

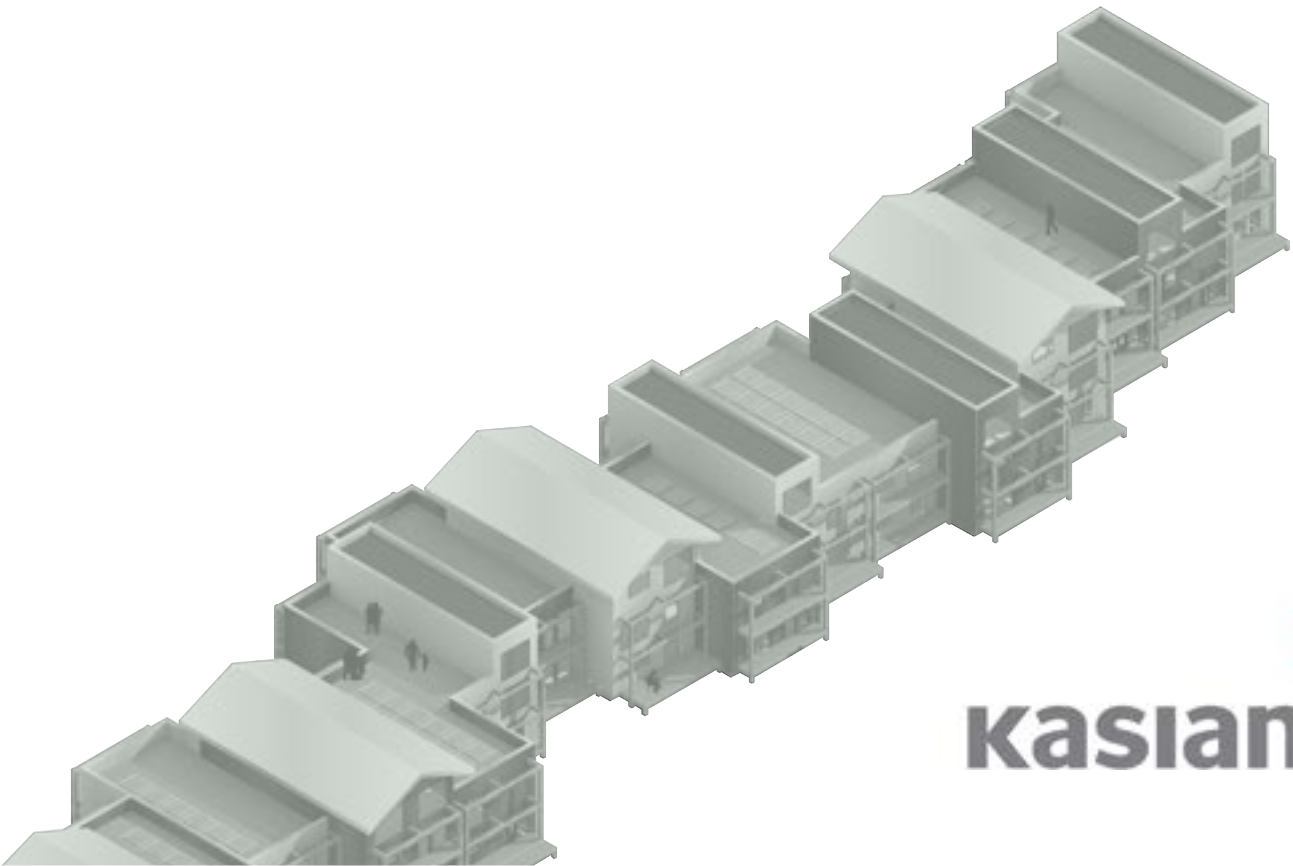
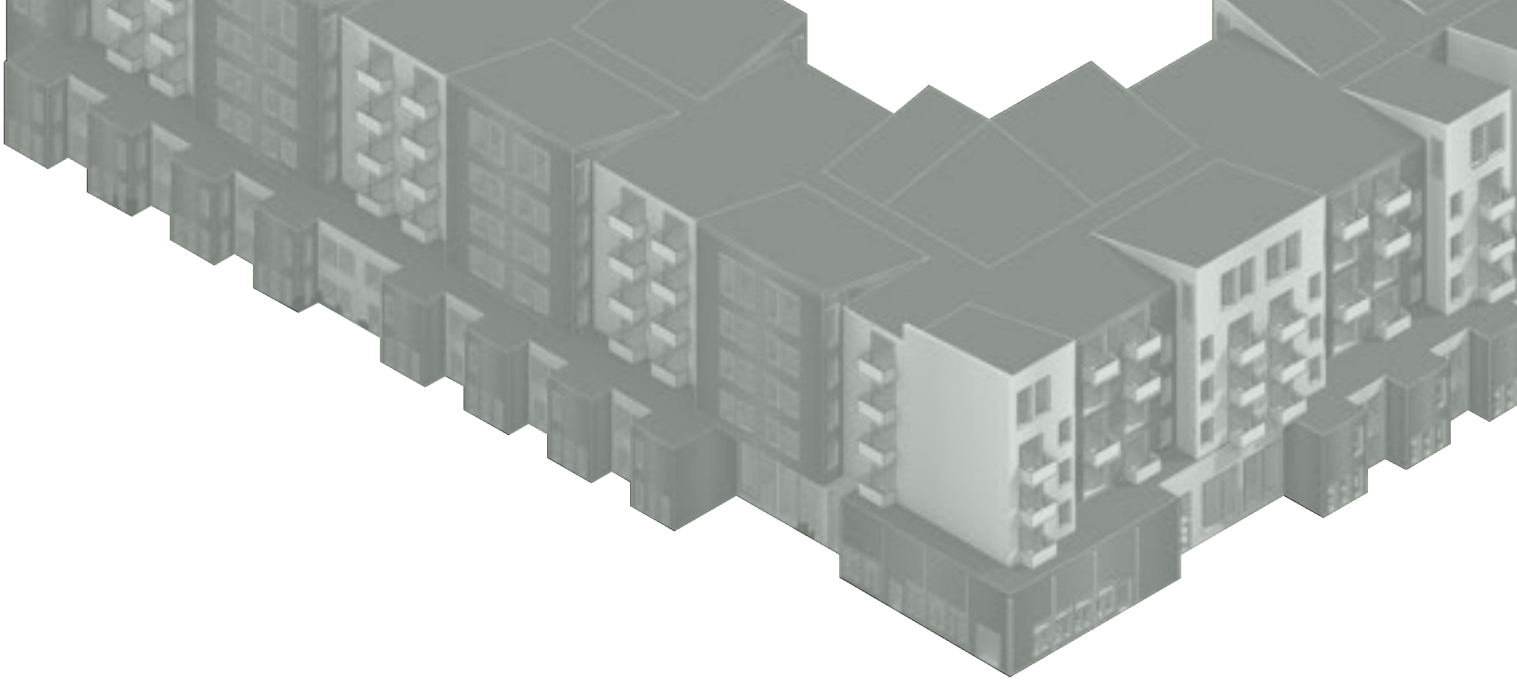
The Missing Middle



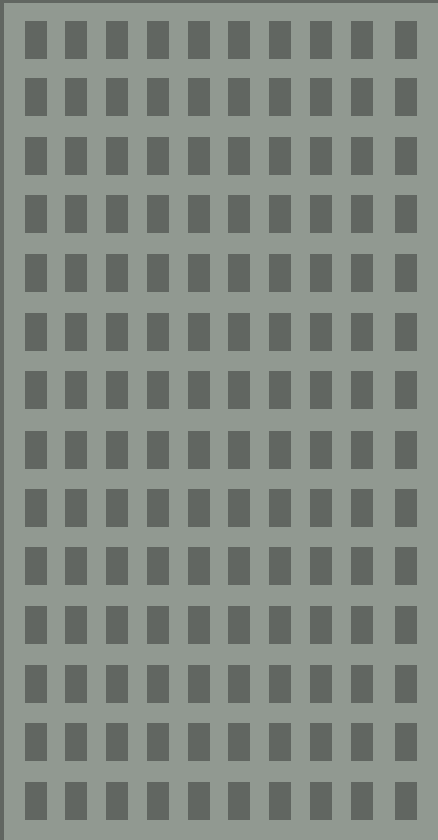
A modular CLT building system designed to scale from townhouse to mixed-use low rise typologies to feed society's demand for a medium-density lifestyle.

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1.0 INTRODUCTION



1.1 PROJECT SUMMARY

The missing middle problem refers to the shortage of housing types that fall between single-detached homes and high-rise apartments such as duplexes, townhomes, mid rise apartments, and small multiplexes. In Calgary, much of the city's housing stock is dominated by single-family homes, while most new developments tend to be high-density towers concentrated around the downtown core or transit hubs. This creates a gap in affordable, family-oriented, and community-based housing options for middle-income residents who want to live closer to amenities, schools, and employment without sacrificing space or affordability. The kit of parts approach uses a system of prefabricated, standardized components such as wall panels, floor cassettes, and service cores that can be combined in different configurations to suit various building types and lot sizes.

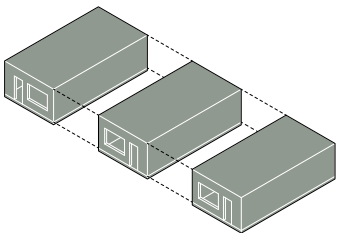
In Calgary's context, this method allows developers to rapidly build adaptable medium-density housing that fits within existing neighborhoods while maintaining high design quality. It reduces construction time and waste, lowers costs, and supports infill development that enhances community vibrancy. By using modular kits, Calgary can efficiently deliver flexible, sustainable housing that fills the missing middle, helping balance the city's housing supply and create more inclusive, connected communities.



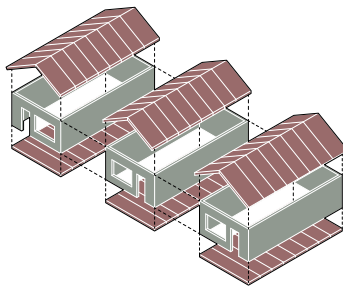
1.2 MODULAR SYSTEMS

Modular construction is a modern building approach that uses prefabricated components to streamline design, production, and assembly. The three main types, **volumetric**, **hybrid**, and **kit of parts**, differ in their level of prefabrication and flexibility. **Volumetric modular construction** involves fully finished three-dimensional modules, such as rooms or units, built off-site and assembled on-site like building blocks. **Hybrid modular construction** combines volumetric modules with prefabricated panels or structural systems, offering more design versatility while maintaining the speed and efficiency of modular methods. **Kit of parts** construction, by contrast, is a system-based approach that fabricates a standardized set of components such as walls, floors, and facades that can be configured in multiple ways to create diverse building types.

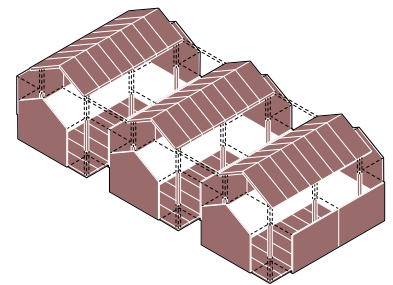
For medium-density residential construction, the **kit of parts** method is especially well-suited. It allows for design flexibility to accommodate varied site conditions and unit layouts while maintaining the efficiency of off-site fabrication. The standardized components can be produced cost-effectively and assembled rapidly on-site, reducing construction time, waste, and disruption to surrounding communities. Furthermore, the approach supports incremental development, enabling buildings to adapt or expand over time. This balance of customization, scalability, and efficiency makes the kit of parts approach an ideal solution for sustainable, community-oriented housing at medium density.



Volumetric



Hybrid



Kit of Parts

1.3 PRECEDENTS

ELEMENT5 TREEHOUSE

The Element5 Mass Timber “Treehouse” project is an innovative retirement living development that demonstrates how sustainable design and prefabrication can redefine senior housing. Constructed primarily from cross-laminated timber (CLT) and glulam beams, the project emphasizes warmth, and low embodied carbon. The exposed mass timber structure not only provides natural aesthetics and improved indoor air quality but also contributes to resident well-being through tactile and acoustic comfort.

Element5 employed a prefabricated, panelized approach, manufacturing large CLT wall, floor, and roof components off-site with precision. This method minimized on-site construction time, reduced waste, and ensured high-quality assembly in all weather conditions. The modular nature of the system also allowed for design flexibility, enabling efficient repetition of units while maintaining architectural character and spatial variety.

This precedent is highly applicable to Calgary’s context. The city’s growing demand for sustainable, medium-density housing especially for aging populations aligns with the Treehouse’s design principles. Prefabricated mass timber construction can accelerate project delivery in Calgary’s short building season while meeting net-zero and embodied carbon goals.



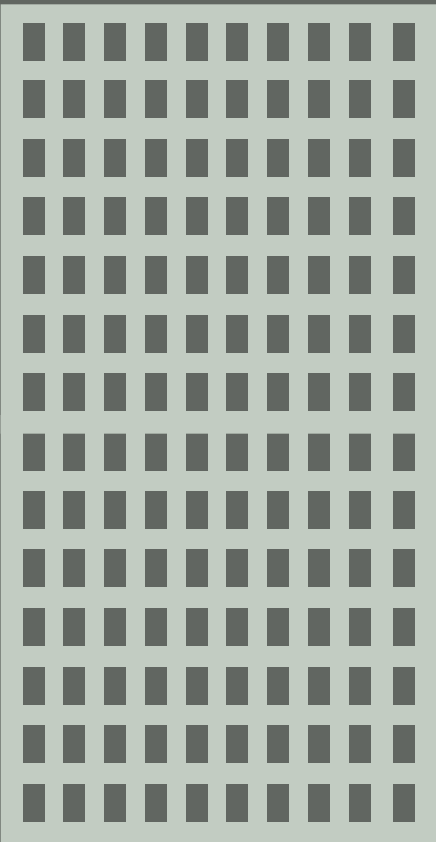
1.4 SCALING TYPOLOGIES

The intent behind researching and developing a modular system of construction for medium density housing is to address the housing crisis seen in Calgary and other major Canadian cities. This approach calls for two scale types to address the issues as this the housing crisis is not a one-size solution. Densification through different means including townhouse models and mid rise multifamily structures are a way to counteract and address the housing crisis.





2.0 BUILDING SYSTEM

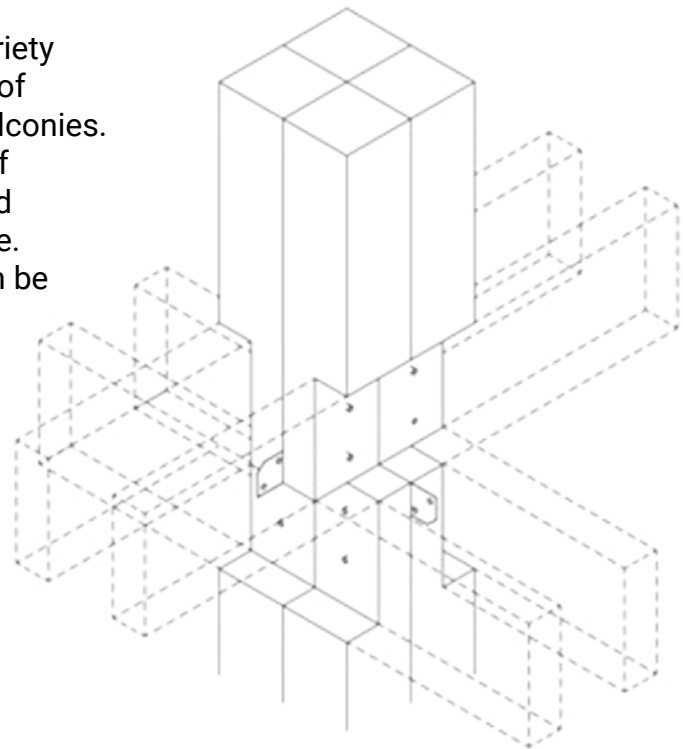


2.1 INTRODUCTION

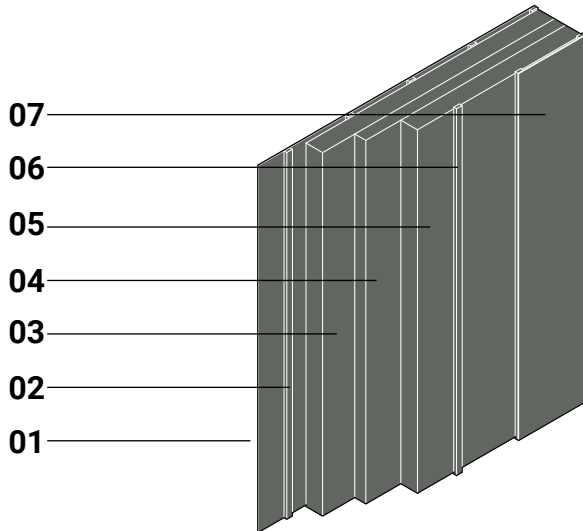
The primary material used within all assemblies consists of cross-laminated timber due to its ability to store carbon, a low-energy manufacturing process, and potential for reuse or recycling at the end of a building's lifespan. Additional layers in each assembly incorporate the appropriate seal of the building envelope, additional structure for finishes, and space for other building systems, such as light wood frame walls for plumbing and electrical systems, or the raised floor that allows for underfloor air distribution to be utilized.

Various assemblies and the connections between them have specifically been chosen due to their ability to be disassembled and reused, in place of more traditional building systems that are typically taken down via demolition. For example, connections between all CLT floor and wall components consist of either a wood-to-wood joint or metal bolt connections. The raised floor system can be easily taken apart and recycled while still providing a sufficient sound barrier between floors in place of the traditional method of pouring a concrete soundproofing layer directly on top the CLT floor. All CLT parts can be prefabricated off-site, accompanied by a catalogue of interior and exterior door and window openings.

Three roof assembly types have been chosen to provide the option for both slow-slope and pitched roofs to provide variety to the elevation of various aggregated units. A walkable roof assembly also makes it possible for rooftop patios and balconies. The exterior balcony and deck system consists primarily of an LVL beam structure where all parts can be prefabricated then assembled as they are attached to the building on-site. Prefabricated railings, decks and shading devices can then be attached to the LVL structure.

