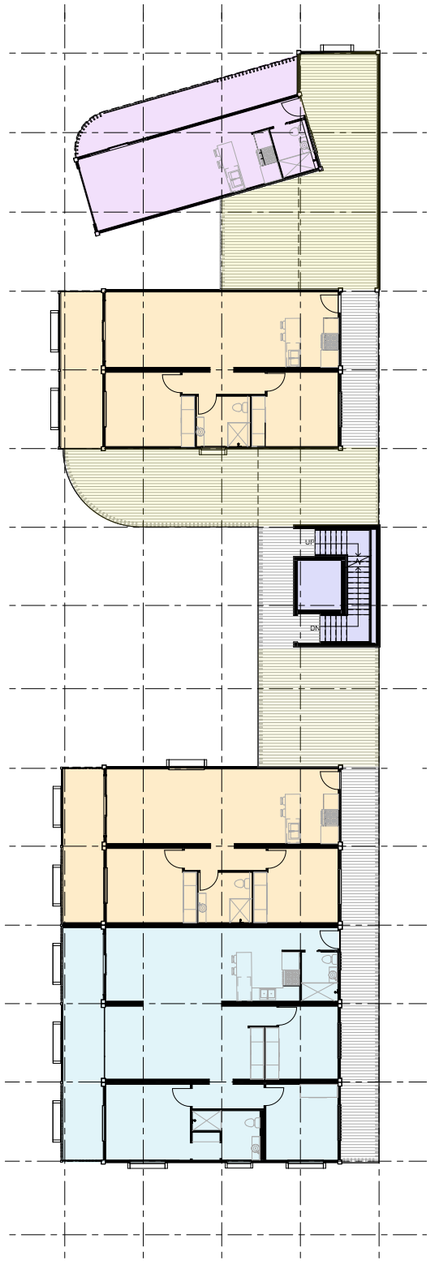
ACCESS



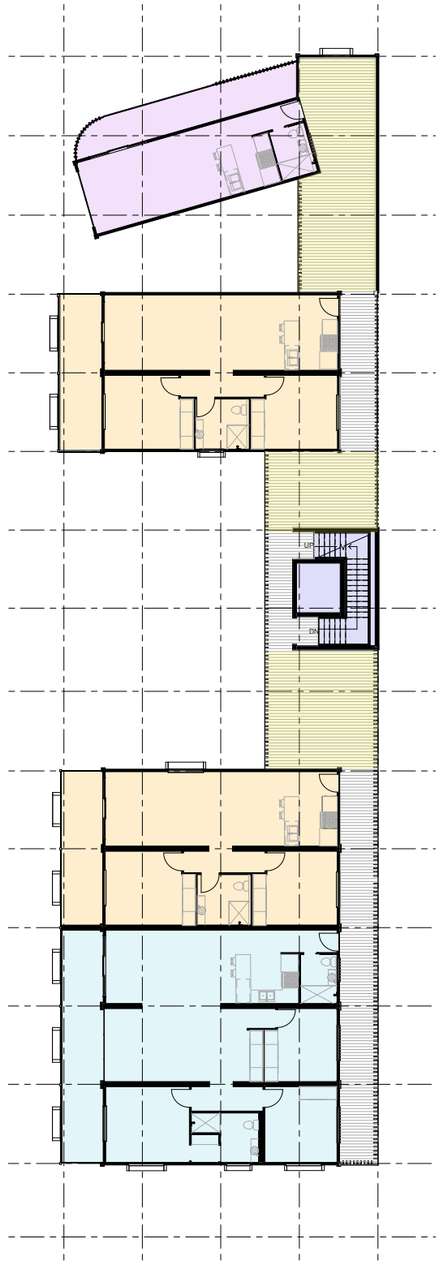
GRID LAYOUT

APARTMENT PROGRAM

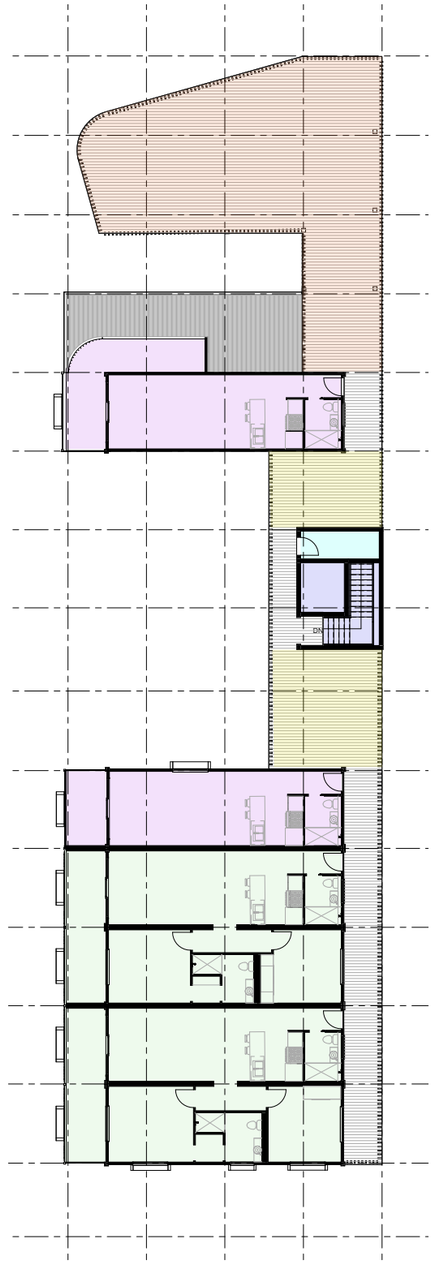
- 1 BED 1 BATH STUDIO
- 2 BED 1 BATH APARTMENT
- 2 BED 2 BATH APARTMENT
- 3 BED 2 BATH APARTMENT
- SHARED BALCONIES
- ROOF TERRACE
- LIFT + STAIRWELL
- STORAGE



FIRST LEVEL FLOOR PLAN



SECOND LEVEL FLOOR PLAN



THIRD LEVEL FLOOR PLAN

03. DESIGN CONCEPT

MODULE BREAKDOWN.

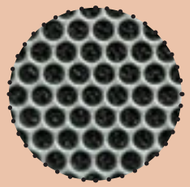
All services required for electricity, gas, telecommunications and water etc will be located underground, and each module will be pre-fitted with the required services and pipes before onsite assembly. The idea of using prefabricated modules aids in the construction process by allowing a base that can be easily modified through the interchanging of internal wallls to meet spatial requirements of that unit. Consisting of 4 different configurations, the minimisation of excess building materials and space allows for the buildability of each module to service the spatial requirements for each apartment type.

HEBEL FLOORING

Hebel flooring is an innovative and highy lightweight material and makes it a highly versatile flooring solution for prefabricated modules. It consists of thick reinforced steel, aerated concrete panels and will be installed over a minimal steel truss system. While it is very structurally sound, the material also has very high thermal qualities to minimise the amount of active heat systems within the building. Clad in recycled timber planks.

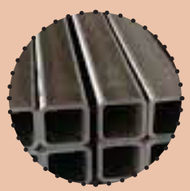
RECYCLED TIMBER PLANK CLADDING

The material itself has a very long lifespan and is a sustainable option. Timber is also essentially carbon neutral as its replantation releases oxygen back into the atmosphere to replace those CO2 emissions. It acts as an extra layer of insulation to the modules



