

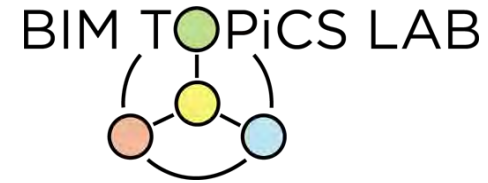


Design Phase Overview Presentation

March 2023



This presentation was created by UBC Sustainability Hub based on the information in the Vienna House Design Phase Case Study (March 2023) with contributions from the Vienna House project team and stakeholders.



The case study was completed as part of the BC Housing Vienna House Multi-Unit Affordable Housing Demonstration Initiative, which received funding from the Canada Mortgage and Housing Corporation (CMHC) National Housing Strategy Demonstrations Initiative, Natural Resources Canada (NRCan), and Forestry Innovation Investment (FII). The views expressed are the personal views of the authors; CMHC and other funders accept no responsibility for them.



Project Owners

BC Housing

Main development sponsor and primary funder for the design and construction of Vienna House.

City of Vancouver

Land owner of Vienna House site and party to the Memorandum of Cooperation with the City of Vienna.

NMHDO

City of Vancouver's development agent and project manager for below-market housing projects on city-owned land.

More Than a Roof

Non-profit social housing operator and the Vienna House project developer, operator and lessee.

CPA Developments

Development and project management consultant, engaged by More Than a Roof.



Project Team

Planning & Rezoning Enquiry Team

Rezoning Enquiry

Yamamoto Architecture

E3 Eco Group

Durante Kruek Ltd.

Site Assessment

Keystone Environmental

ArboTech, ACL Group Consulting

GEOPACIFIC Consultants

SLR Consulting

Design Team

Prime Consultant / Architect

Public Architecture + Communication

Sub-Consultants

Structural Engineer

Wicke Herfst Maver (WHM)

Mech, Electrical & Passive House Lead

Introba

Civil Engineer

Core Group Civil Consultants Ltd.

Landscape Architect

Matthew Thomson Design (MTD)

Building Envelope

Morrison Hershfield

Acoustical Engineer

BKL Consultant Ltd.

Passive House Certification

Steven Winter Associates (SWA)

Elevator

GUNN Consultant

Building Code Compliance

GHL Consultants Ltd.

Construction Team

Construction Manager

Kindred Construction

Sub-Consultants

Cost

Hanscomb Ltd.

BIM

Modelo Tech Studio

Knowledge Transfer

BC Housing Research Centre

SCIUS Advisory

UBC Sustainability Hub + BIM Topics Lab

Bright Future Studio

FPIinnovations

LightHouse Sustainable Building Centre

BIM Consultants

SUMMIT BIM

BIM One Inc.



Vienna-Vancouver Collaboration

In 2018, a Memorandum of Cooperation was signed as a commitment to knowledge transfer between the cities of Vancouver Canada and Vienna Austria.

Knowledge sharing topics:

- Decarbonization in the built environment
- Innovative construction techniques
- Near-zero emission buildings initiatives
- Effective market transformation programs



Vienna House in Vancouver (Source: Public Architecture + Communication)



Vancouver House in Vienna
(Source: Rüdiger Lainer + Partner)

Vienna House Project Charter

Goals:

1. Increase the supply of safe, accessible, sustainable, and affordable housing.
2. Reduce greenhouse gas emissions through high performance buildings.
3. Explore opportunities to accelerate the development and construction process.
4. Maximize quality performance design.
5. Increase knowledge of the capabilities of the prefabrication construction industry.