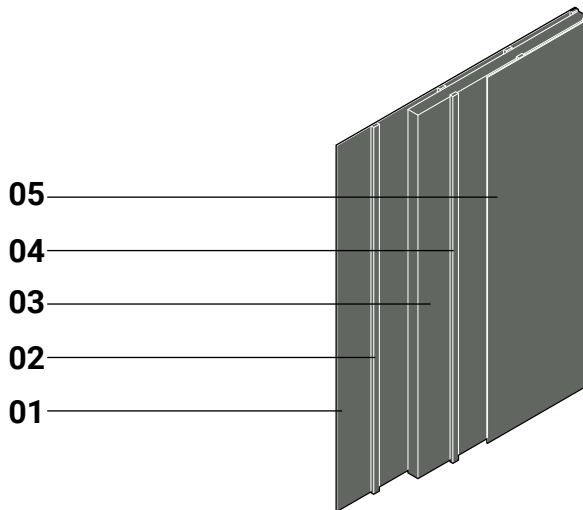


2.2 ASSEMBLIES



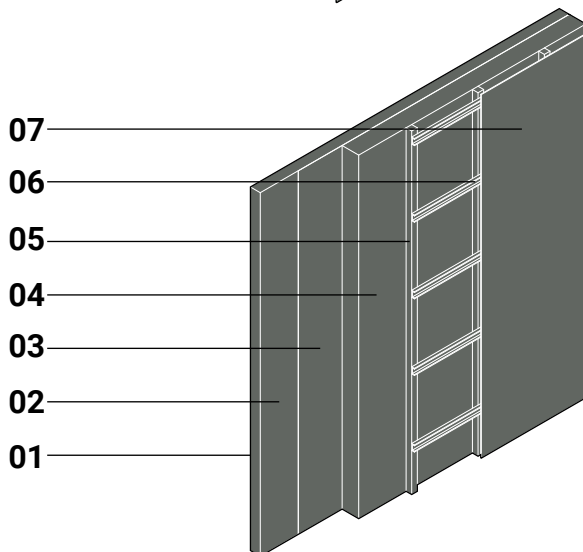
Party Wall

- 01** - 1/4" Gypsum Board
- 02** - 25 x 50mm Furring Strips
- 03** - 150mm CLT Panel
- 04** - Insulation (for acoustic barrier)
- 05** - 150mm CLT Panel
- 06** - 25 x 50mm Furring Strips
- 07** - 1/4" Gypsum Board



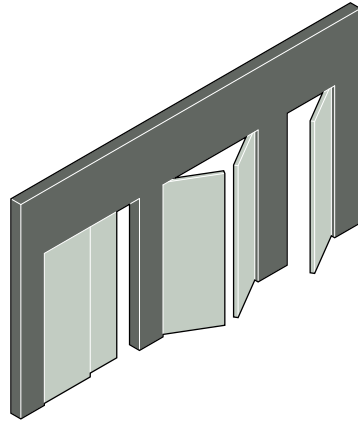
Interior Partition Wall

- 01** - 1/4" Gypsum Board
- 02** - 25 x 50mm Furring Strips
- 03** - 90mm 3-ply CLT Panel
- 04** - 25 x 50mm Furring Strips
- 05** - 1/4" Gypsum Board



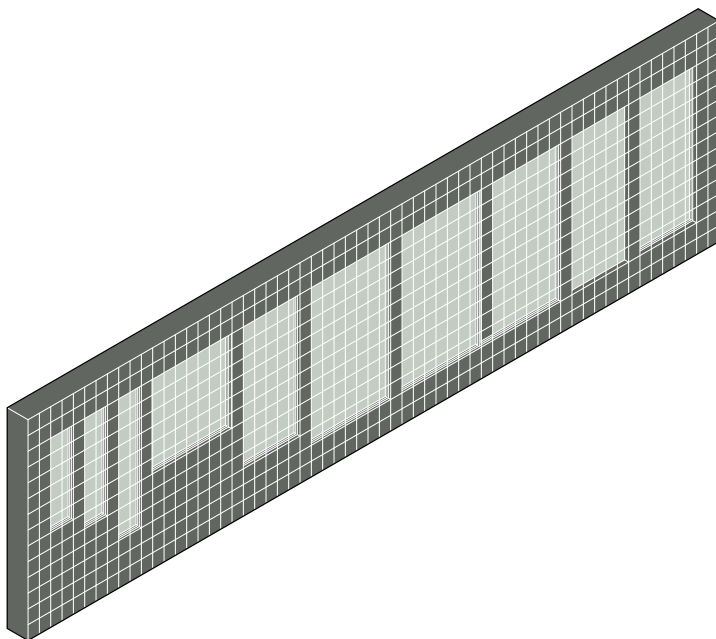
Exterior Wall

- 01** - 1/4" Gypsum Board
- 02** - 90mm 3-ply CLT Panel
- 03** - Air / Vapour Barrier
- 04** - 150mm Rigid XPS Insulation
- 05** - 50 x 50mm Battens
- 06** - Z-girts
- 07** - Metal Cladding



Interior Partition Wall Panel Openings

- Sliding Door
- Double Door
- Single Door



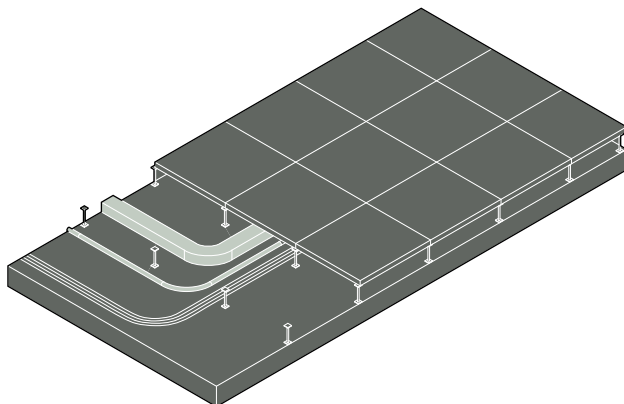
Exterior Facade Panel Openings

Windows

- 350 x 1265mm
- 350 x 1475mm
- 350 x 1900mm
- 1225 x 1265mm
- 875 x 1900mm
- 1225 x 2110mm
- 2450 x 2110mm

Doors

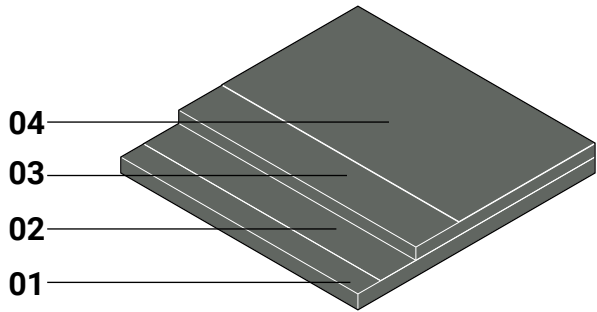
- 875 x 2110mm
- 875 x 2110mm



Raised Floor

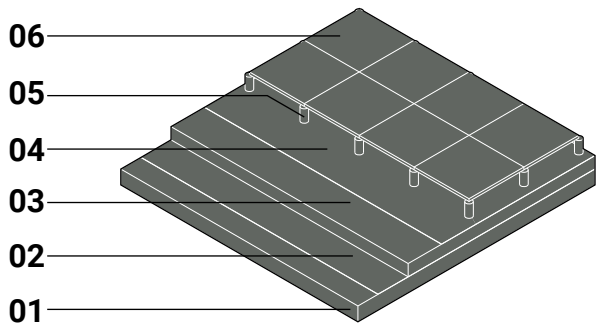
- 01** - 50mm 5-ply CLT Panel
- 02** - 127mm Metal Pedestals + Service Cavity
- 03** - 600 x 600 x 38mm finished floor tiles

2.3 ASSEMBLIES



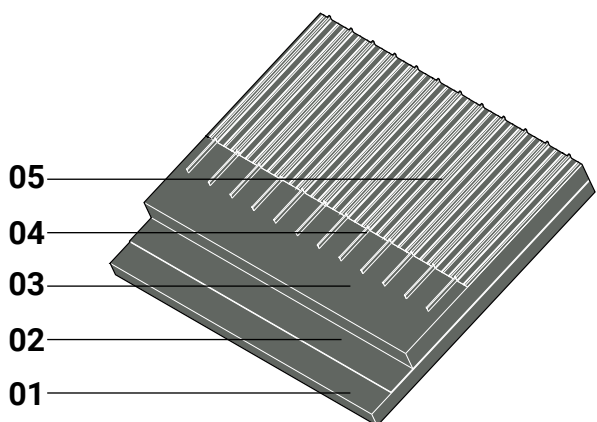
Low Slope Roof

- 01** - 150mm 5-ply CLT Panel
- 02** - Air / Vapour Barrier
- 03** - 150mm XPS Rigid Insulation
- 04** - 5mm Bituminous Membrane



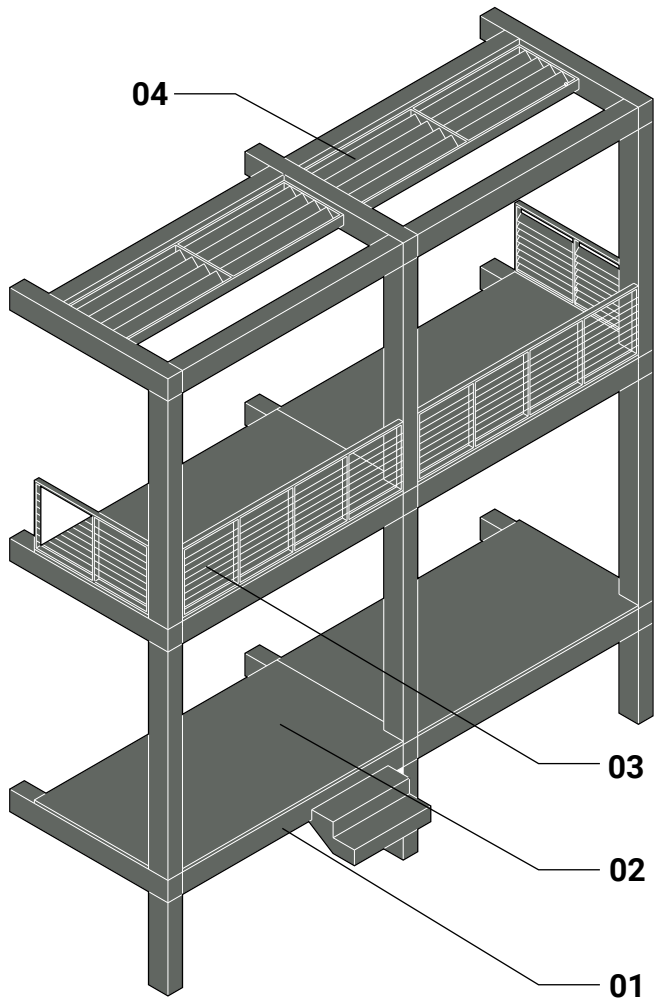
Walkable Roof

- 01** - 150mm 5-ply CLT Panel
- 02** - Air / Vapour Barrier
- 03** - 150mm XPS Rigid Insulation
- 04** - Protective Layer
- 05** - 135mm Pedestals
- 06** - 25 x 600 x 600 mm Cement Tiles



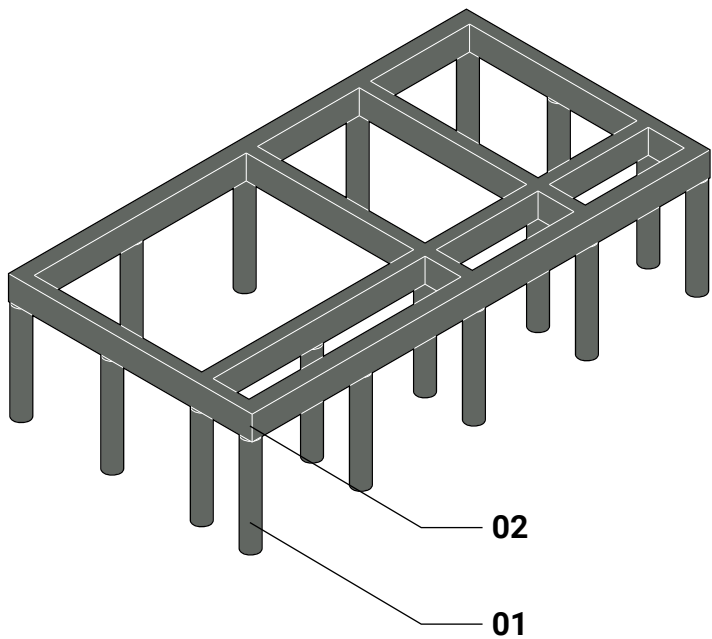
Standing Seam Roof

- 01** - 150mm 5-ply CLT Panel
- 02** - Air / Vapour Barrier
- 03** - 150mm XPS Rigid Insulation
- 04** - Bemo Halter Clip
- 05** - Standing Seam Roof Panel



Exterior Balcony + Deck System

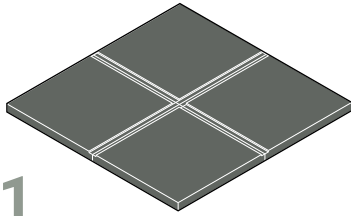
- 01 - LVL Beams
- 02 - Wood Deck
- 03 - Railings
- 04 - Shading Device



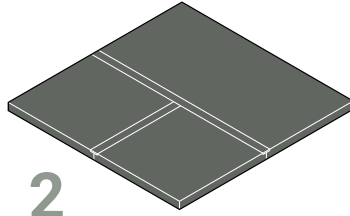
Substructure

- 01 - Piles
- 02 - Wood Deck

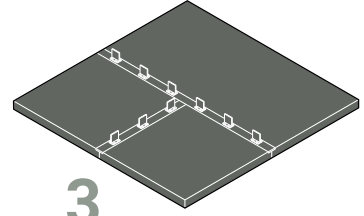
2.4 TECTONICS



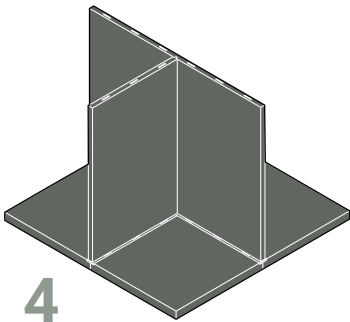
1
Place CLT Floor Panels
on Grade Beams



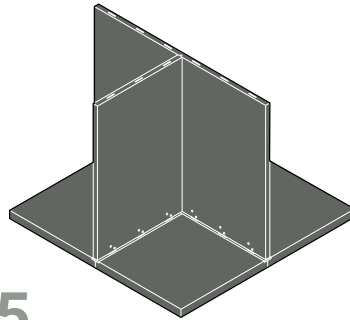
2
Attach Splines to CLT
Floor Panels



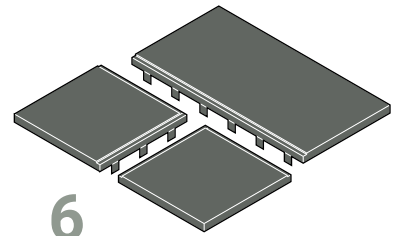
3
Attach Concealed Anchors



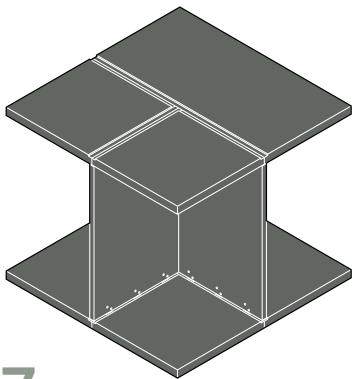
4
Slot CLT Wall Panels into
Concealed Anchors



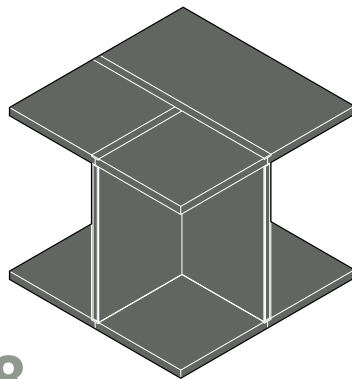
5
Fasten CLT Wall Panels
to Concealed Anchors



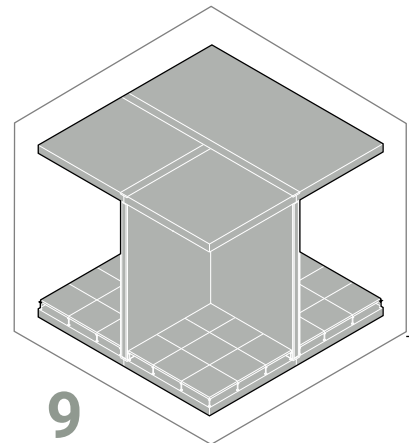
6
Attach Concealed Anchors to
CLT Floor Panels



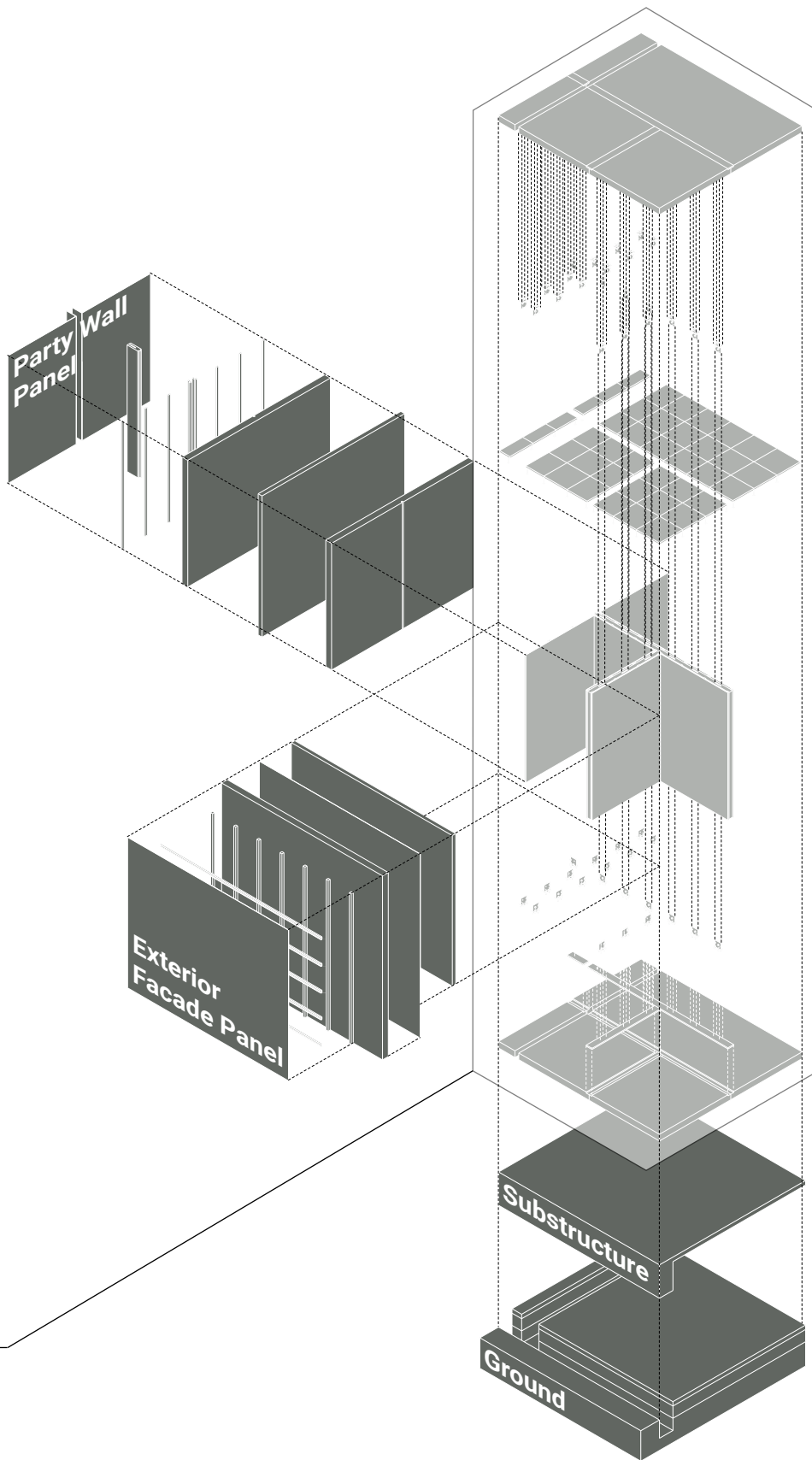
7
Slot CLT Floor Panels +
Concealed Anchors into
Wall Panels



8
Attach Furring Strips +
Drywall to CLT Wall Panels

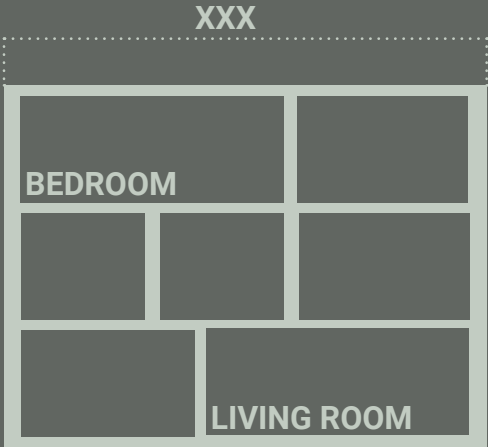
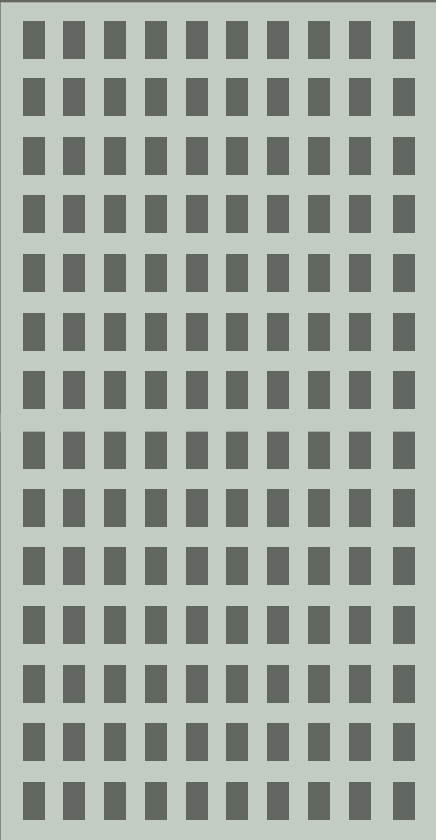


9
Attach Raised Floor System
to CLT Floor Panels



Exploded Tectonic Diagram

3.0 PROGRAM



3.1 INTRODUCTION

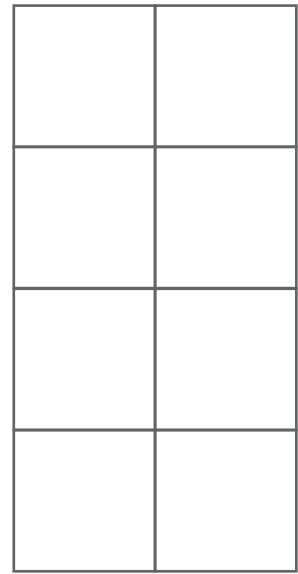
The programming structure is meant to represent each scale of the medium density residential typology while creating distinct dwellings that are both comfortable and fit within the system of construction.

In this section, the construction grid, and unit types are explained within the system, moving through from unit components, floor plan arrangement and unit types in a large mid rise 6 storey building.