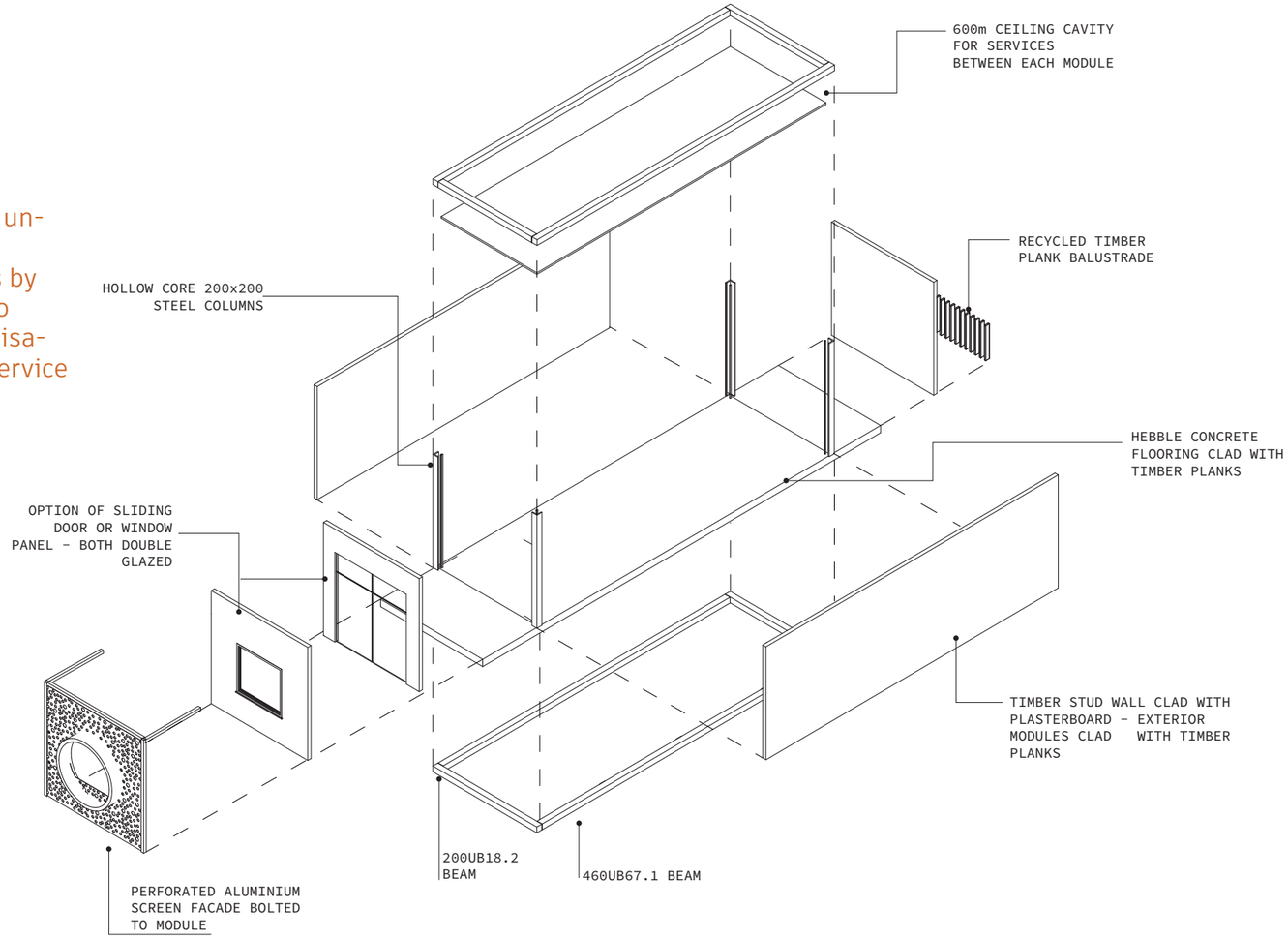
PERFORATED ALUMINIUM SCREENS

The facade screen works to regulate heat input into the internal spaces of the building as it controls and refracts daylight into the space. Aluminium is to be recycled from previous members.