Vienna House Project Charter

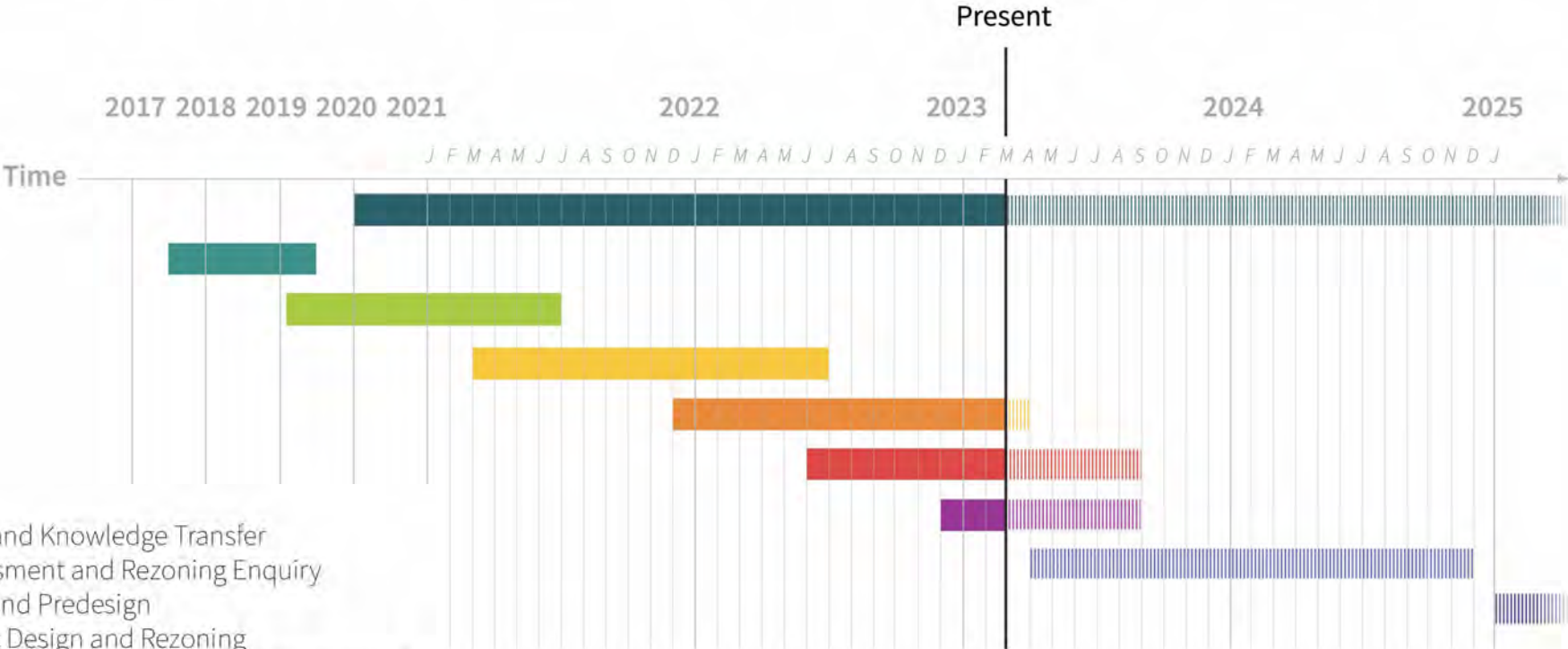
Objectives:

1. Near Zero Emission Building
2. Climate Resilient Design
3. Off-site Pre-fabrication
4. Knowledge Transfer
5. Improve affordable housing supply and availability
6. Maximized capital investment
7. Use of renewable construction materials
8. Use of Vancouver's SHORT program