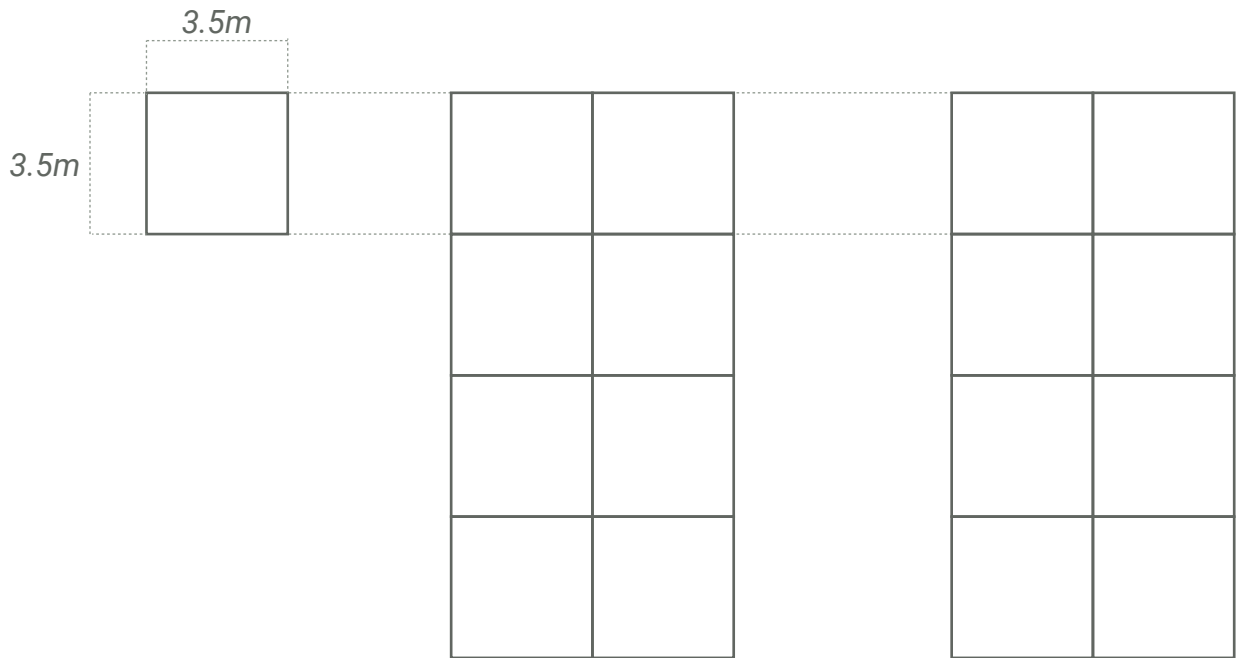
3.2 LOGISTICS + GRID LOGIC

The construction and assembly of buildings within this system follow a 3.5m x 3.5m grid system. This spacing allows for flexibility and convenient spans in system while also prioritizing the transportation and assembly of the prefabricated elements on site.

The grid spacing is also conducive to the arrangement of program associated in residential dwellings and allows for the layouts of homes and apartments to be flexible and adaptable to change. The townhouses are able to implement this system to create a wide array of arrangements in their spaces.



Commercial Unit Grid



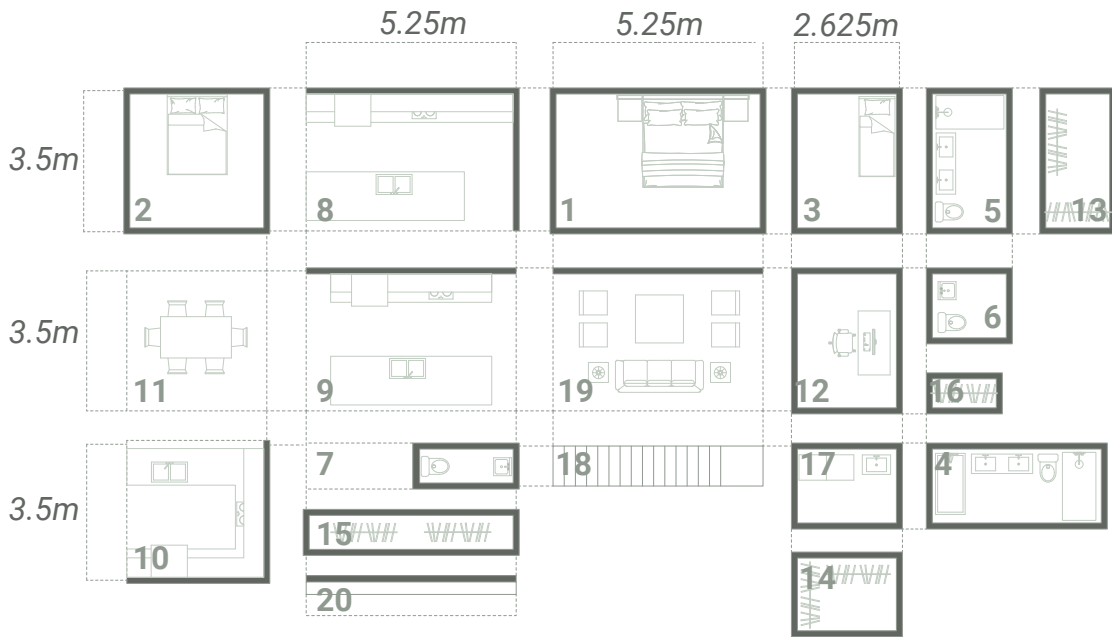
Townhouse Grid

Apartment Unit Grid

Program Kit

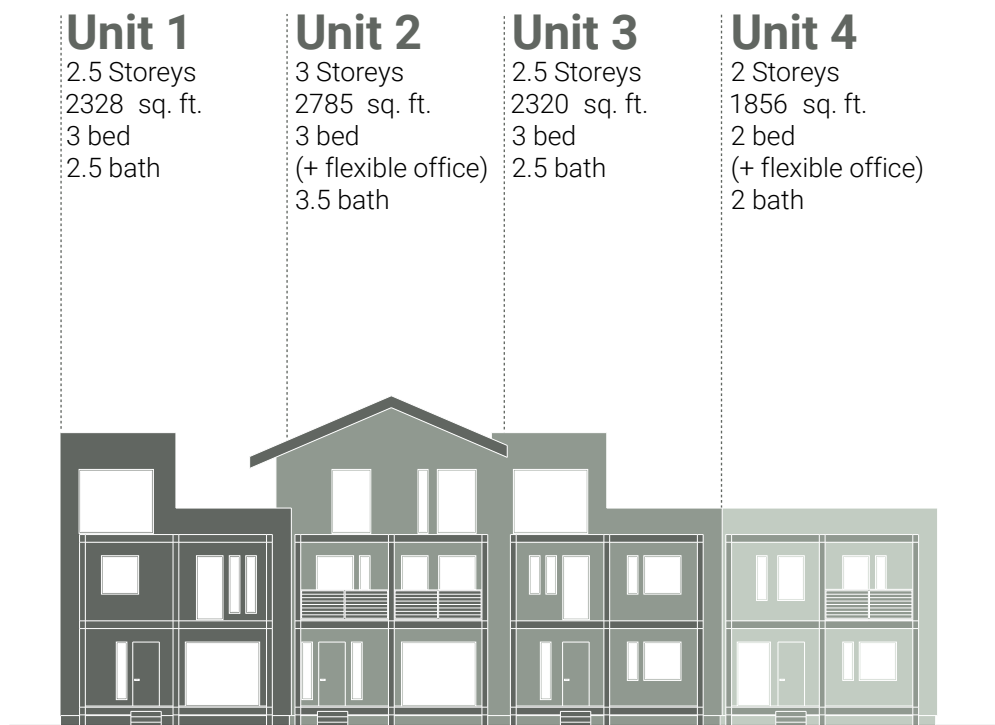
- 1 - Large Bedroom
- 2 - Medium Bedroom
- 3 - Small Bedroom
- 4 - Large Bathrom
- 5 - Medium Bathroom
- 6 - Large Half Bathroom
- 7 - Small Half Bathroom
- 8 - Large Corner Kitchen
- 9 - Large Straight Kitchen
- 10 - Small C Kitchen

- 11 - Dining
- 12 - Office
- 13 - Large Walk-in Closet
- 14 - Small Walk-in Closet
- 15 - Medium Closet
- 16 - Small Closet
- 17 - Laundry
- 18 - Stair
- 19 - Living
- 20 - Library

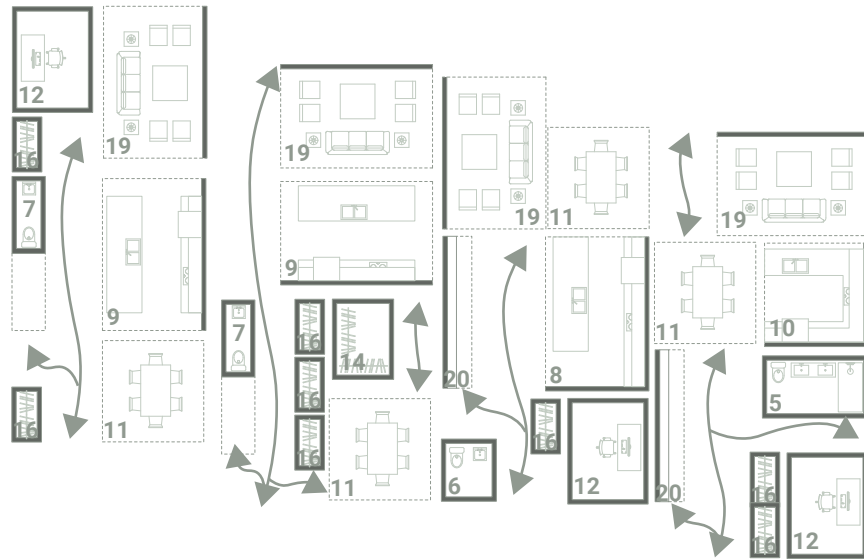


3.3 TOWNHOUSE FLOOR PLAN OPTIONS

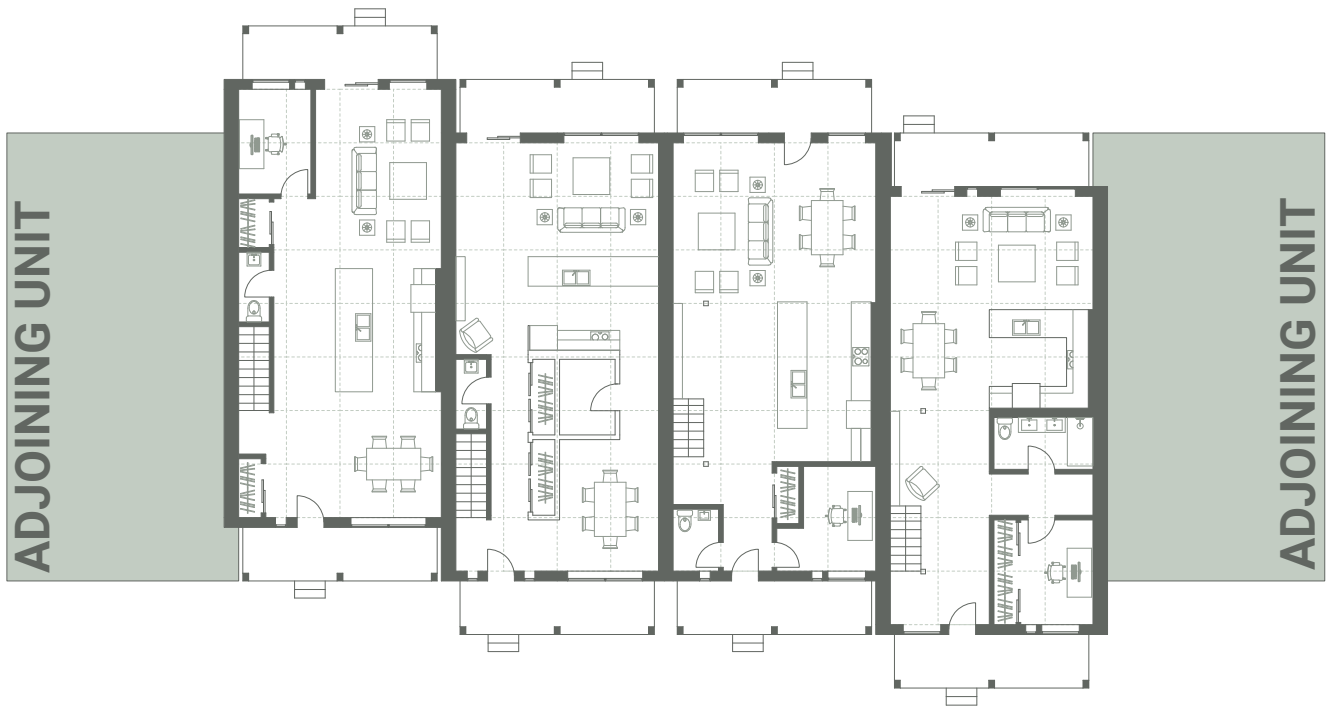
The flexibility of the floor plans is crucial to creating a vibrant dwelling for the occupants. Shown below are 4 unit types that offer different numbers of variety in the number of bedrooms, bathrooms, and flexible spaces that can be used for a home office. There is also the possibility to include a third storey on these typology of housing to act as a office space or family room, all with access to a rooftop space for a patio and garden box planters.