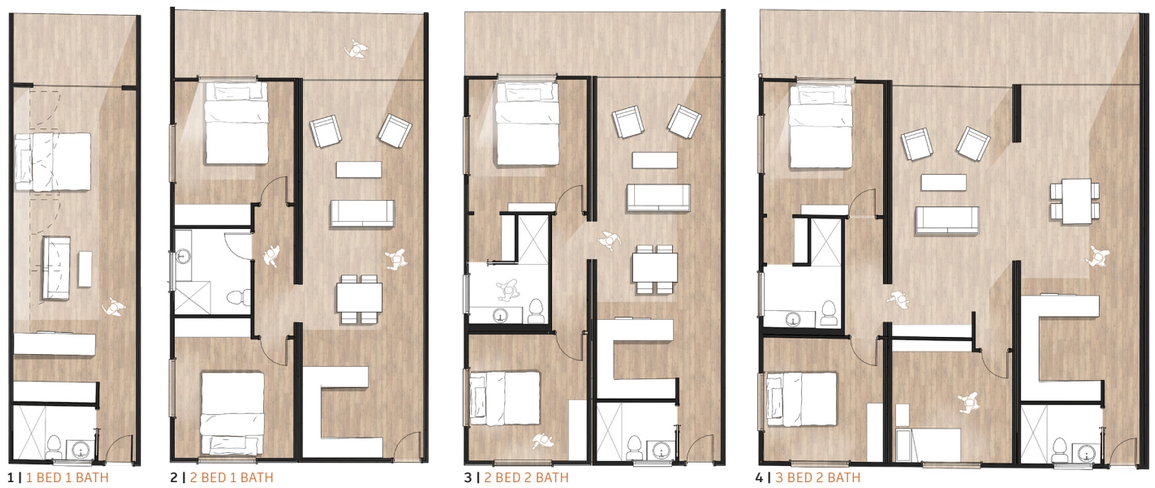


HOLLOW CORE STEEL FRAMING

While walls are made up of timber stud framing, the loadbearing members that hold up the modules and allow its ease in stackability are made up of recyled steel columns and beams. While these are not completely carbon neutral, measures such as not using excess amounts of framing, and recycling the elements after the buildings lifespan contribute to the structures net zero design values. The framing utilises a combination of exposed and hidden members to unify the facade system, as well as aid in the structures industrial aesthetics.



INDIVIDUAL APARTMENT TYPES



1 | 1 BED 1 BATH

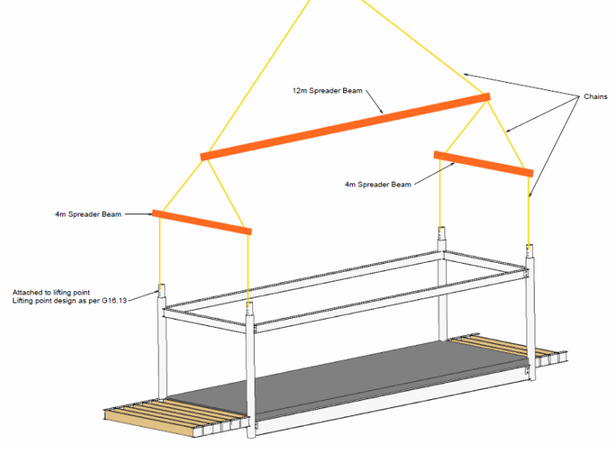
2 | 2 BED 1 BATH

3 | 2 BED 2 BATH

4 | 3 BED 2 BATH

04. STRUCTURAL ANALYSIS OF MODULE.

Whilst the lot is cleared, the structures 42 modules will be constructed at a fabrication shop within the area and then be transported to site for quick assembly. All modules will contain a 4mx3.3m steel portal frame shell with flooring, ceilings, balconies, walkways, stairs, and roofs with timber infill stud walls. For ease in onsite assembly, the modules have been designed to be lifted from four corners of the structural columns, which will slide into and secured with bolts to the below module and adjacent module.



Steel Member	Member Section	Loading		Deflection (mm)		Bending (kN.m)	Shear (kN)
Floor Beam (12m)	460UB67.1	DL	5.65KN/m	DL	28.78	217.31	72.44
		LL	3KN/m	0.7LL	9.58		
Balcony Beam (2.5m)	310UB32.0	DL	2KN/m +2KN PL	DL	1.66	29.68	21.64
		LL	4KN/m	0.7LL	4.01		
Ceiling Beam (12m)	250UB31.4	DL	0.9KN/m	DL	36.69	29.37	9.79
		LL	0	0.7LL	0		
Column	200SHS x16	470kN Factored			0.6	29.68	139.3