Project Timeline Overview

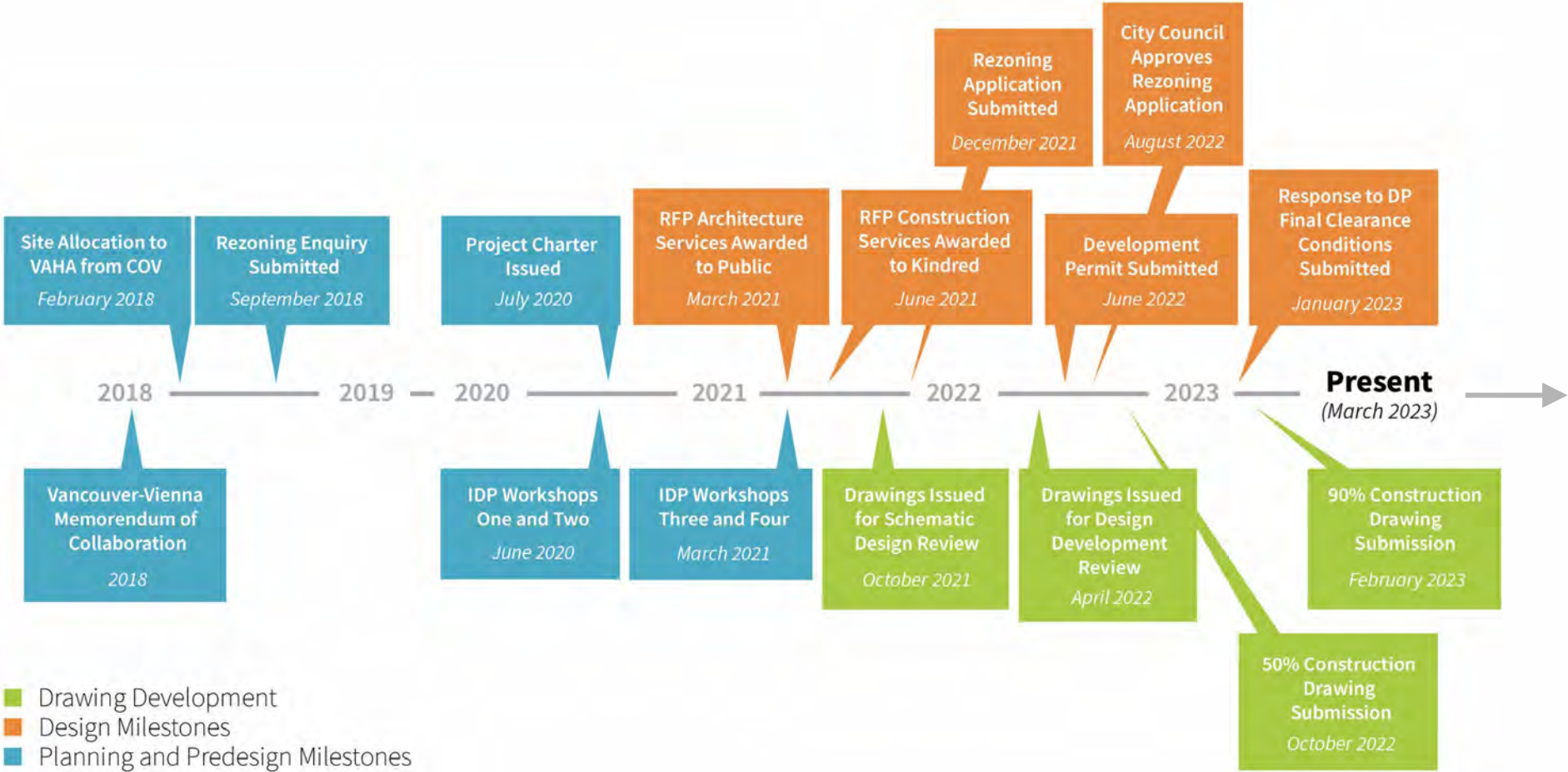
Project Timeline



- Research and Knowledge Transfer
- Site Assessment and Rezoning Enquiry
- Planning and Predesign
- Schematic Design and Rezoning
- Design Development and Development Permit
- Construction Documents and Building Permit
- Construction Procurement
- Construction
- Occupation



Project Milestones



Site Assembly and Rezoning Enquiry

The City of Vancouver in 2018 designated 5 lots in East Vancouver for development of a multi-unit affordable housing project.

Rezoning Enquiry in 2019 included:

- Preliminary building design
- Integrated stormwater management plan
- Passive House plan



Render of early Vienna House design (Source: Yamamoto Architecture)



Zoning District Schedule (Source: Public Architecture + Communication)



Consultant Request for Proposals (RFP)

- Issued by the City of Vancouver Supply Chain Management department to engage the design team and construction manager for Vienna House
- Both RFPs included some unique requirements:
 - Experience with Passive House certification
 - Engagement in knowledge transfer activities
 - Proficiency with BIM Preferred

Architectural Services RFP | Issued: November 2020

Awarded to:

public

Construction Management RFP | Issued: April 2021

Awarded to:

**KINDRED
CONSTRUCTION**



Schematic Design

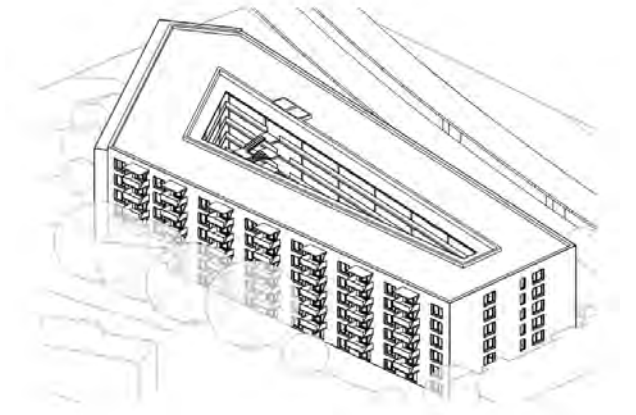
Building massing and form decisions:

‘J’ Option – double loaded corridor, common in Vancouver

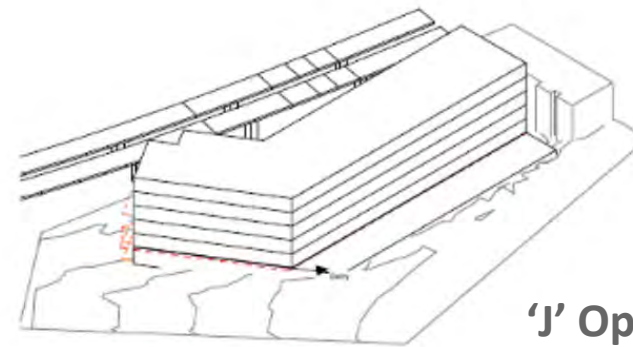
‘O’ Option – central courtyard and open walkways, common in Vienna