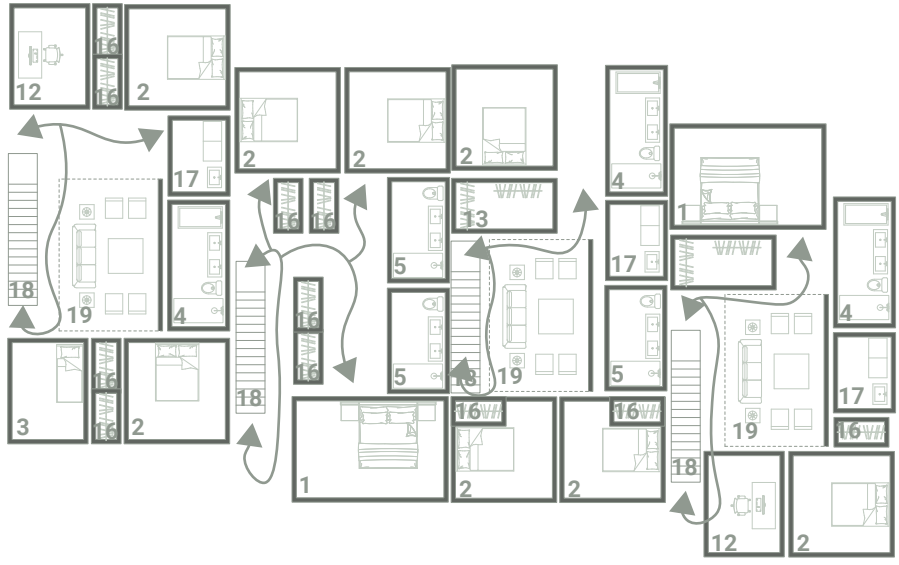
Front Elevation



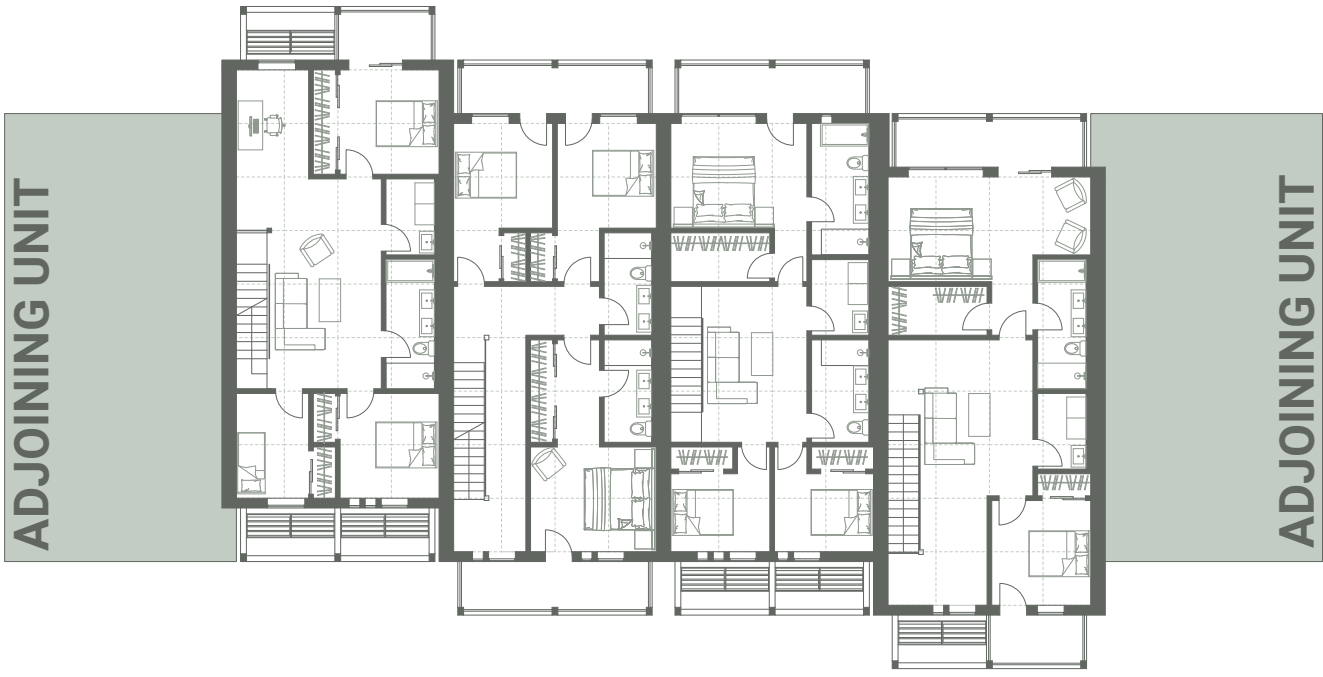
Level 1 Programming



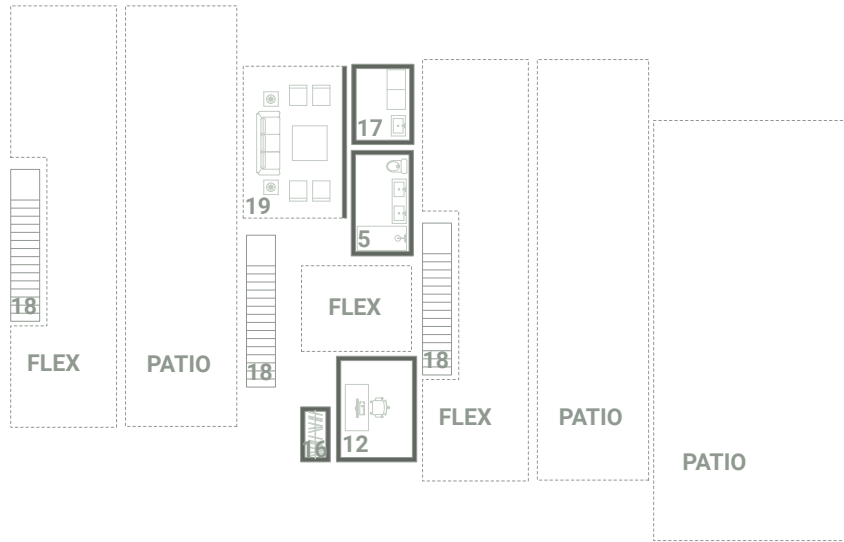
Level 1 Plan



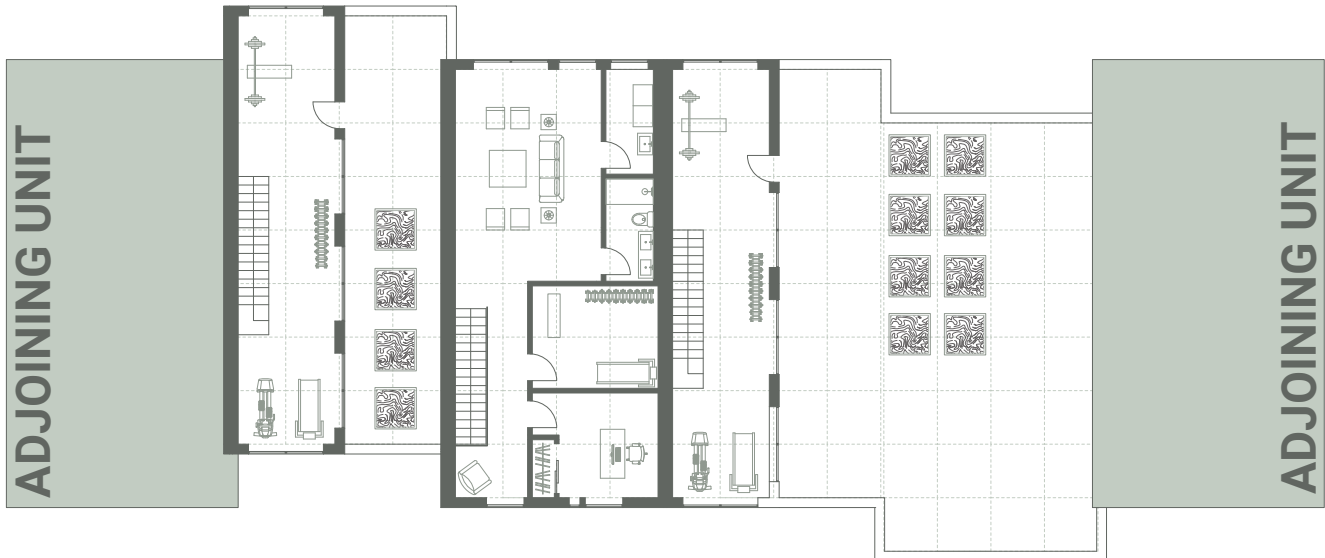
Level 2 Programming



Level 2 Plan

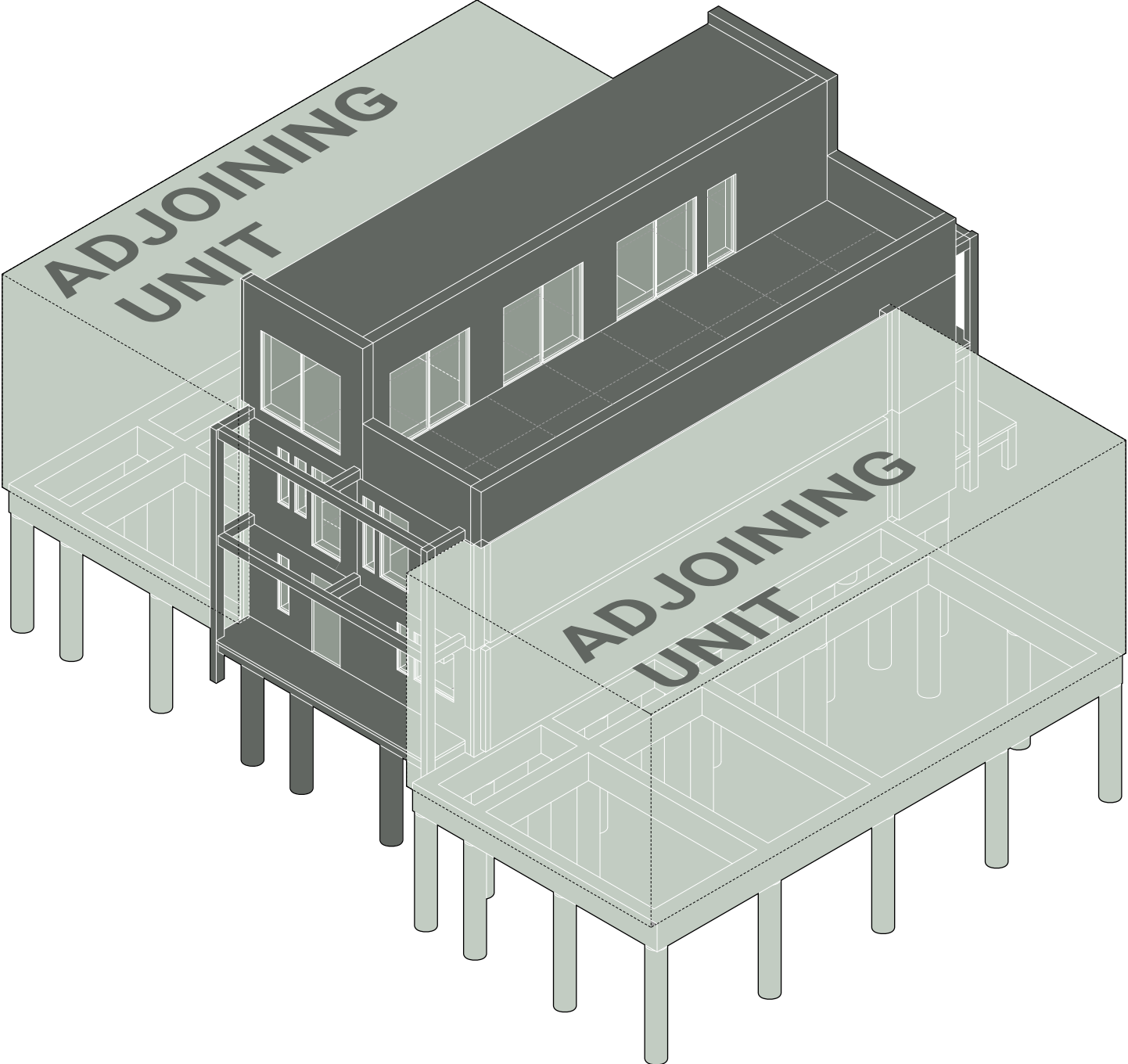


Level 3 Programming

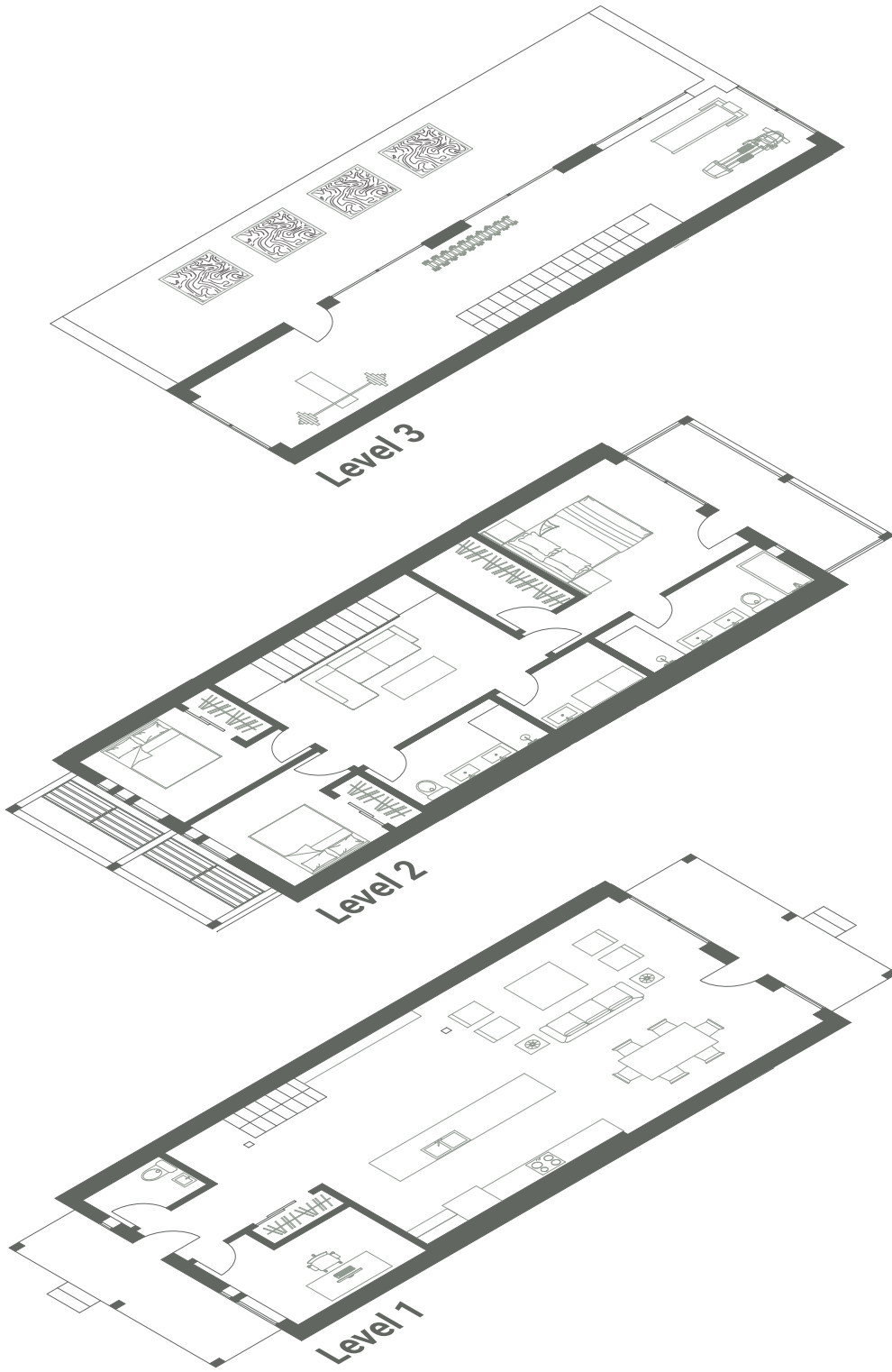


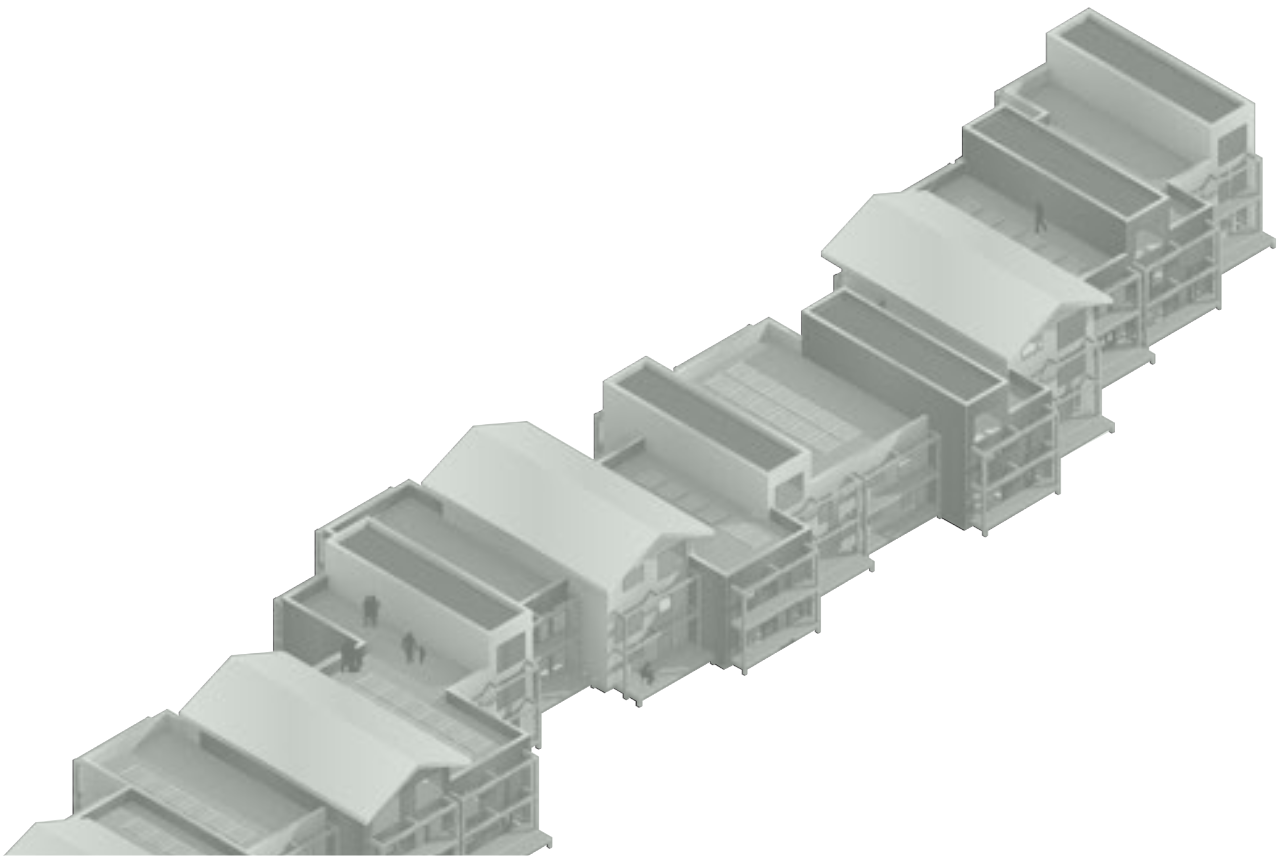
Level 3 Plan

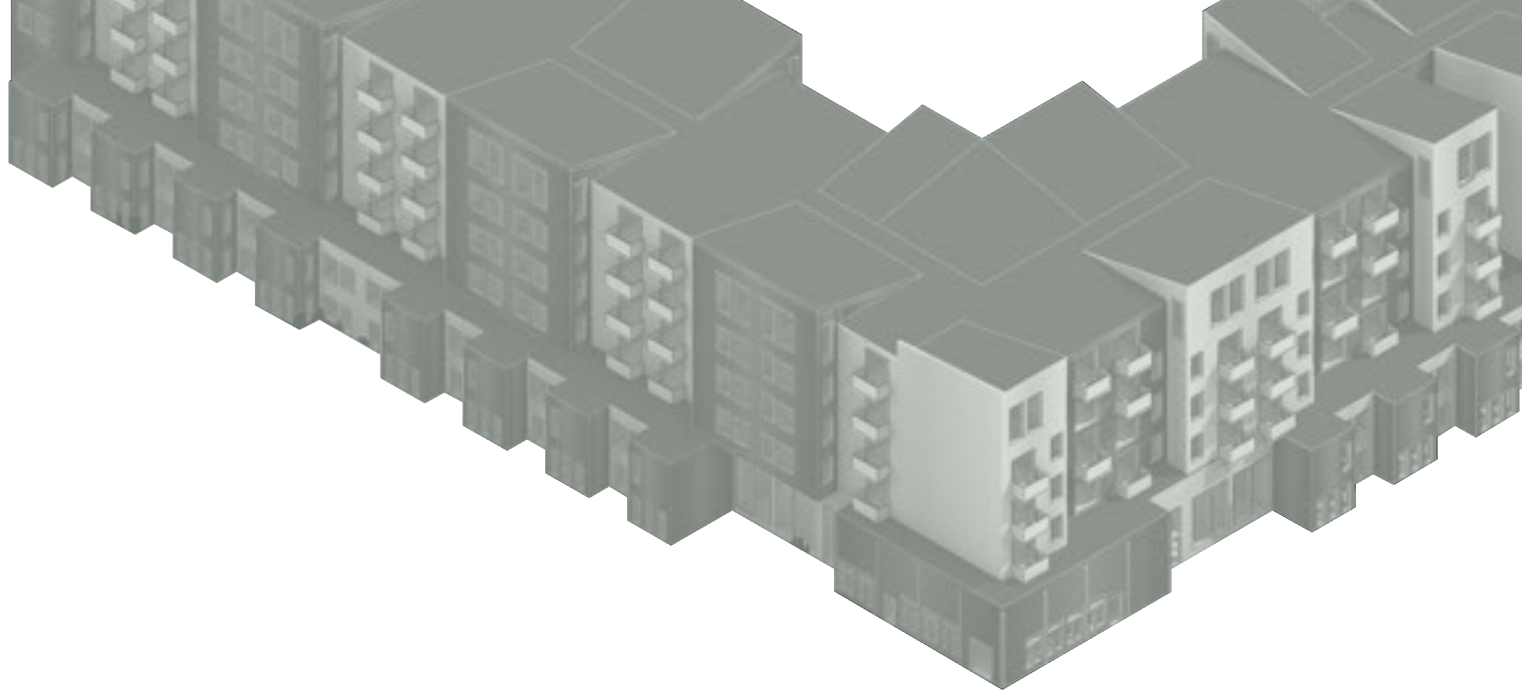
3.4 TOWNHOUSE UNIT

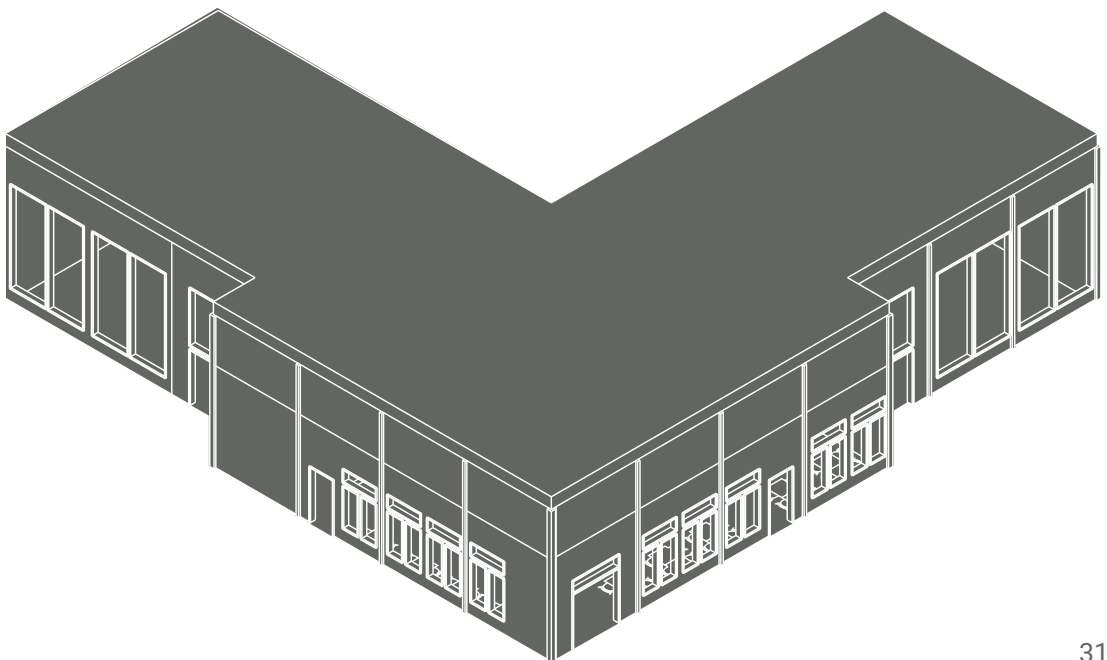
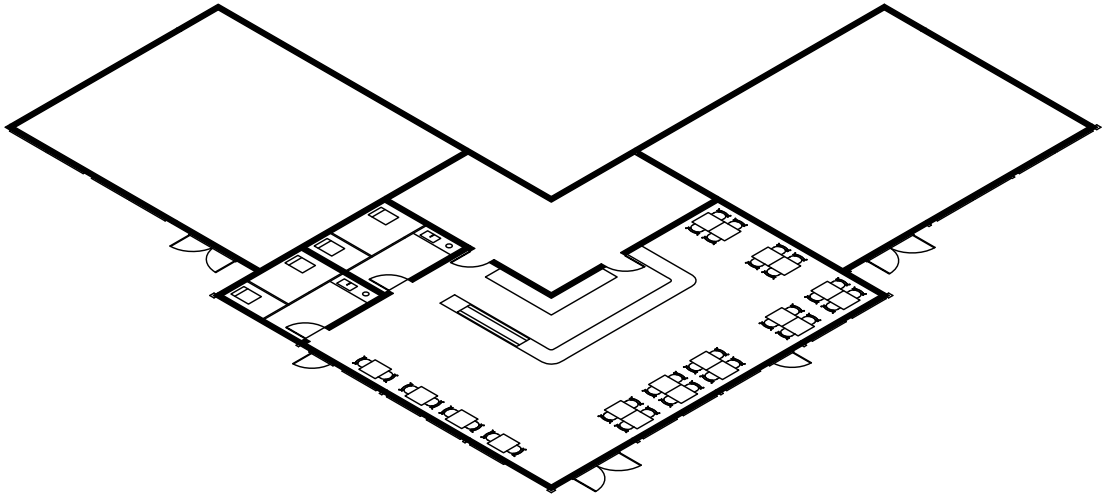
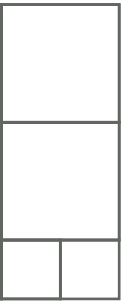
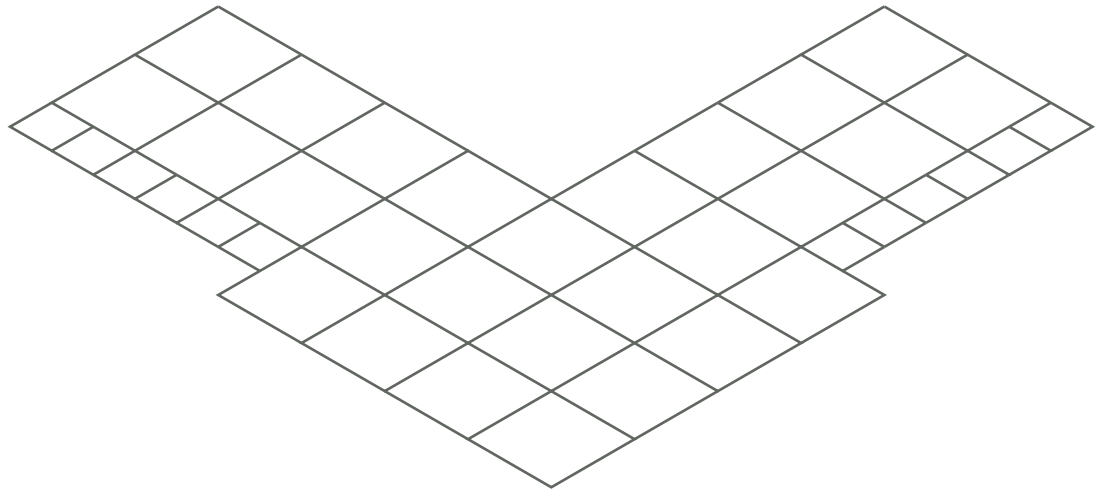