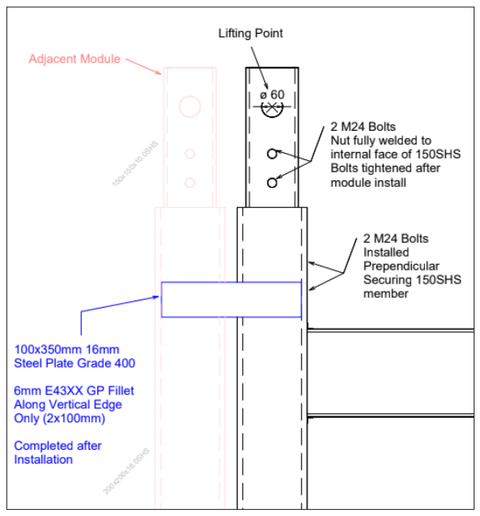
In reference to the structural engineers report, the following considerations were made to aid in improving time efficiency and reducing the cost of onsite construction:

- In situ reinforced concrete foundations will be excavated and poured during the fabrication of the modules offsite, to allow for immediate assembly once foundations are completed.

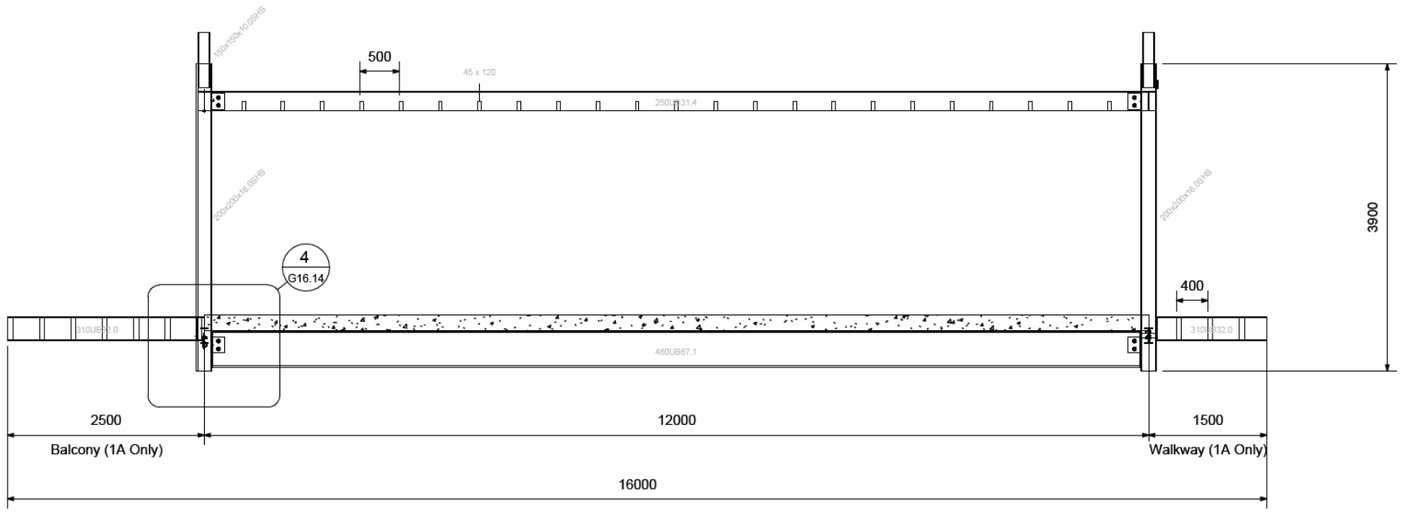
- Column-to-column connections has been designed to reduce the time of securing each module and overheds associated with the crane.