Influencing Factors

- Livability
- Cost and value to owner and residents
- Energy and GHG efficiency
- Climate resiliency and lifecycle considerations
- Acoustics
- Construction complexity



‘O’ Option



‘J’ Option

(Source: Public Architecture + Communication)

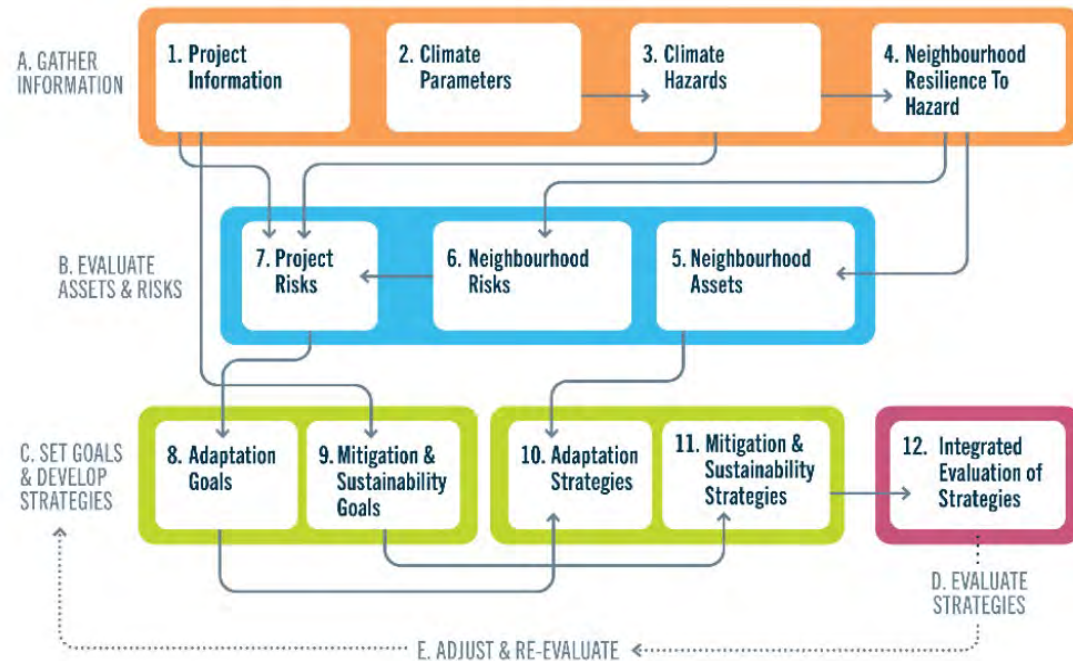


Schematic Design

Explorations of innovations during schematic design:

- Mobilizing Building Adaptation and Resilience (MBAR) workshops, using the IBAMA framework for climate resiliency
- Social interactions and connections, using the FLUID sociability study
- Exterior solar shading study
- CO2 heat pump for domestic hot water

THE INTEGRATED BUILDING ADAPTATION AND MITIGATION ASSESSMENT (IBAMA) FRAMEWORK

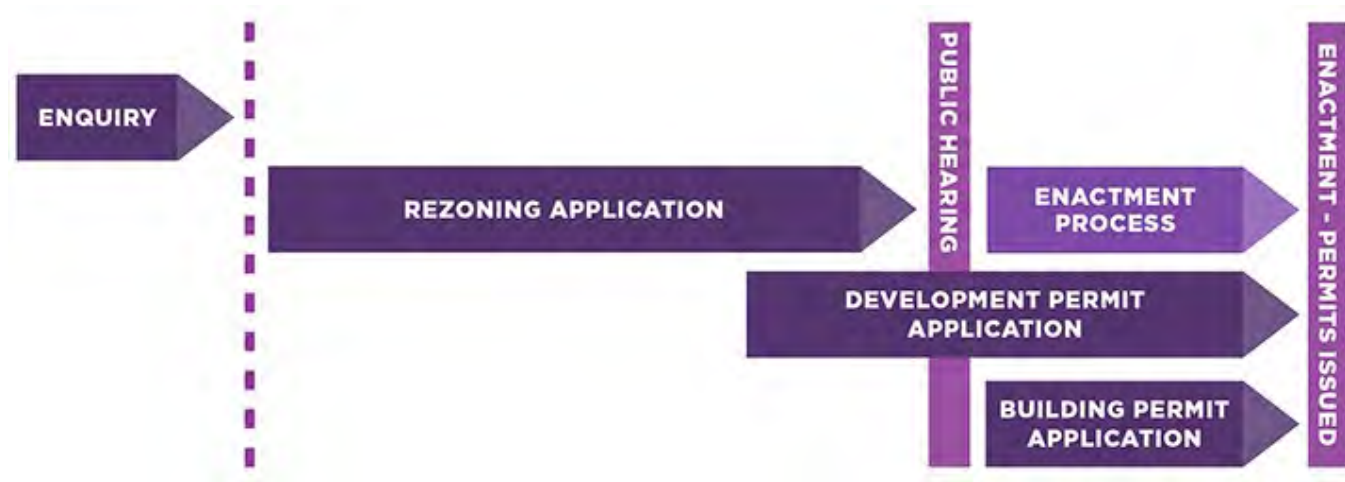


IBAMA framework (Source: Ilana Judah, University of British Columbia)