Unit Type 3 Axonometric



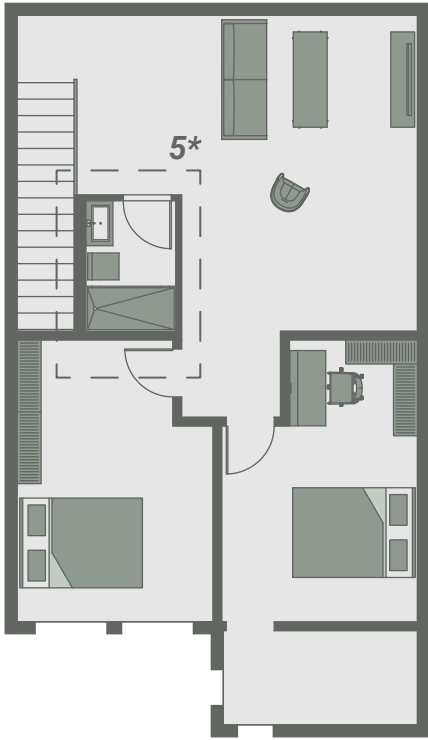




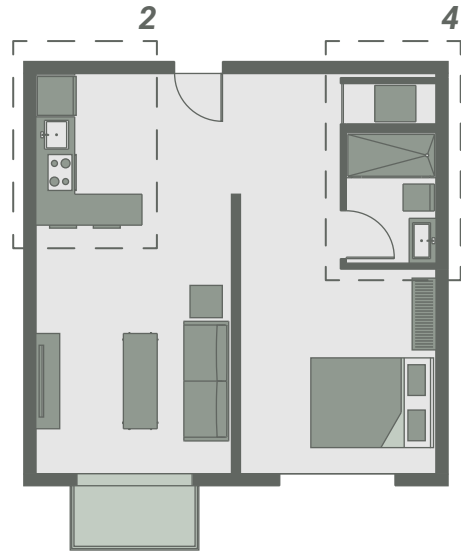


3.6 COMPONENTS

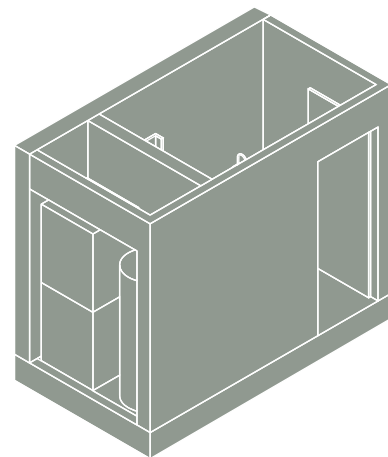
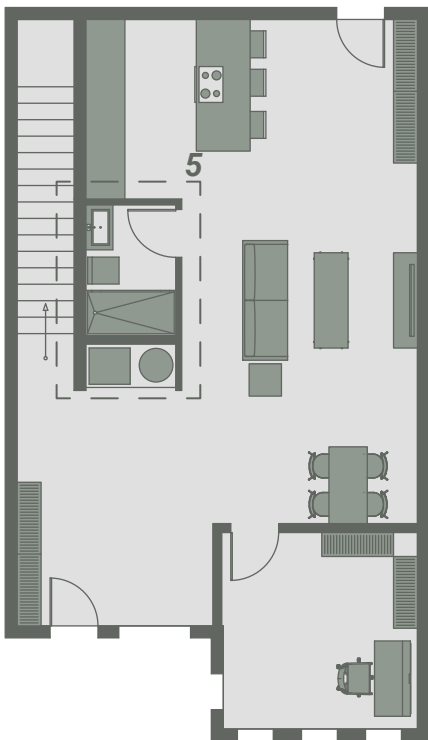
Townhouse Apartment



Typ. Studio Apartment



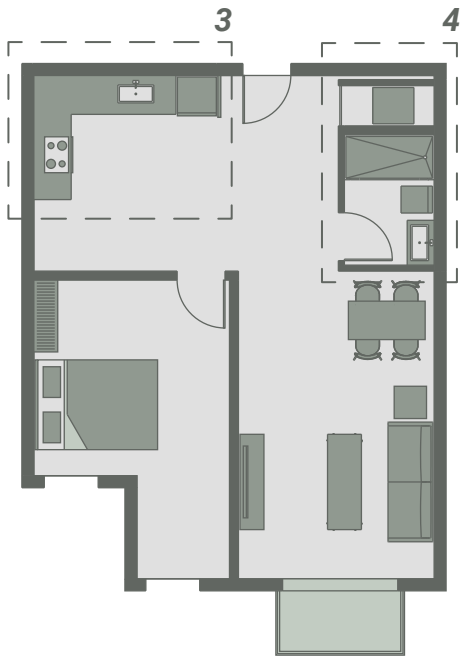
SECOND FLOOR PLAN



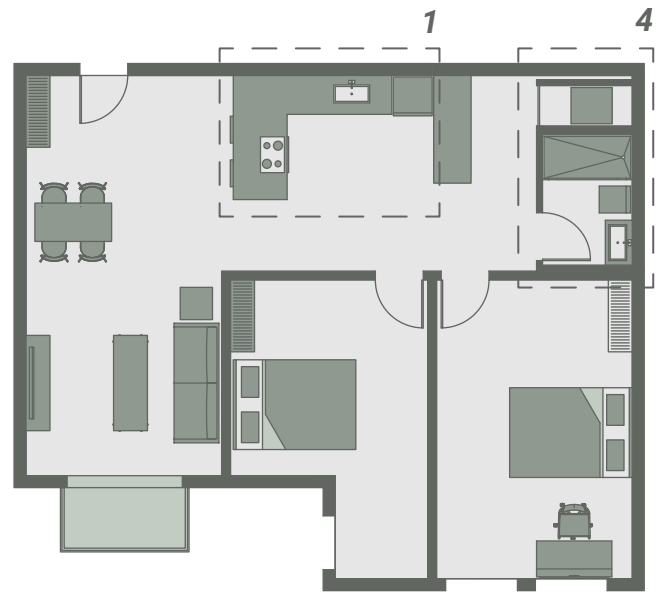
WASHROOM / LAUNDRY POD

GROUND FLOOR PLAN

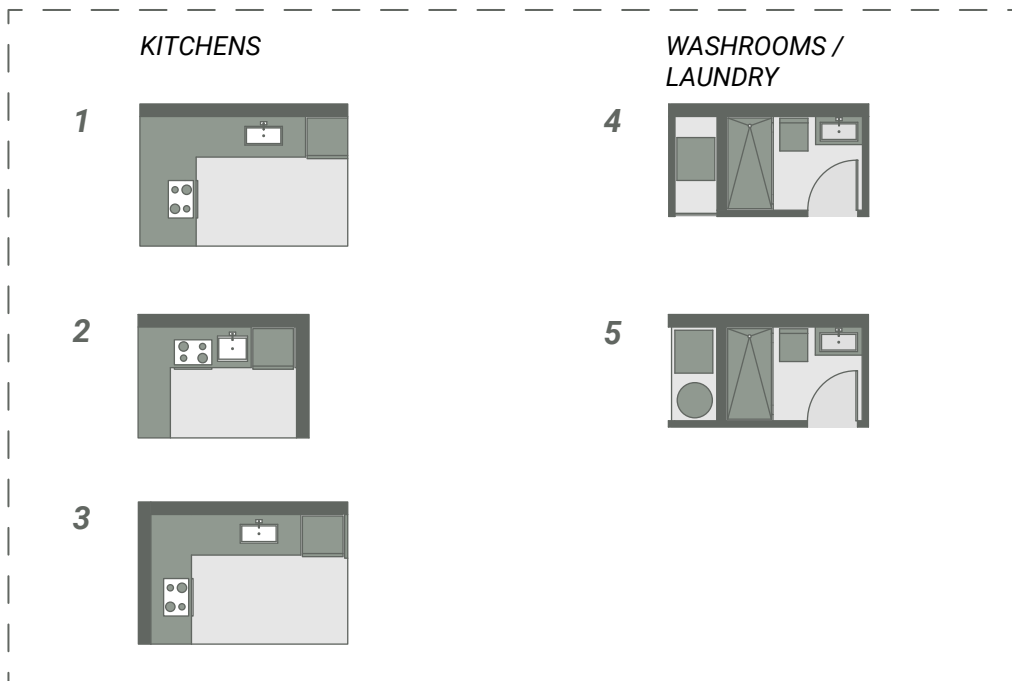
Typ. 1 Bedroom Apartment



Typ. 2 Bedroom Apartment



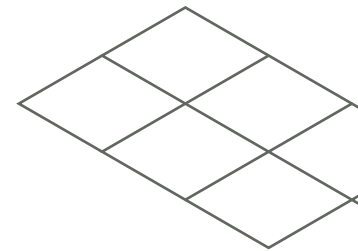
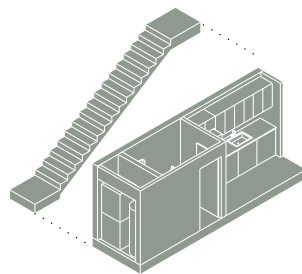
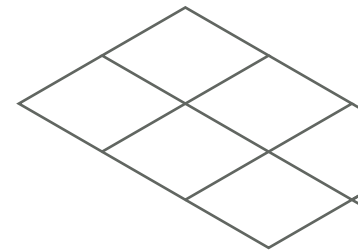
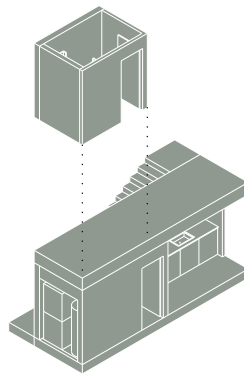
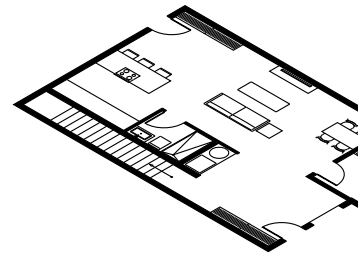
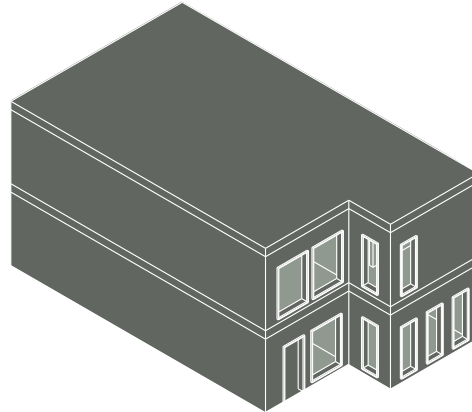
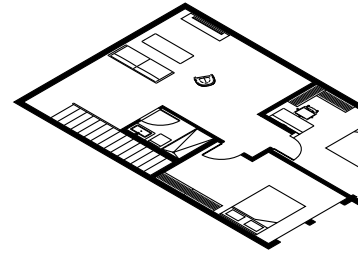
REPEATED POD MODULAR ELEMENTS



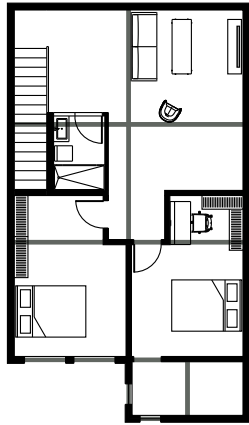
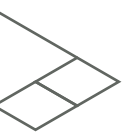
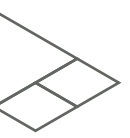
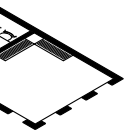
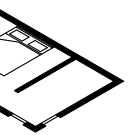
3.7 TOWNHOUSE APARTMENTS

The townhouse units feature a prefabricated bathroom, kitchen and laundry pod and a bathroom pod on the second floor. This unit has ample living space.

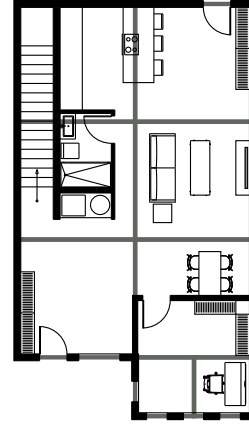
This unit is designed with families in mind, with the option for 3 bedrooms and ground floor access from both the exterior of the building and the interior circulation spaces.



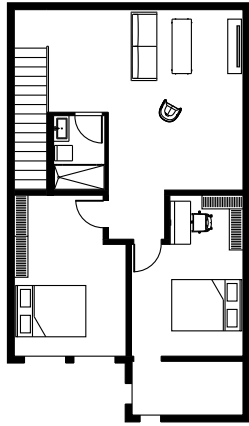
POD SYSTEM
BATHROOM, KITCHEN, UTILITY CLOSET, LAUNDRY



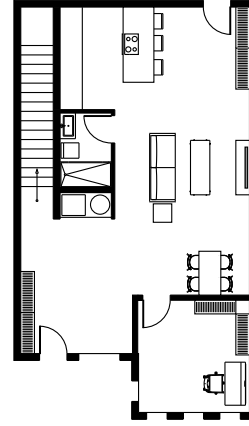
*GRID OVERLAY
2ND FLOOR*



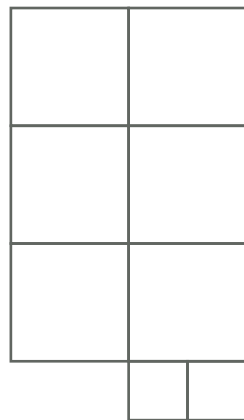
*GRID OVERLAY
1ST FLOOR*



*FLOOR PLAN
2ND FLOOR*

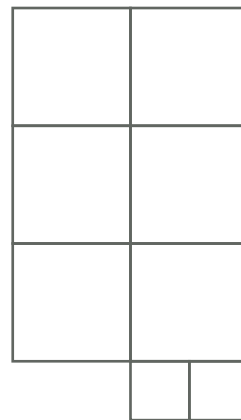


*FLOOR PLAN
1ST FLOOR
3.5m*



COMPONENT GRID

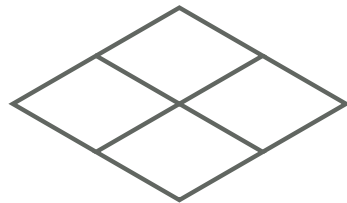
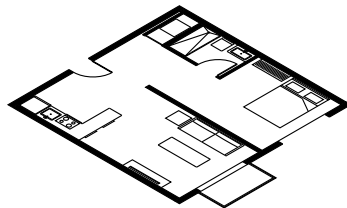
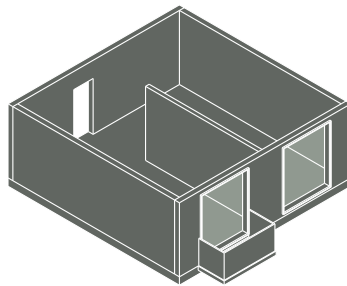
3.5m



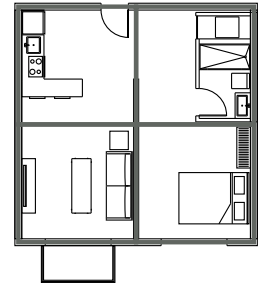
3.8 STUDIO AND 1 BEDROOM APARTMENTS

The 1 bedroom apartment units feature the prefabricated bathroom and laundry pod and ample living space.

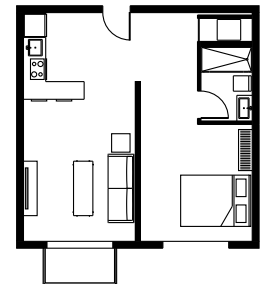
The studio unit is compact and highly efficient, featuring the prefabricated bathroom and laundry pod. This unit type offers open concept comfort.



Typ. Studio Apartment



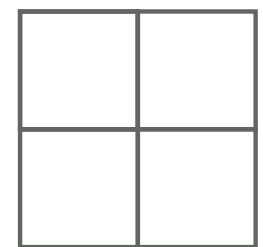
GRID OVERLAY



FLOOR PLAN

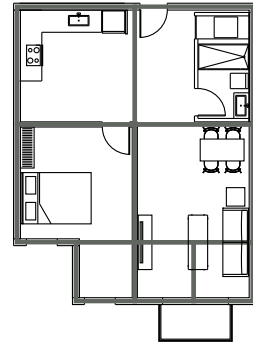
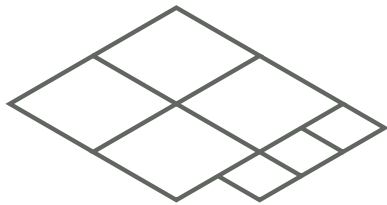
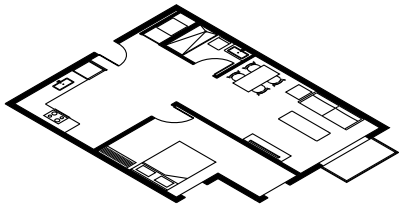
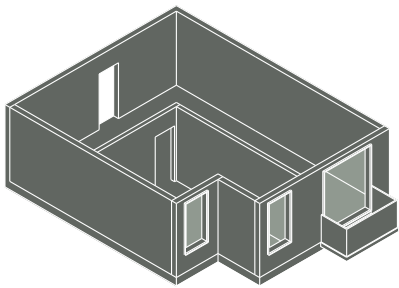
3.5m

3.5m

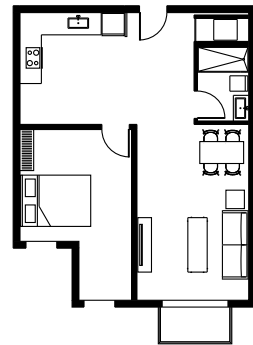


COMPONENT GRID

Typ. 1 Bedroom Apartment



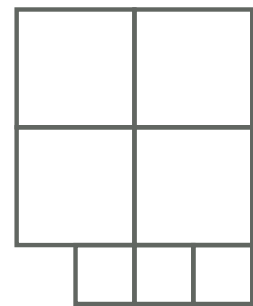
GRID OVERLAY



FLOOR PLAN

3.5m

3.5m



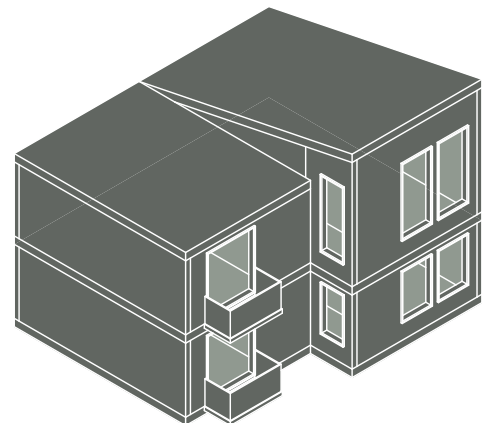
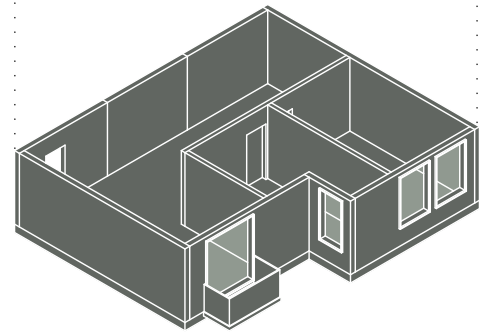
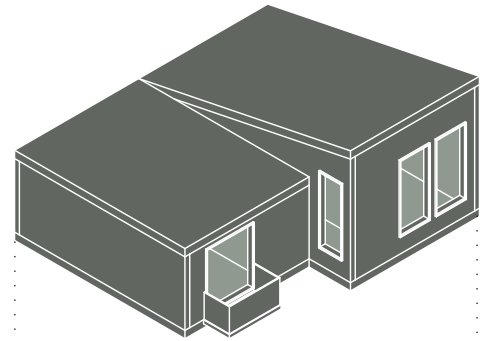
COMPONENT GRID

3.9 2 BEDROOM APARTMENTS

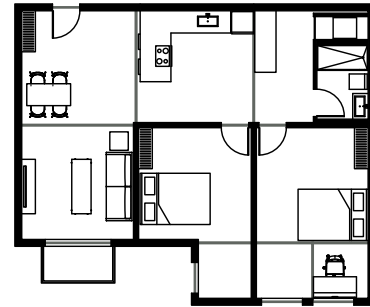
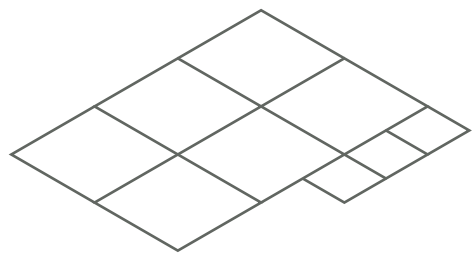
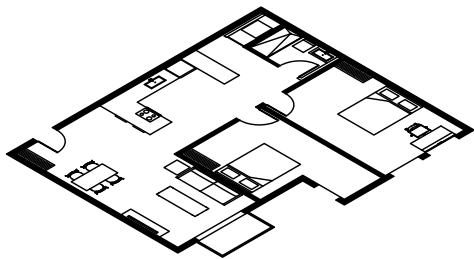
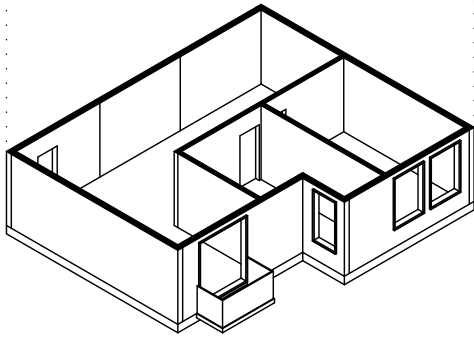
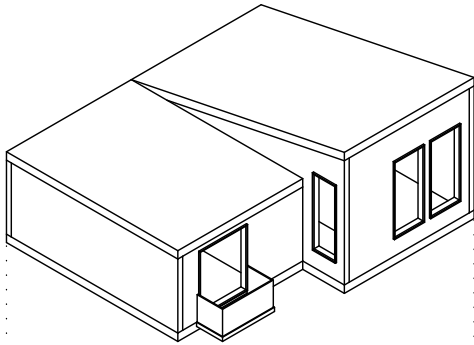
The 2 bedroom apartment units feature the prefabricated bathroom and kitchen pod and ample living space.