- With assistance from the building surveyor, base plate hold-down bolts will be cast in situ with the foundations to ensure the welded base plate will slide through the bolts on site

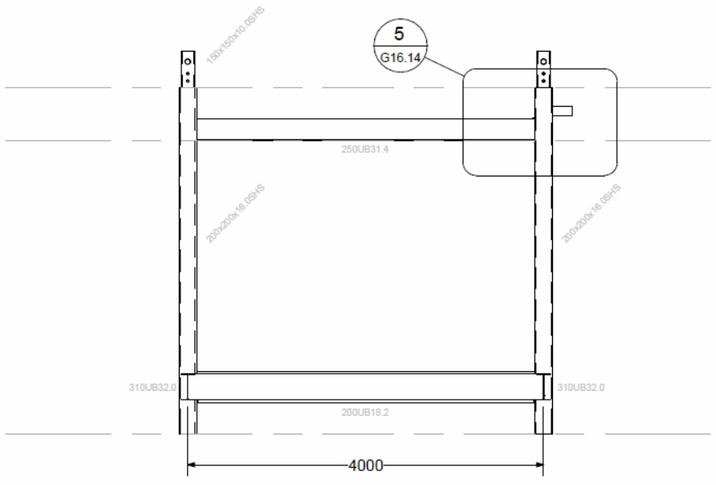
- To allow for ease in module installation, tolerances for column-to-footing installation have been considered.



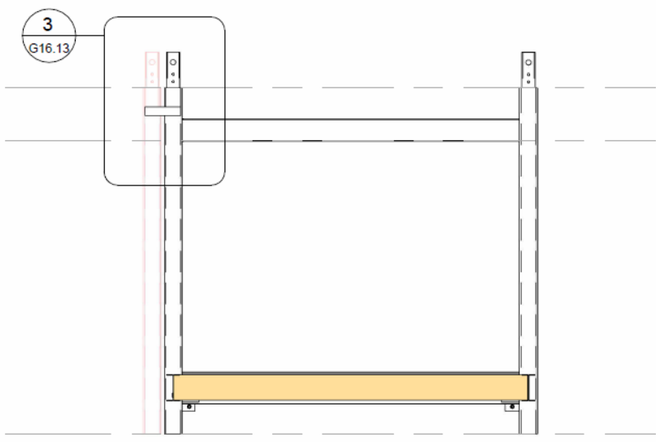
DETAIL 3 - MODULE CONNECTION



SOUTH MODULE ELEVATION



WEST MODULE ELEVATION



EAST MODULE ELEVATION

APPENDIX 05.

STRUCTURAL CALCULATIONS OF MODULE + BUIDLING COMPLIANCE.

LOADING ANALYSIS

MODULAR WALLS
Internal Timber Framing of partition walls: 20kg/m2
Gyprock Fyrchek classing per side installation: 12.9kg/m2
Thus with 3.3m high walls, UDL = 137.3kg run of wall

EXTERNAL CLAD FRAMING
Assumed as 30kg/m2 as external stud framing exposed

EXTERNAL STUD WALLS
Framing was assumed to run from floor to ceiling across the entire wall space
Timber stud partition wall w/ 12.5mm plasterboard both sides = 27kg/m2

STRUCTURAL FRAMING
Floor beam holds maximum shear value of 72.4KN
Hebel Powerfloor can resist 1.5KPA dead load for a span of 4.4m
The maximum calculated dead load = 046KPa

CEILINGS
(including lights, airconditioning and other products acting on the ceiling joists and plasterboard sheeting)
Ceiling services assumed to have dead load = 0.1kPa

AUSTRALIAN STANDARDS

- Structural Design Actions - AS1170.0:2002, AS1170.1:2002 and 1170.2:2021
- Structural Steel - AS4100:2020
- Concrete Footings - AS3600:2018
- Timber - AS1684:2021, AS1720:2010
- DCT for Structural Steel vol.1 Open Sections

BCA STATUARY COMLIANCE

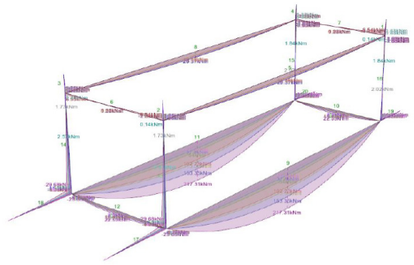
BUILDING CLASSIFICATION
The building has multiple building classifications as follows: Class 2, 5 and 6

FIRE DESIGN
Fire safety engineering has been a design driver in the projects process, due to the decision to have one central circulation core to facilitate the whole building. Positioning of the service core as well as chosen structural materials complies with section C1.1-C1.14, C2.4-C2.14, and C3.11.