Rezoning Application

- **Summer 2021** – Architect met with city planners to get feedback on building design
- **December 2021** – Rezoning Application submitted through SHORT program
- **January and February 2022** – Public hearing and feedback
- **June 2022** – Architect submits rezoning conditions response to city
- **July 2022** – Rezoning application approved



SHORT Program (Source: City of Vancouver)



Design Development Phase

Key design decisions made during design development:

- Use of prefabricated panel systems for CLT floors and exterior walls
- Alignment of load-bearing walls and services paths through stacked units to simplify design
- Integrated approach to ventilation and cooling using passive strategies and active mechanical systems
- Designing to future 2050 climate conditions to improve resiliency and residents' comfort
- Integration rainwater management in building and landscape design; landscape design to support biodiversity and social interaction



Building section (Source: Public Architecture + Communication)



Development Permit Application

Development Permit Submittal

- **May 2022** – Architect met with City of Vancouver staff pre-application
- **June 2022** – Architect submits Development Permit Application
- **April & August 2022** – Review by the City’s Urban Design Panel (UDP)
- **September 2022** – Development Permit application approved with conditions, and design team responded
- **December 2022** – City issued Final Clearance Conditions, and design team responded
- **April 2023** – Expected Development Permit approval



Construction Documents

Summer 2022 – Work begins on construction documents (2D drawings and specs)

- Details developed for prefabricated CL floors and exterior wall panels
- BIM used to support design coordination and clash detection, development of model for facility management
- Passive House performance verified @ 50% CDs
- Continued discussion around broader accessibility and livability considerations

Phased Building Permit Submittal (anticipated):

- Phased Building Permit application divided into excavation, foundation and structure
- Winter/Spring 2023 – Development of BP package
- April 2023 – Anticipated submittal of first BP package



Anticipated Construction Timeline

Phased construction approach:

- **Spring 2023** – Excavation
- **Summer 2023** – Foundation
- **Spring/Summer 2023** – Off-site prefab
- **Summer 2023-24** – On-site construction
- **Fall 2024** – Substantial completion, PH testing, inspection and handover
- **2025** – Occupancy



Future Construction Site (Source: Public Architecture + Communication)