The unit type also includes a penthouse style with vaulted ceilings which is exclusive to the 2 Bedroom unit type.

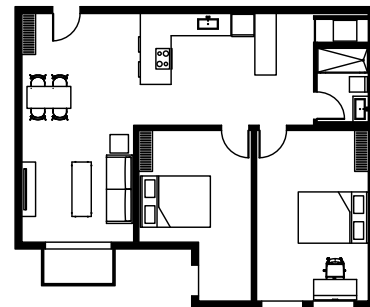
Unit Aggregations



Typ. 2 Bedroom Apartment



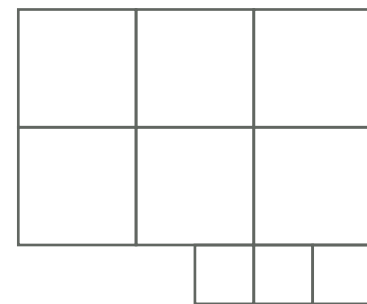
GRID OVERLAY



FLOOR PLAN

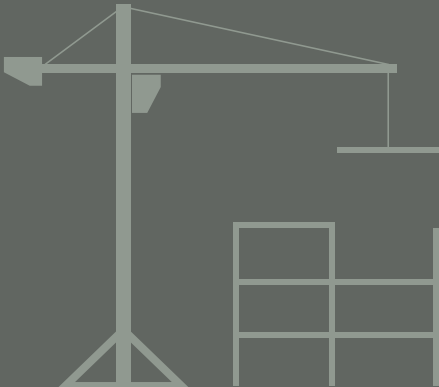
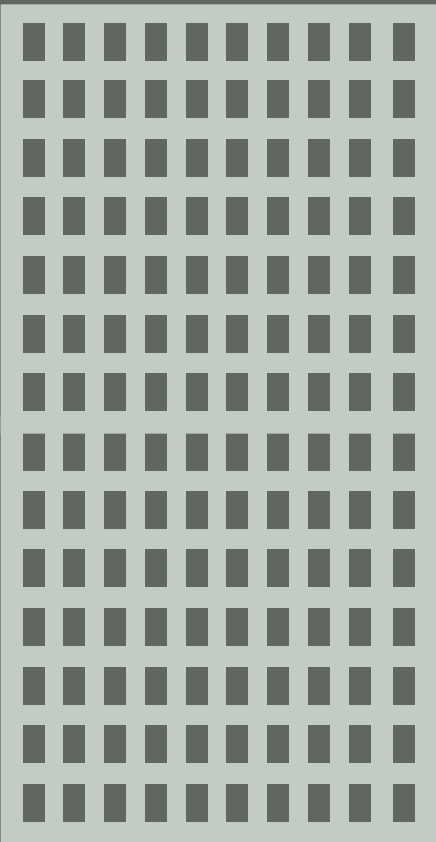
3.5m

3.5m



COMPONENT GRID

4.0 MASSING



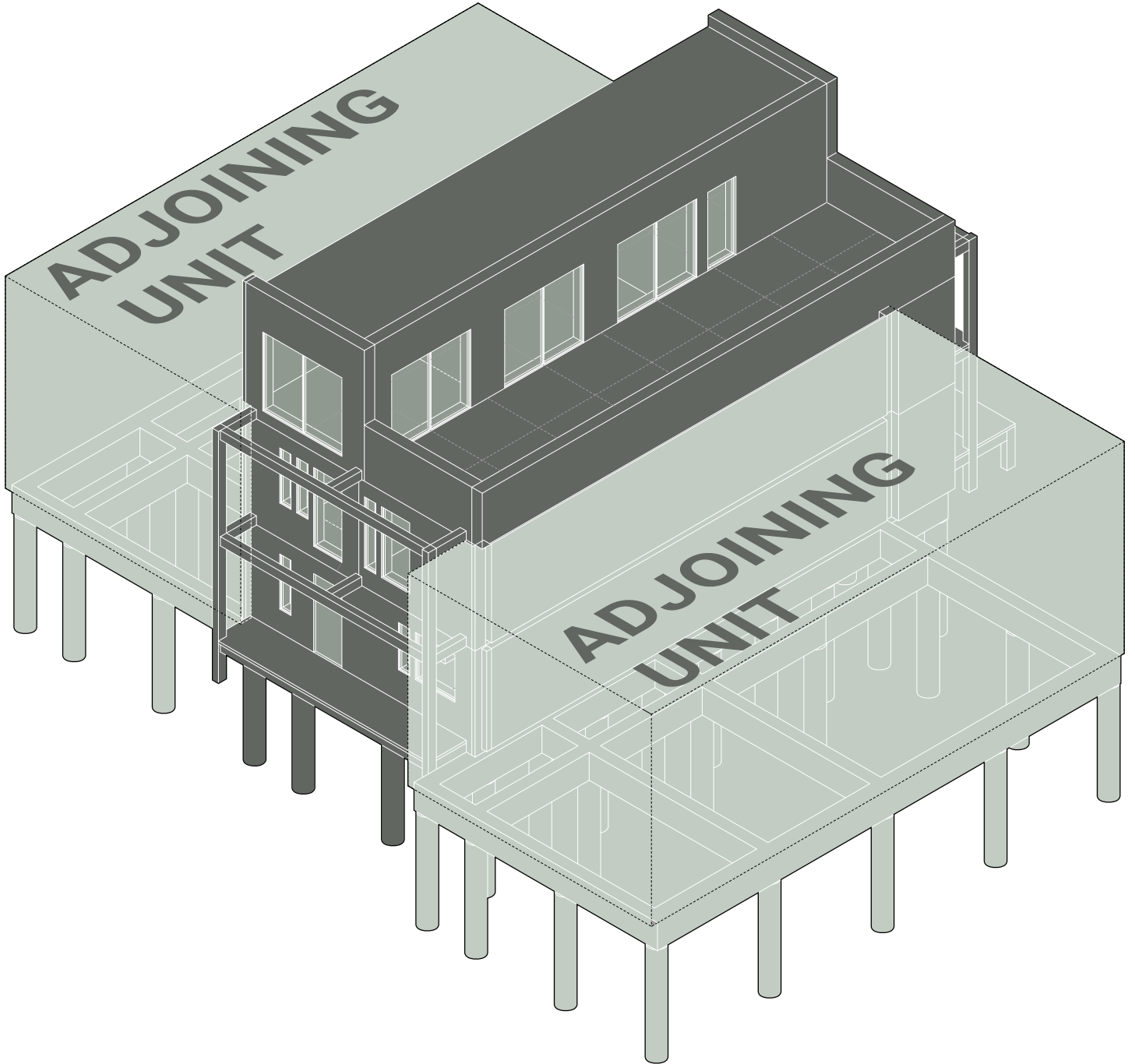
4.1 DESIRED MASSING

The goal of creating a system for medium density residential housing was to create a repeatable massing that fits into a system of modular construction. Both the townhouse and 6 storey mid rise typologies utilize the same system to different effects, but toward that same goal of repetition.

Due to the construction logic of the modular kit of parts system, the massings are able to be scaled to fit to the desired typology without compromising the system or the design intent.

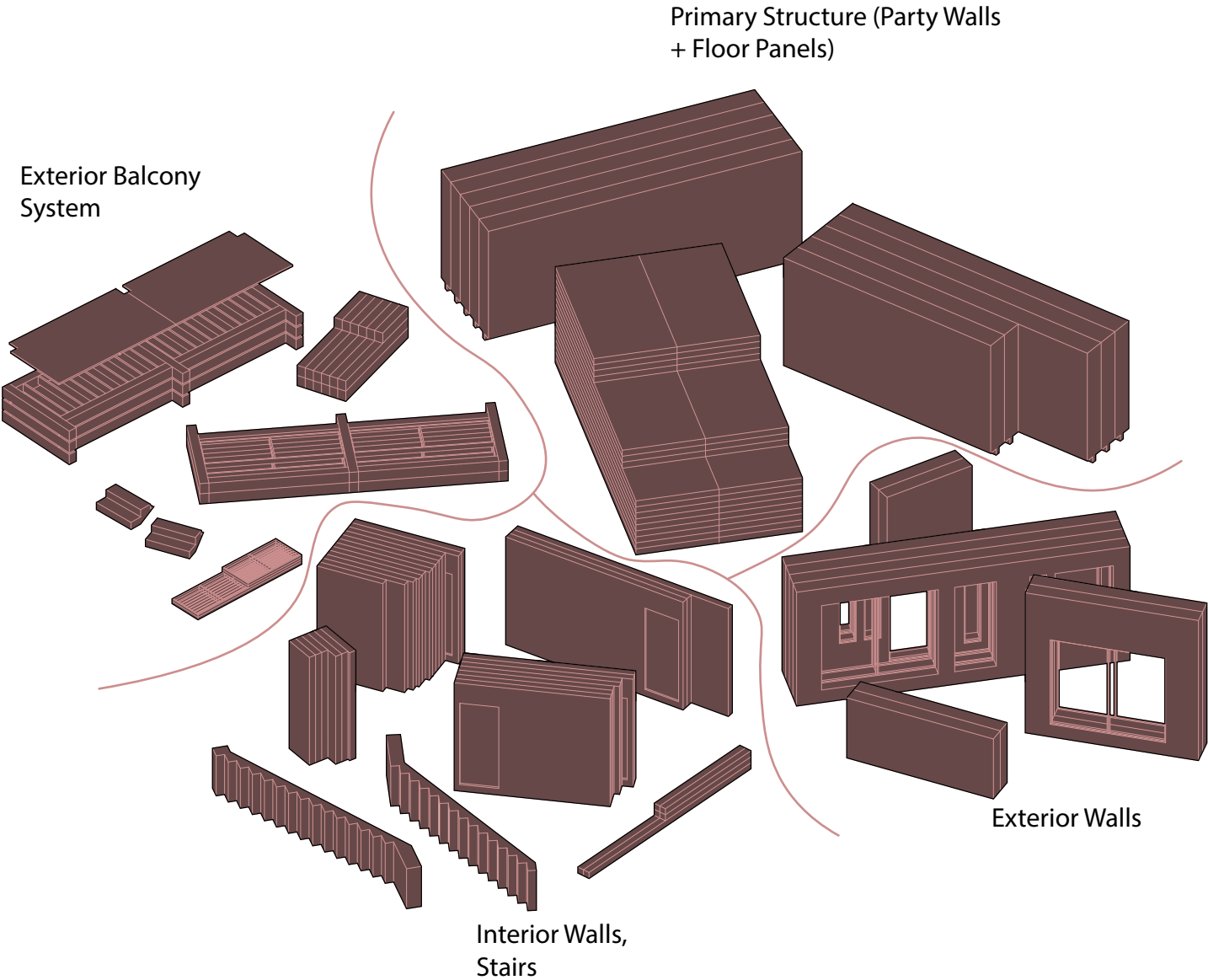
4.2 TOWNHOUSE MASSING

The townhouse massing is meant to offer a variety of interior flexibility, but the overall massing of the project is also meant to do the same. Utilizing the kit of parts method of modular construction. Prefabbed elements can be used to offer different finishes and scales to the dwelling. For example, the image below features an additional storey from the typical 2 storey model and also includes opportunity for bolt on balcony framing. The dwellings are also organized side by side to account for saving material by the usage of shared walls.

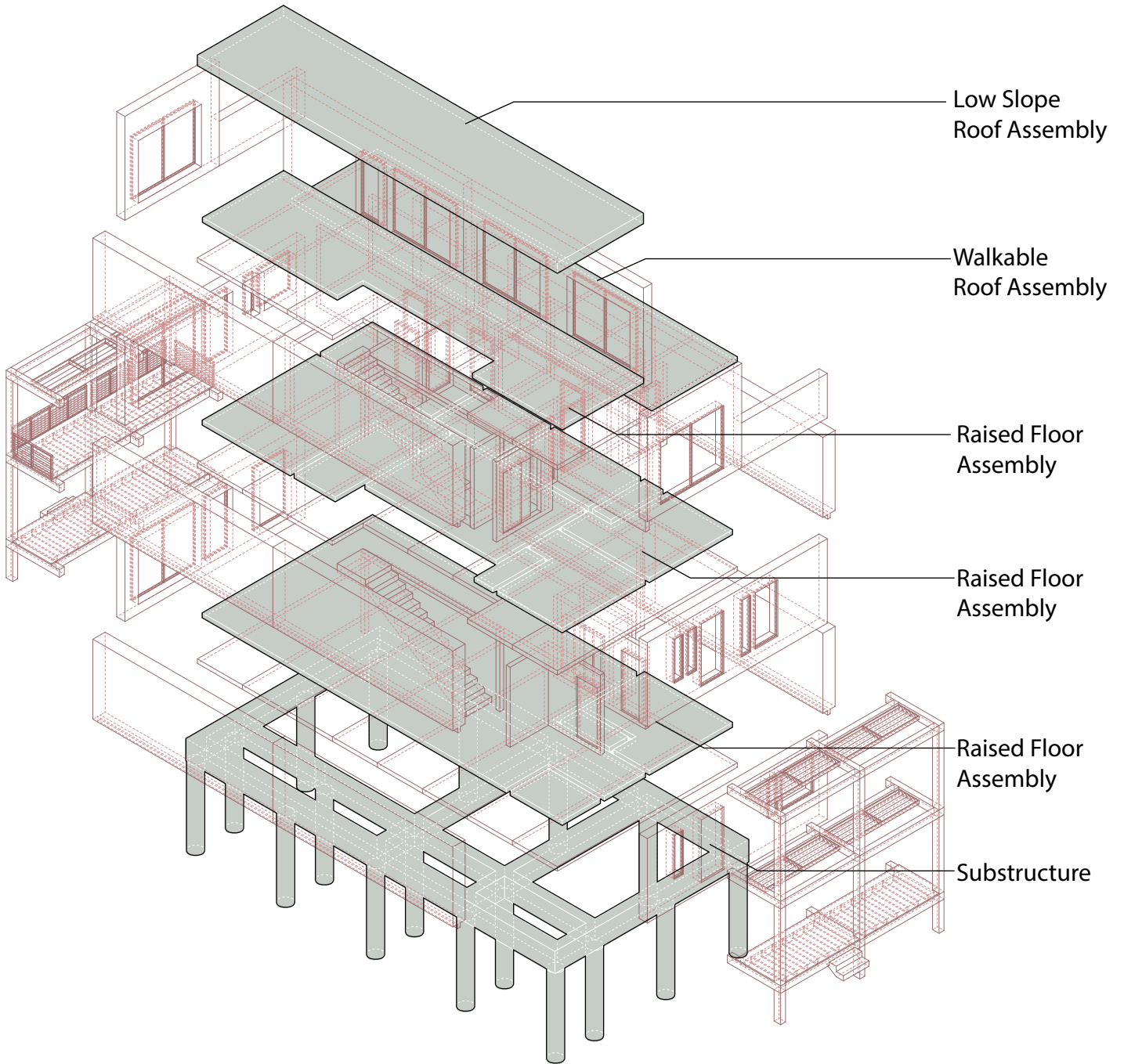


Unit Type 3 Axonometric

4.3 LOGISTICS



Prefabricated Elements



Site-Constructed Elements

4.4 TOWNHOUSE UNIT 3 SECTION





4.5 MIXED USE MASSING

In creating a system for medium-density housing, a goal in mind was to design the system to integrate together to create a podium style 6 storey mixed use residential building that incorporates multiple types of units to create flexibility within the program and has ground floor commercial units to provide community activation.

The building incorporates 4 types of residential units, a townhouse, a studio apartment, and 1 and 2 bedroom apartments.

The unit breakdown within the building is as follows:

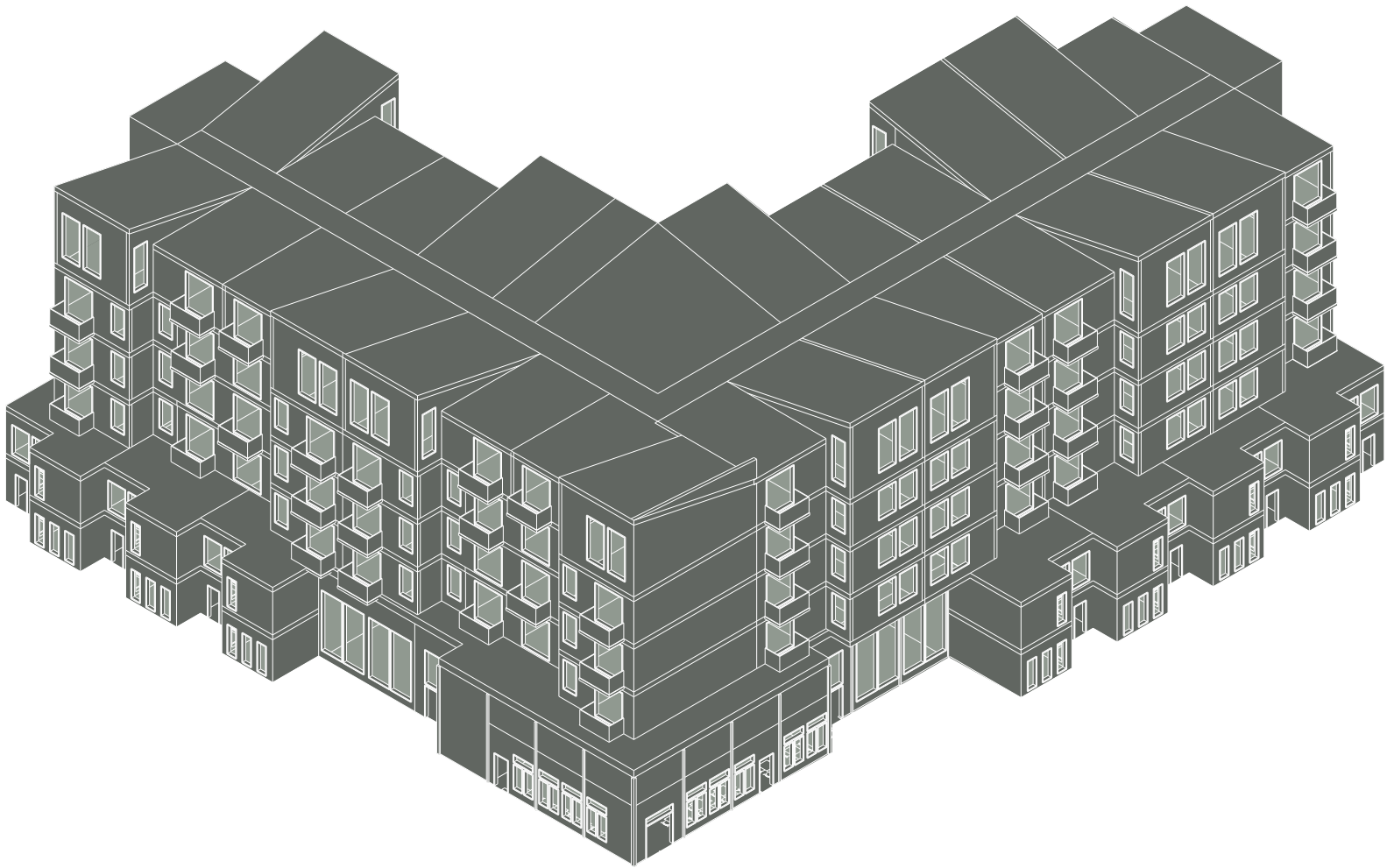
3 Commercial Units

14 Townhouse Units

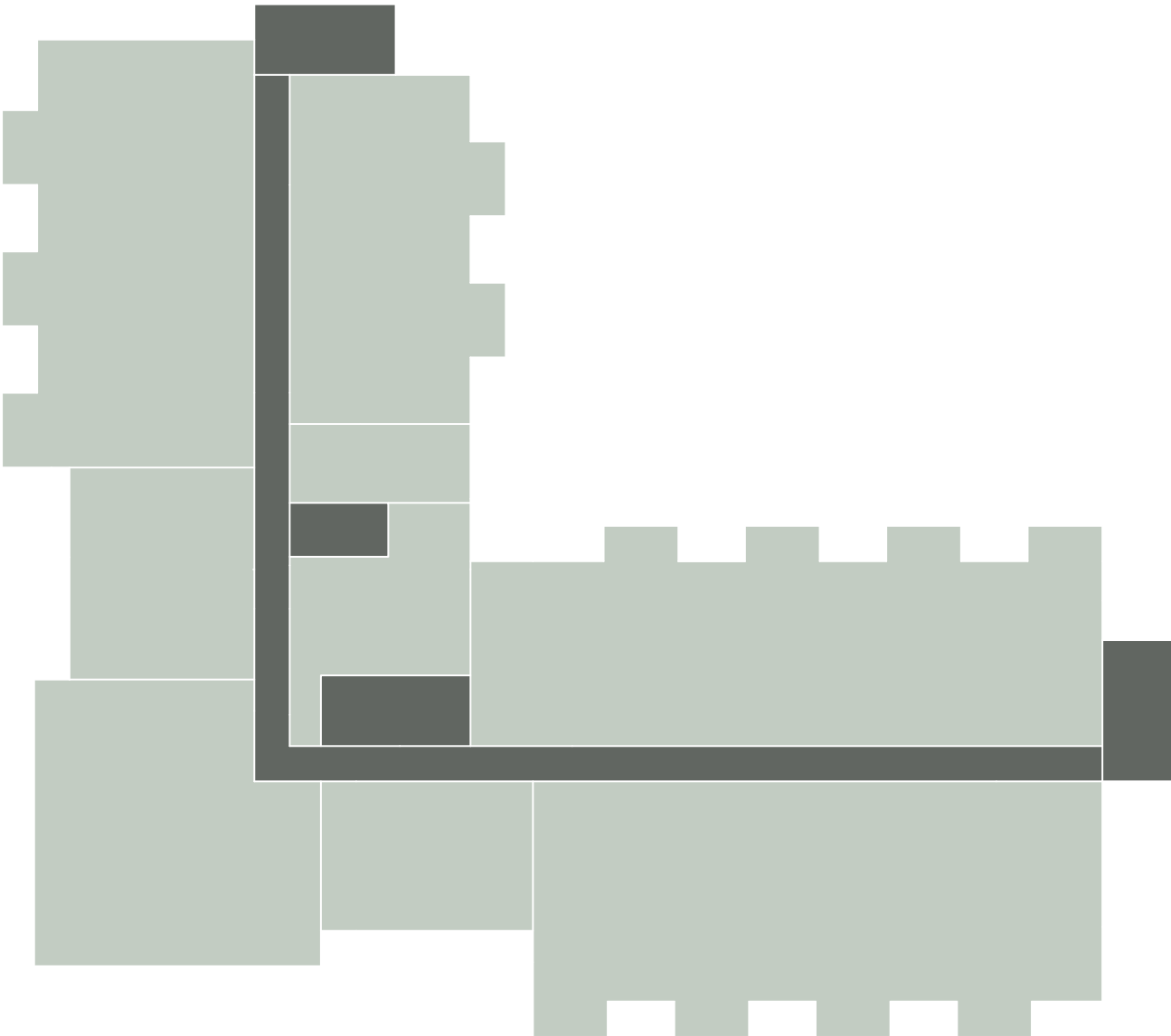
9 Studio Apartments

18 1 Bedroom Units

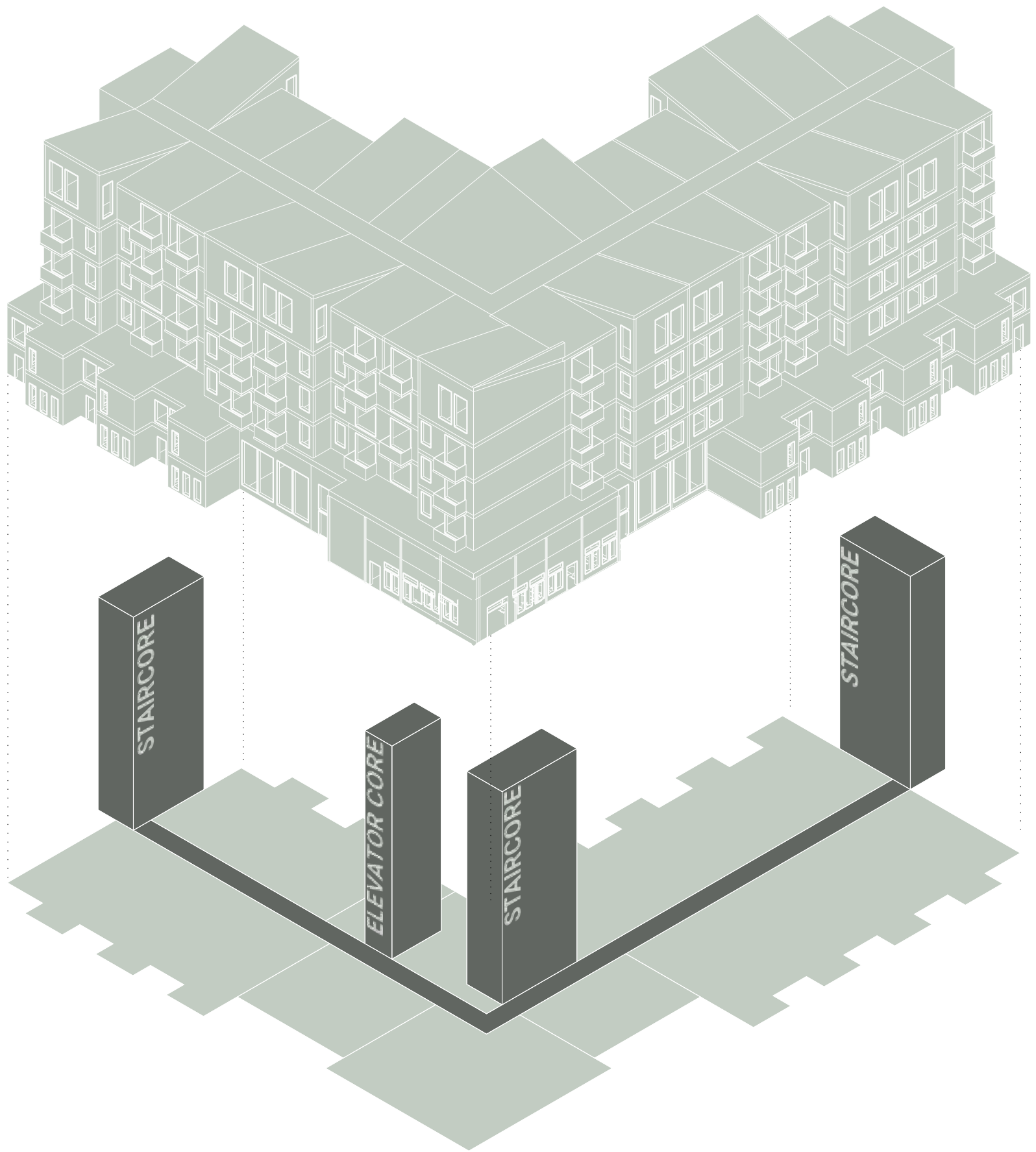
34 2 Bedroom Units



4.6 GROUND FLOOR AND CIRCULATION



GROUND FLOOR PLAN



CIRCULATION DIAGRAM

4.7 ELEVATIONS + 3-6 PLAN

The elevations begin to establish the relation within the building of the podium style including commercial units and townhouse units, to the rest of the residential units above it.

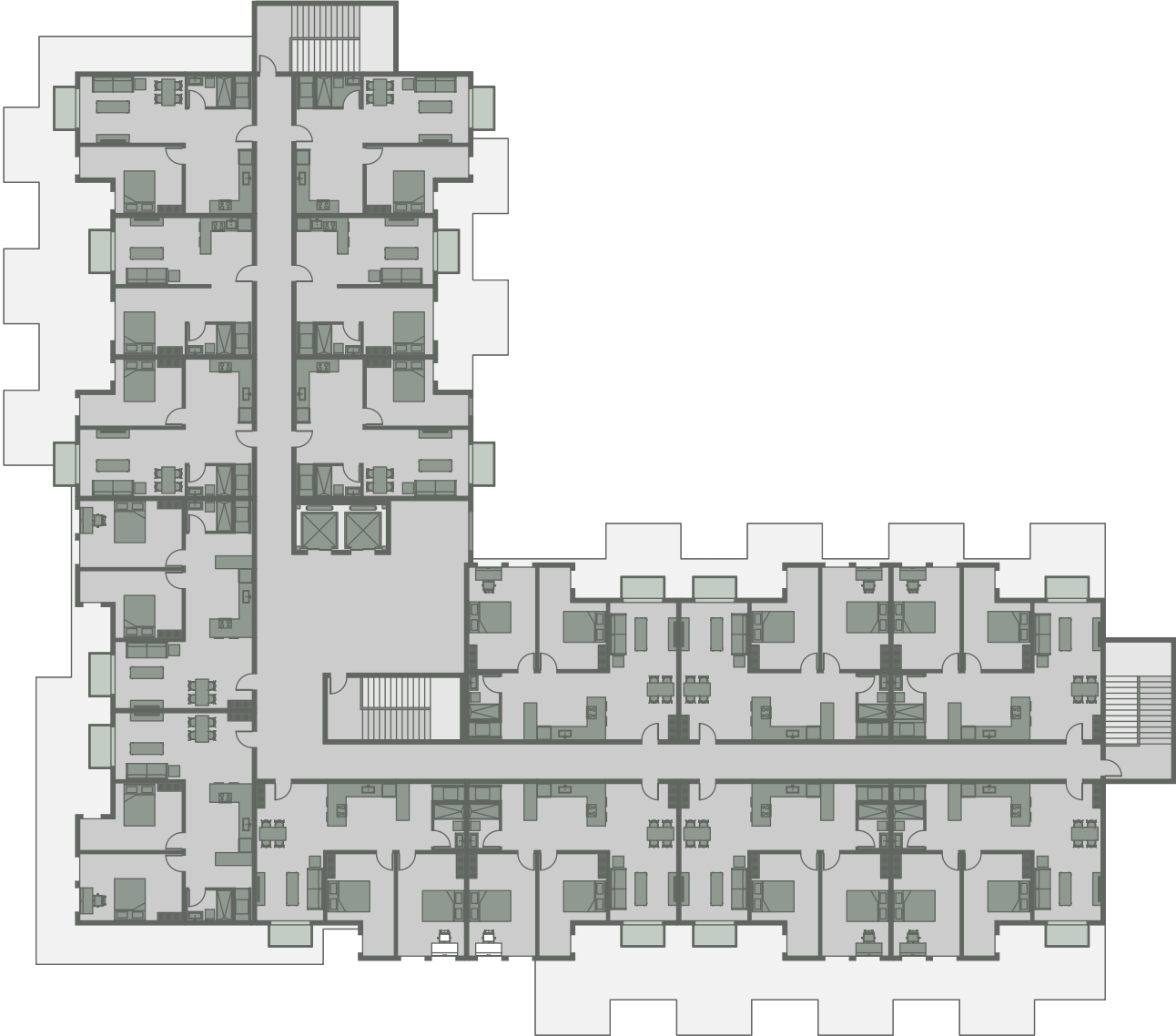


ELEVATION



ELEVATION

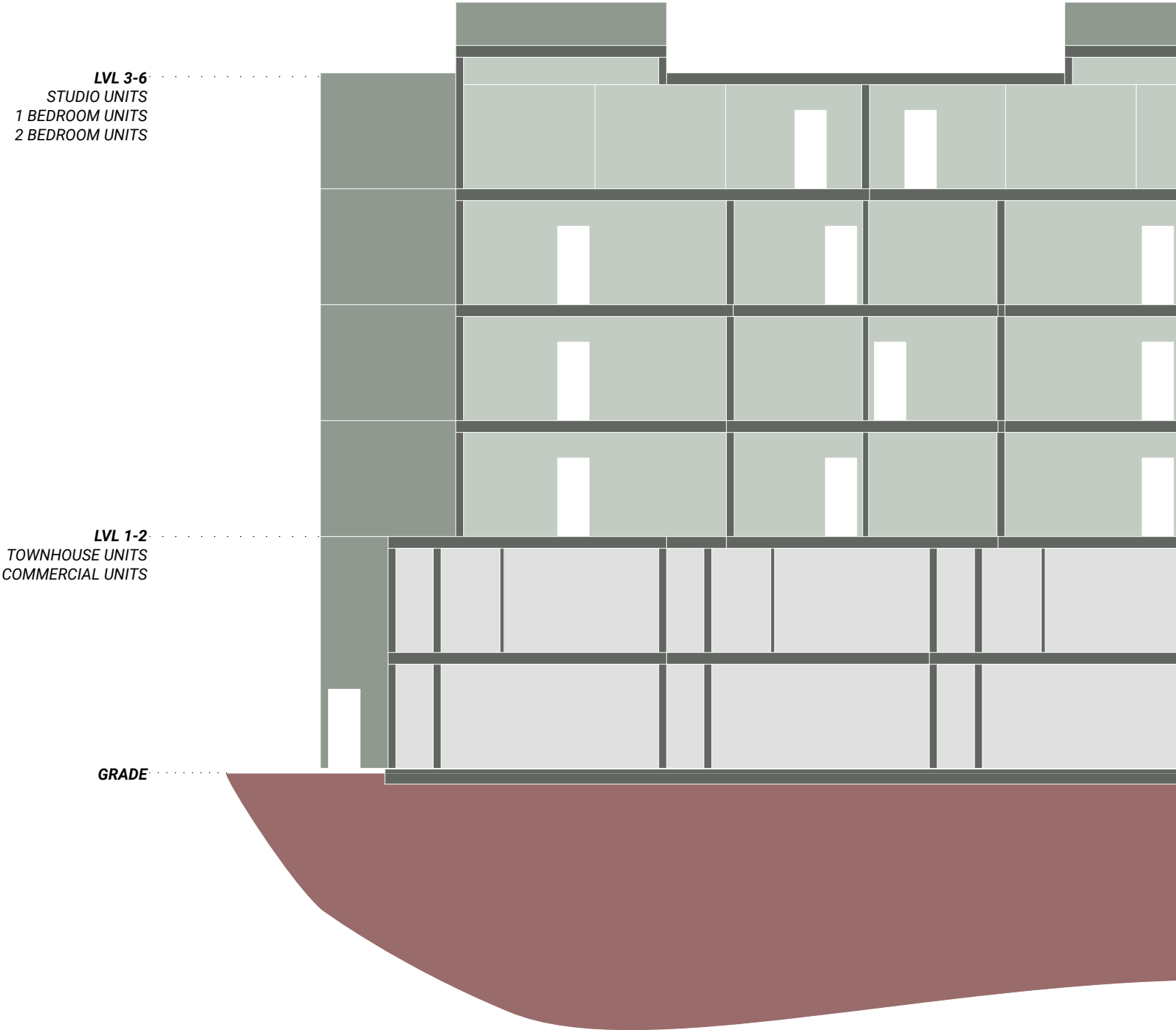
The typical 3-6 plan shows the amalgamation of the different unit types in a standard configuration the floor plate.

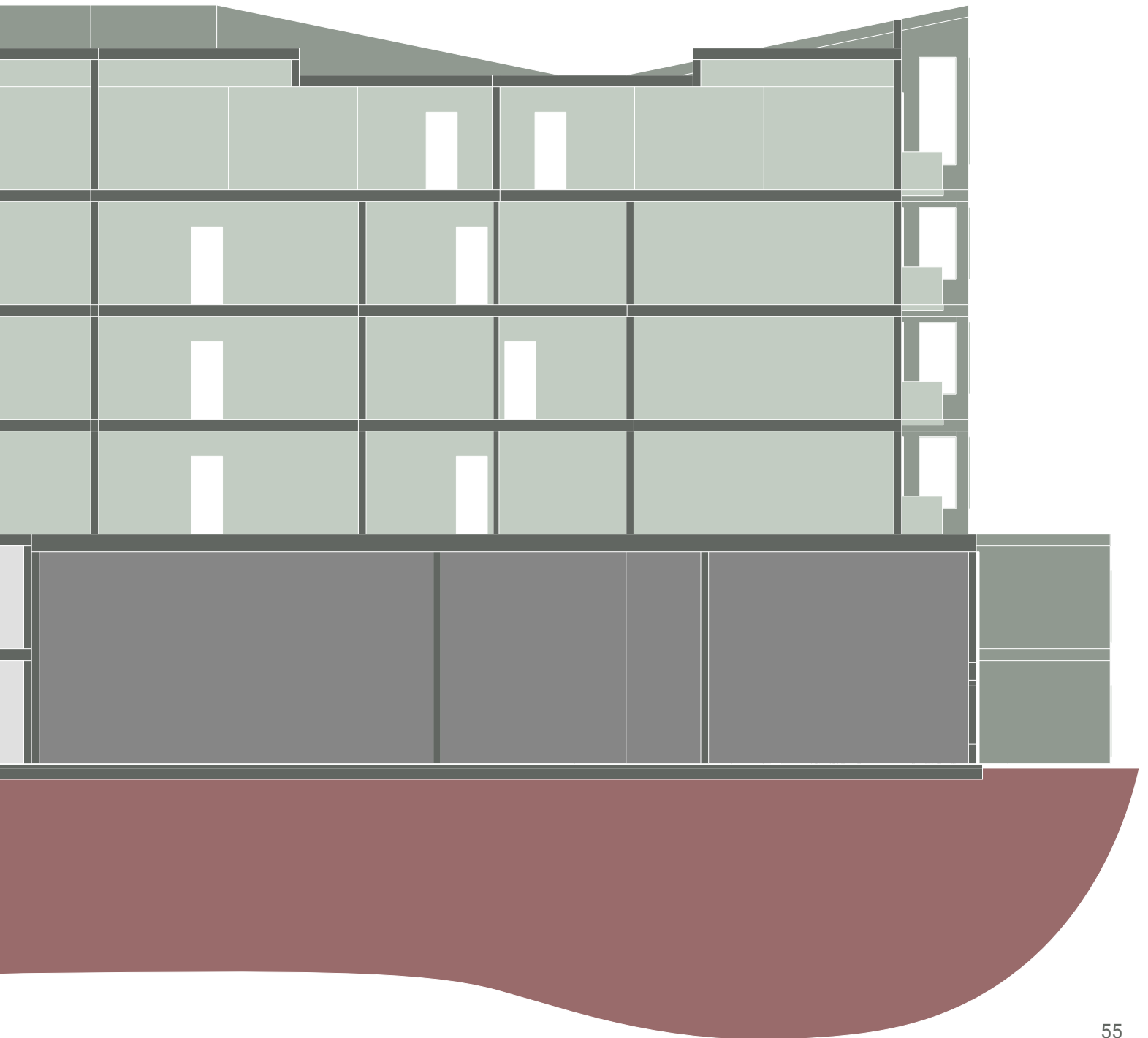
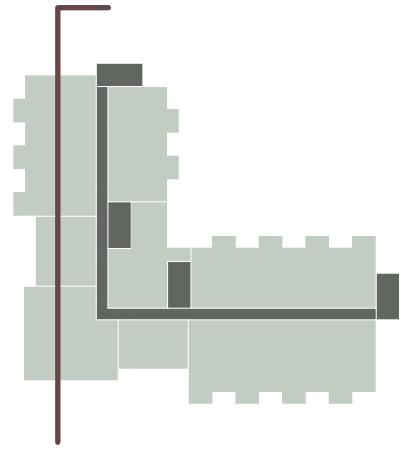