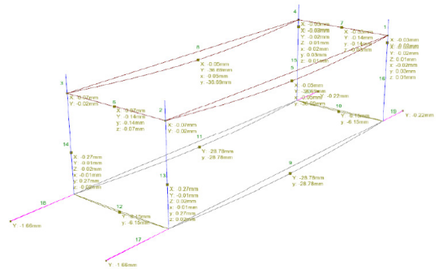
ACCESS
Building contains one central stairway and lift service shaft that connects all 3 upper storeys to the ground floor open space. Fire isolated stairways are not needed, see D1.9. No additional exits are needed as the building does not exceed 25m in height (building height is 16.4m). All sole-occupancy units have access to the stairway exit. Sections D1.2-D1.17 provision for escape, D2.2-25 construction of exits, and D3.1-D3.12 Disability access are compliant

ACOUSTICS
Wall Construction consists of a double layer timber stud wall between each module. In accordance to table F5.2 contains required insulation between levels and adjacent apartment walls.

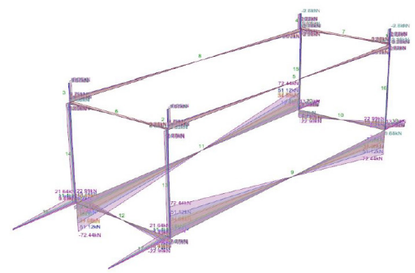
GAS MODEL CALCULATIONS



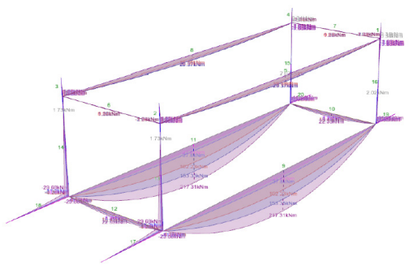
BENDING ALL CASES



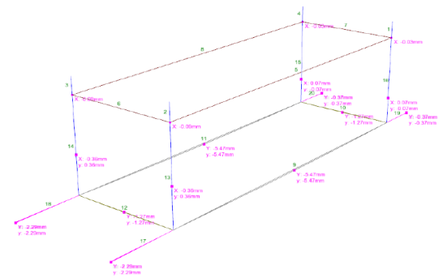
DEFLECTION DL



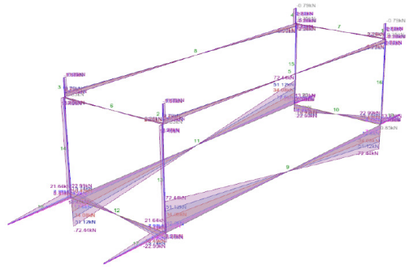
SHEAR ALL CASES



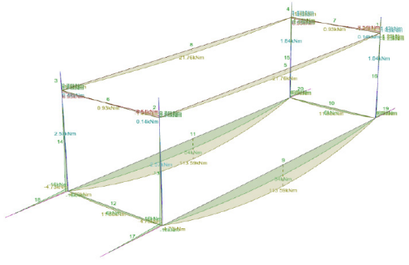
BENDING COMBINATIONS



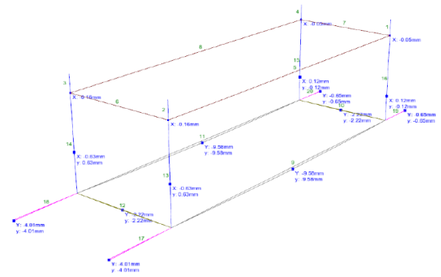
DEFLECTION LT SERVICEABILITY



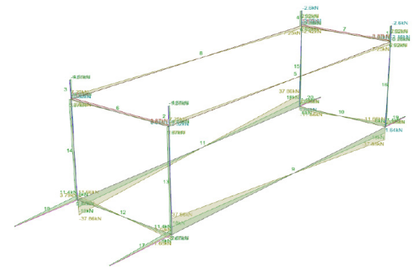
SHEAR COMBINATION CASES



BENDING PRIMARY



DEFLECTION ST SERVICEABILITY



SHEAR PRIMARY CASES