Design Overview

Vienna House



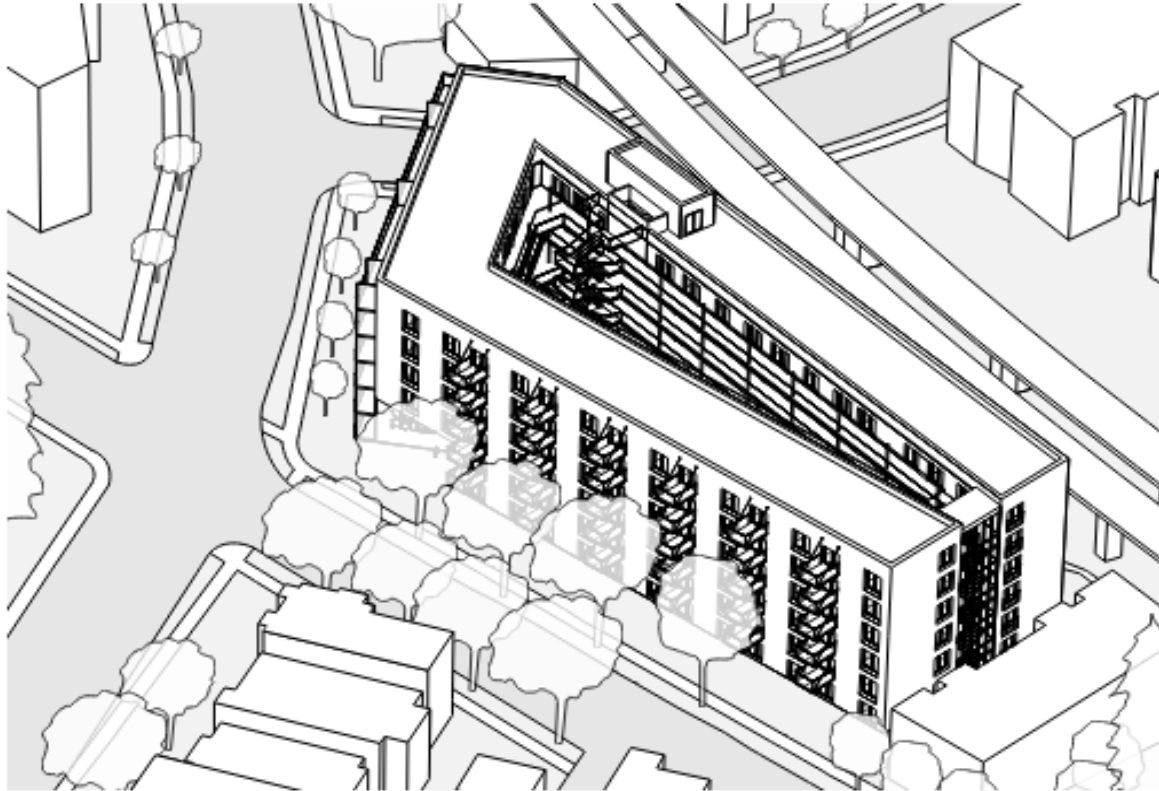


Site Context (Source: Public Architecture + Communication)

Site

- 2,967 m² trapezoid- shaped site
- Bounded by major roads and Skytrain line
- Multi-family, mixed-use neighbourhood
- Amenities and transit within walking distance



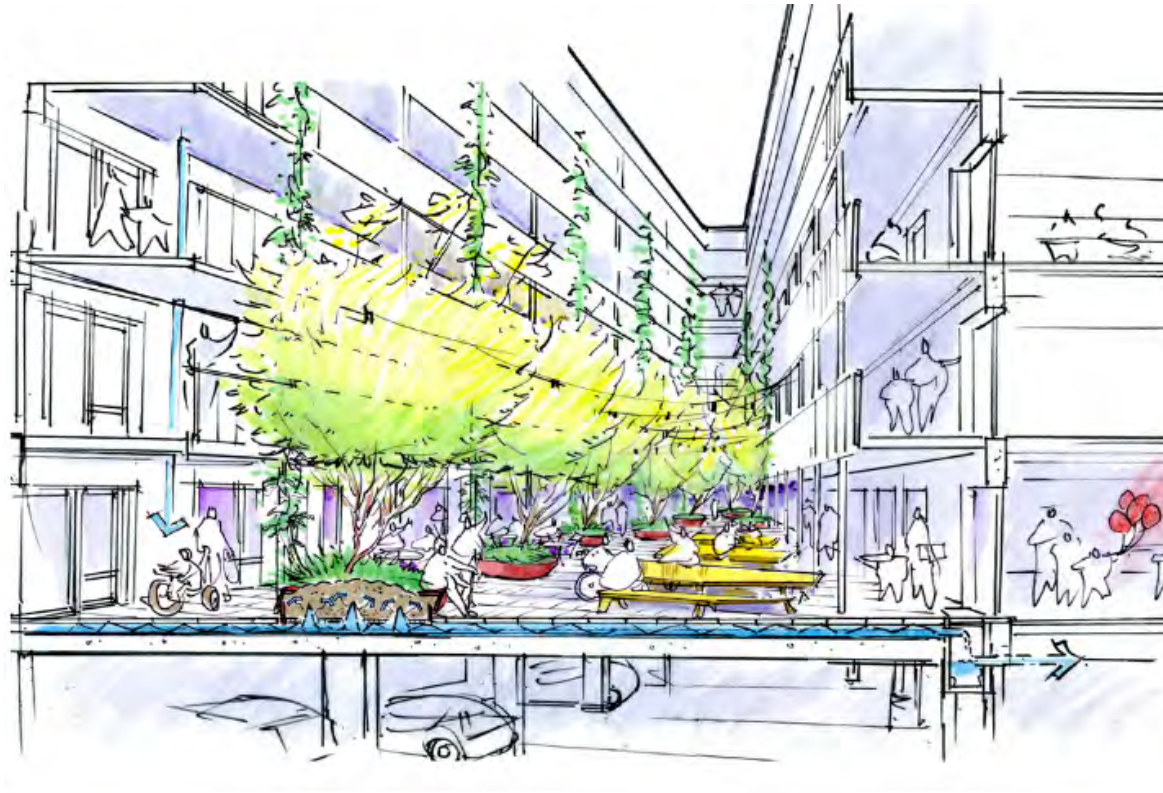


Simple Massing (Source: Public Architecture + Communication)

Massing

- 7-Storey multi-unit residential
- Central courtyard
- Below grade parking and bicycle storage
- 13,039 sq. m² gross floor area
- Designed to maximize site space





(Source: Public Architecture + Communication)