FLOOR 3-6 PLAN

4.8 BUILDING SECTION

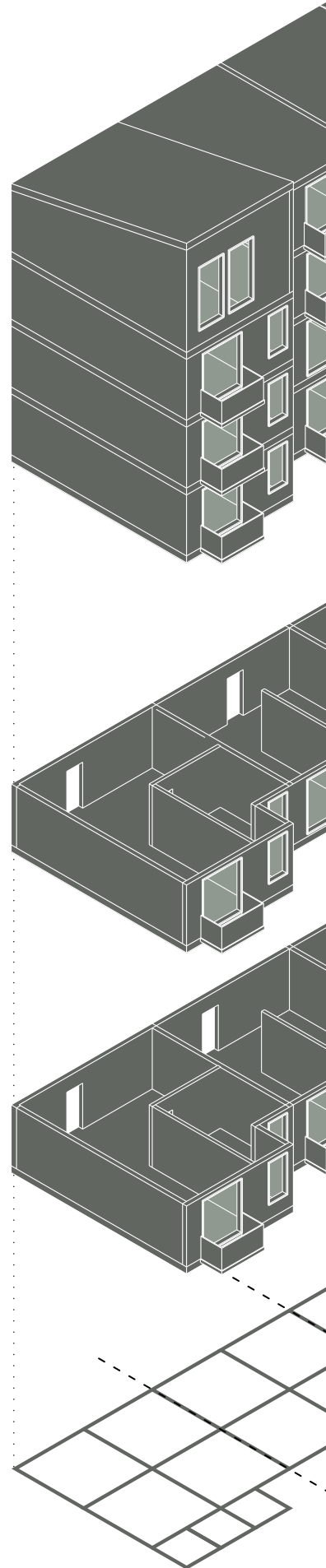
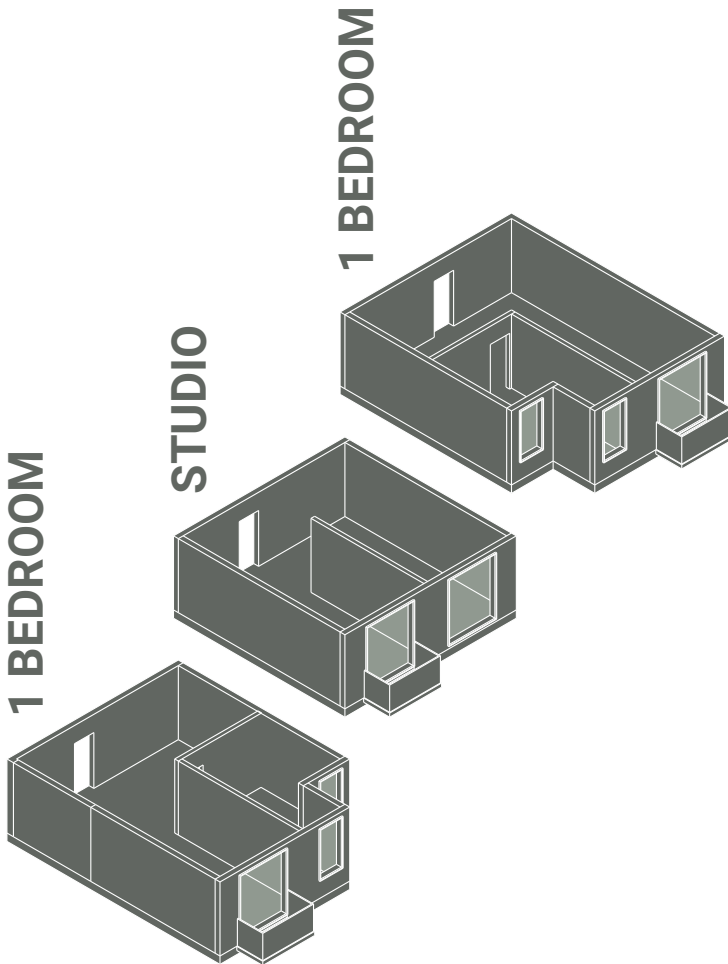
This section illustrates the scale of the building and distribution of the type of residential units and commercial units in the building.

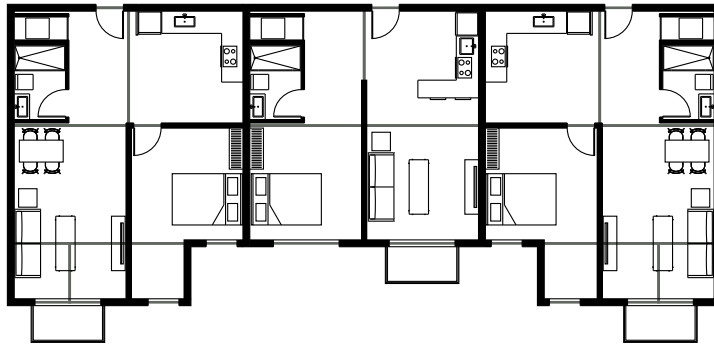
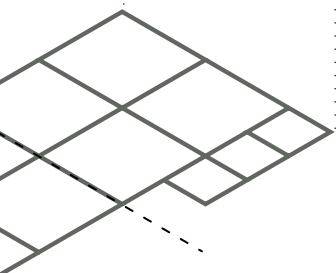
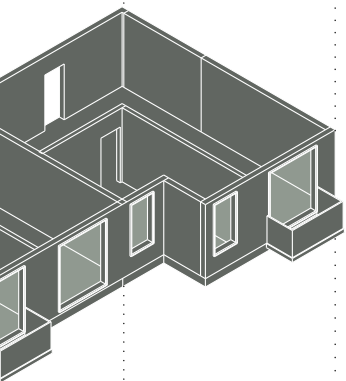
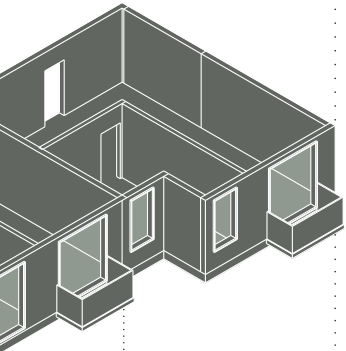
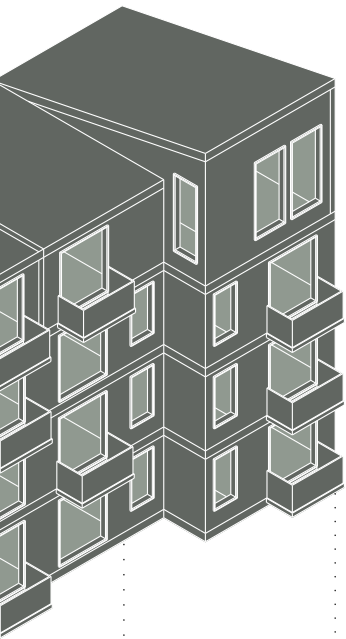




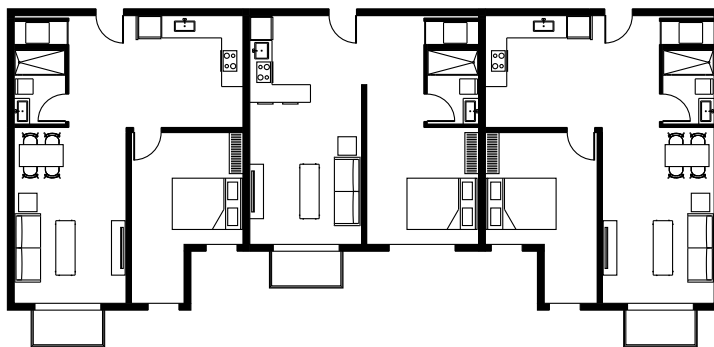
4.9 UNIT TYPE AGGREGATIONS

In this aggregation, 1 bedroom and studio units are arranged to form a block within the levels 3-6 of the mixed use building. The studio is mirrored between levels and is anchored by 1 bedroom units on either side. The 6th level of the building features 2 - 2 bedroom penthouse style apartment units.

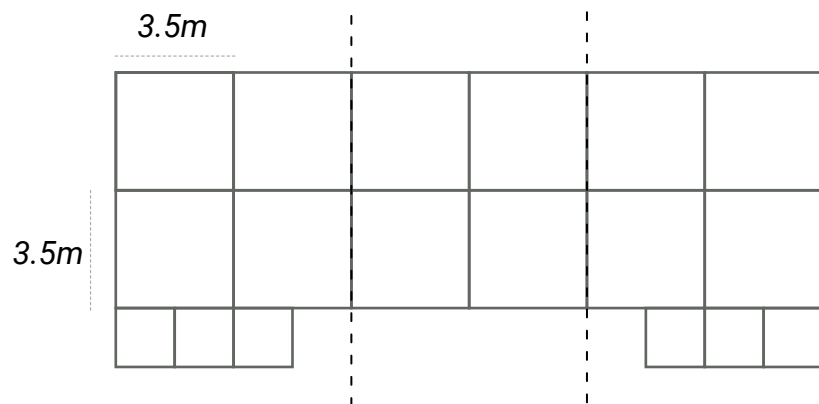




GRID OVERLAY



FLOOR PLAN



COMPONENT GRID

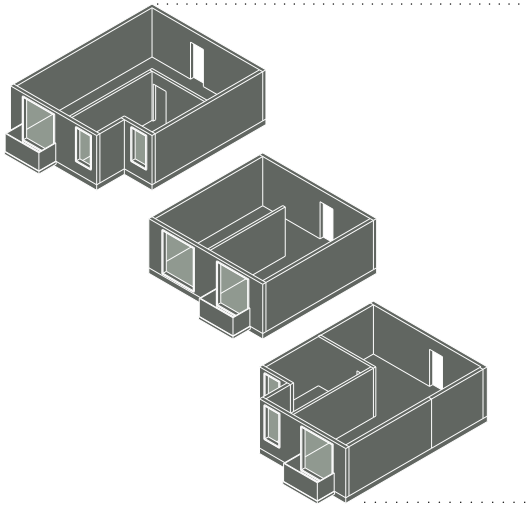
Programming

6 Storey podium building

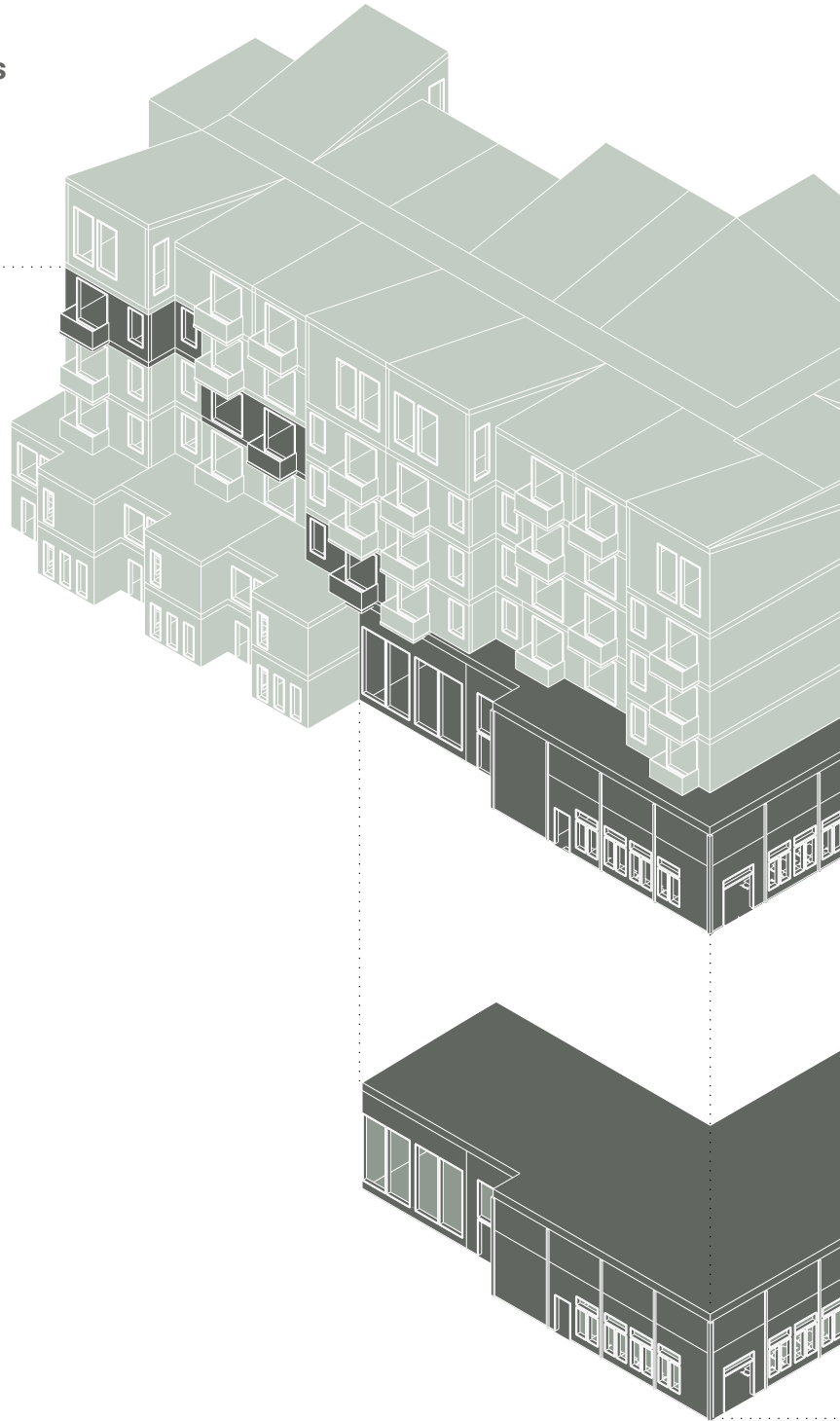
3 Commerical units

Ground floor townhouses

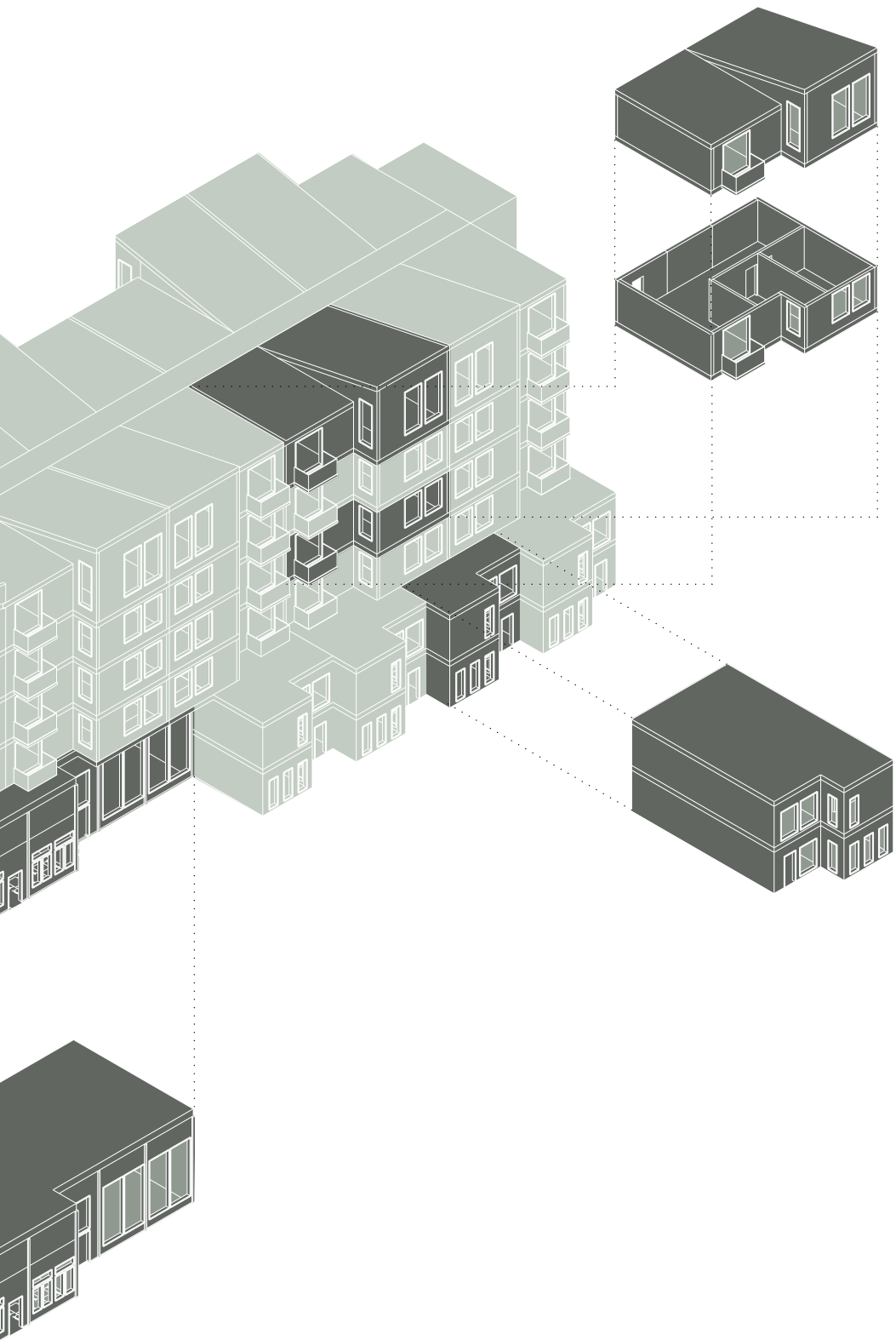
Studio, 1 and 2 bedroom apartments



1 BEDROOM AND STUDIO APARTMENTS



PODIUM MODULAR PREFAB APARTMENT BUILDING



*PENTHOUSE
2 BEDROOM APARTMENT*

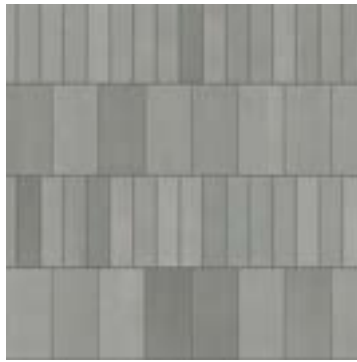
TYP. 2 BEDROOM APARTMENT

TOWNHOUSE APARTMENT

COMMERCIAL UNITS

4.10 TOWNHOUSE MATERIAL PALETTE

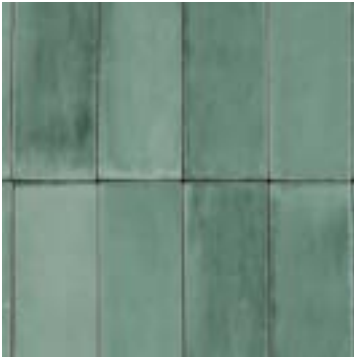
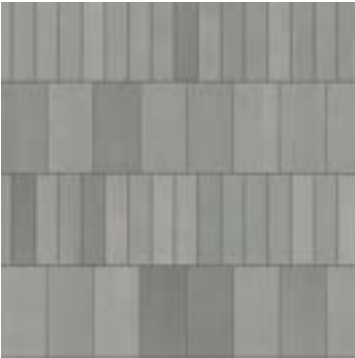
Missing Middle features a simple, sharp material palette that is similar for both townhouse and apartment typologies, tying them together visually to create a cohesive community when they are developed alongside each other. Primary materials used are corrugated metal siding in both silver and black to create variation between adjacent units, as well as wood members for exterior balcony and deck structures.





TOWNHOUSES

4.11 6 STOREY MULTIFAMILY MATERIAL PALETTE





6 STOREY MULTIFAMILY

5.0 COMMUNITY



5.1 INTRODUCTION

Medium-density housing, which including townhomes, row houses, mid-rise apartments, and courtyard developments can play a vital role in creating vibrant, inclusive communities across Calgary. Unlike high-rise towers or single-family suburbs, medium-density housing strikes a balance between compact urban living and neighborhood-scale design. It allows more people to live within walking or biking distance of transit, shops, schools, and parks, supporting the city's goal of sustainable growth.

By introducing more residents into established neighborhoods, medium-density housing can revitalize underused land and increase the customer base for local businesses and services. The human-scale design of these developments also encourages street-level interaction — front porches, shared courtyards, and small public spaces foster casual encounters that build social connection and a sense of belonging.

In Calgary's climate, well-planned medium-density developments can also support energy-efficient building practices and shared green infrastructure, reducing overall environmental impact. When integrated with transit-oriented development zones and mixed-use corridors, medium-density housing enhances affordability, livability, and urban vitality, helping Calgary grow as a city of connected, resilient, and thriving communities.





5.2 BUILDING COMMUNITY

Medium-density mixed-use building typologies foster community by creating vibrant environments where people can live, work, and connect within walking distance. By integrating diverse housing options with local amenities, retail, and community spaces, these developments encourage daily interaction and reduce reliance on cars. Shared amenity spaces provide informal gathering places that strengthen social bonds and support a sense of belonging. Ground-floor commercial spaces further activate the streetscape, providing opportunities for local businesses and cultural engagement that reinforce neighborhood identity.

In Calgary, medium-density mixed-use buildings present a sustainable alternative to both low-density suburbs and high-rise cores, offering a balanced urban form that supports inclusivity, walkability, and community life within a comfortable setting.



TEXT



5.3 REFERENCES

Element5. "Retirement Living and Mass Timber." (2023), Element5.
<https://elementfive.co/fr/kits/retirement-living/>.