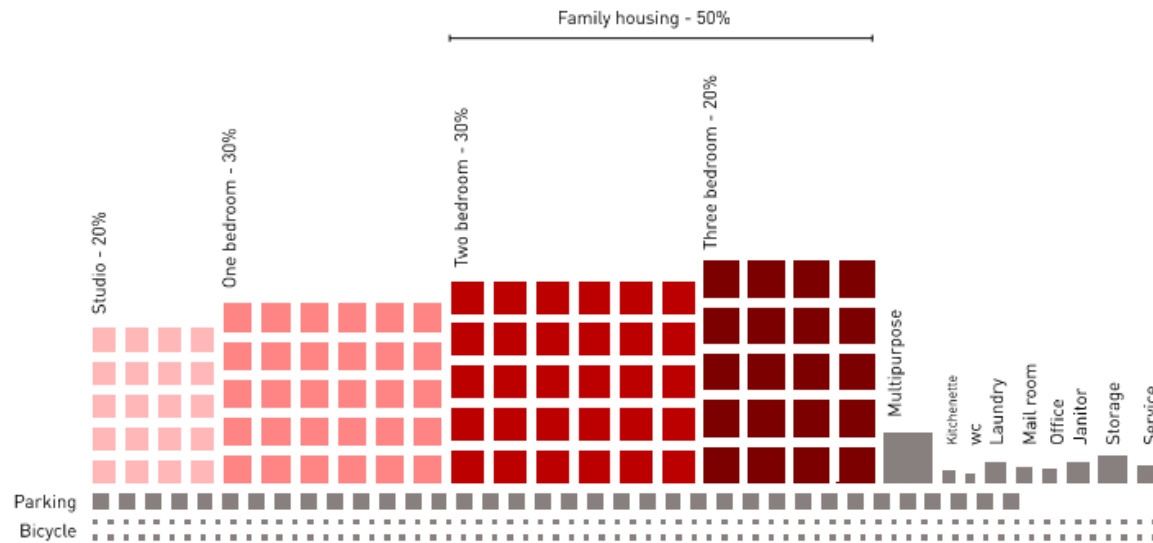
Courtyard

Central courtyard model supports

Vienna House goals:

- Social interaction
- Climate resiliency
- Resident comfort
- Noise mitigation
- Open circulation





VIENNA HOUSE PROGRAM

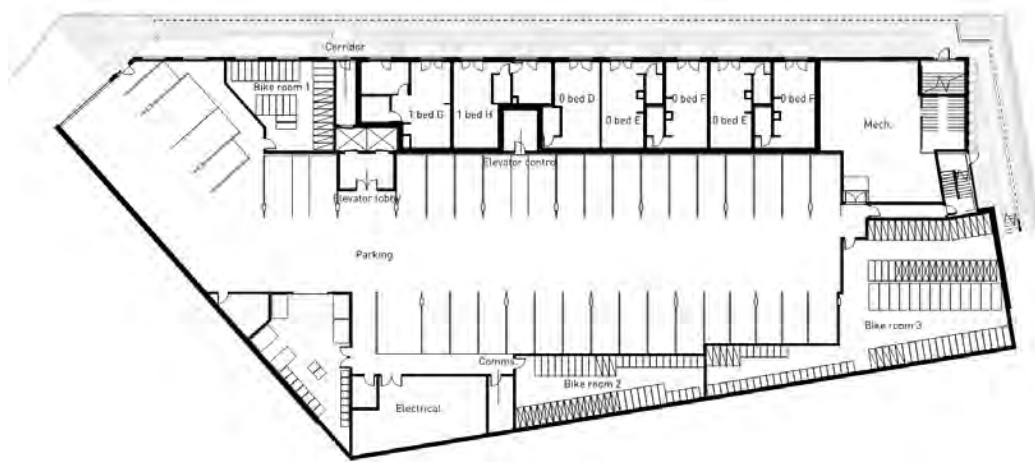
(Source: Public Architecture + Communication)

Program

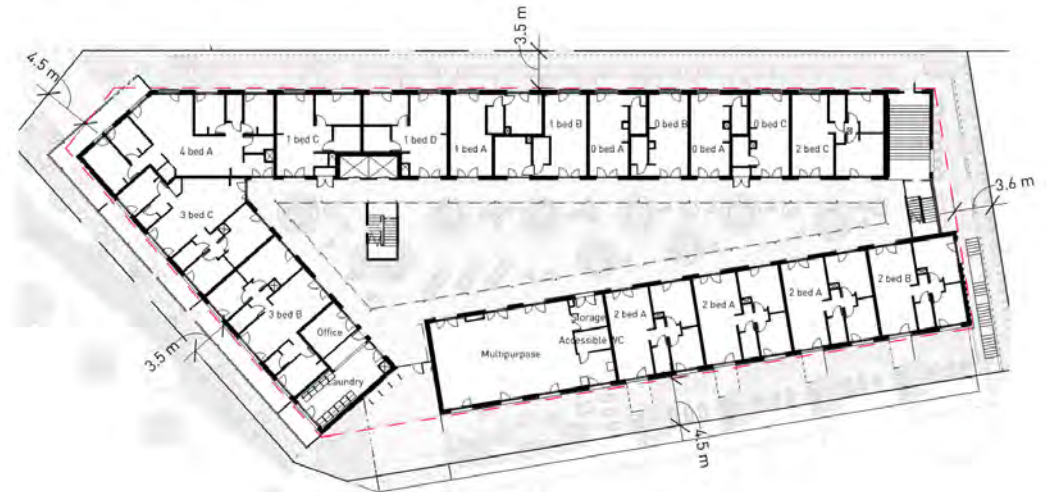
- 123 social housing units
- Mix of studio, 1,2 ,3 and 4-bedroom residences
- 46% are family units (2+ bedrooms)
- Amenities and services spaces on ground floor
- Parking, bicycle and bulk storage



Parkade and Ground Floor Layouts



L0 Parkade Plan

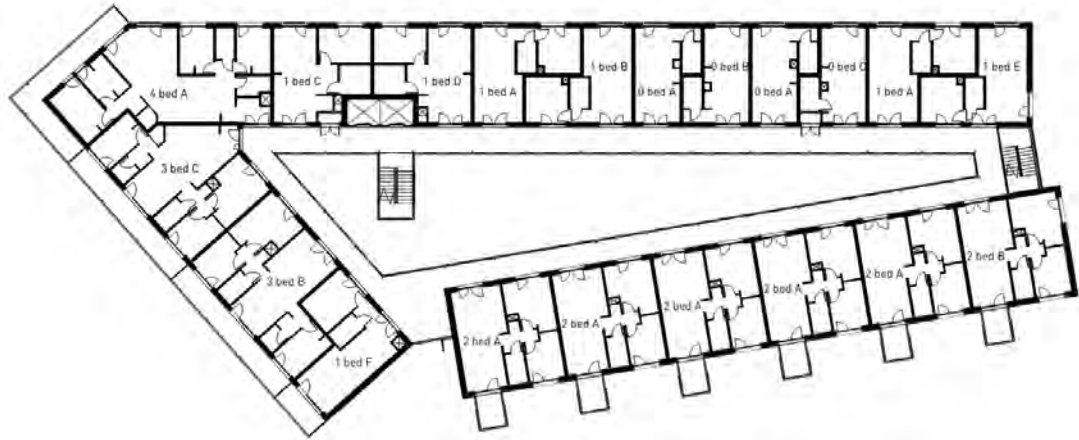


L1 Ground Floor Plan

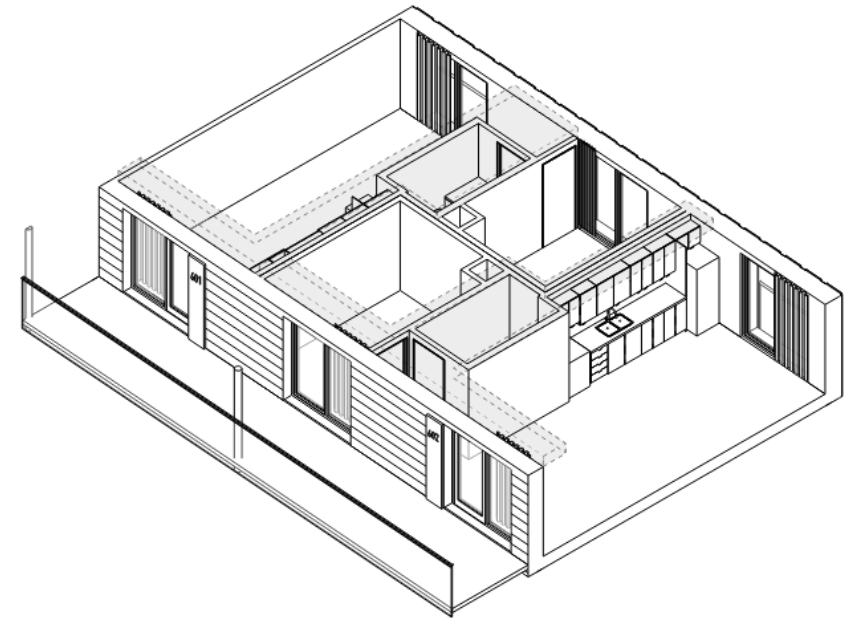
(Source: Public Architecture + Communication)



Upper Floor and Unit Layouts



Typical Upper Floor Plan



Typical One Bedroom Unit Plan

(Source: Public Architecture + Communication)

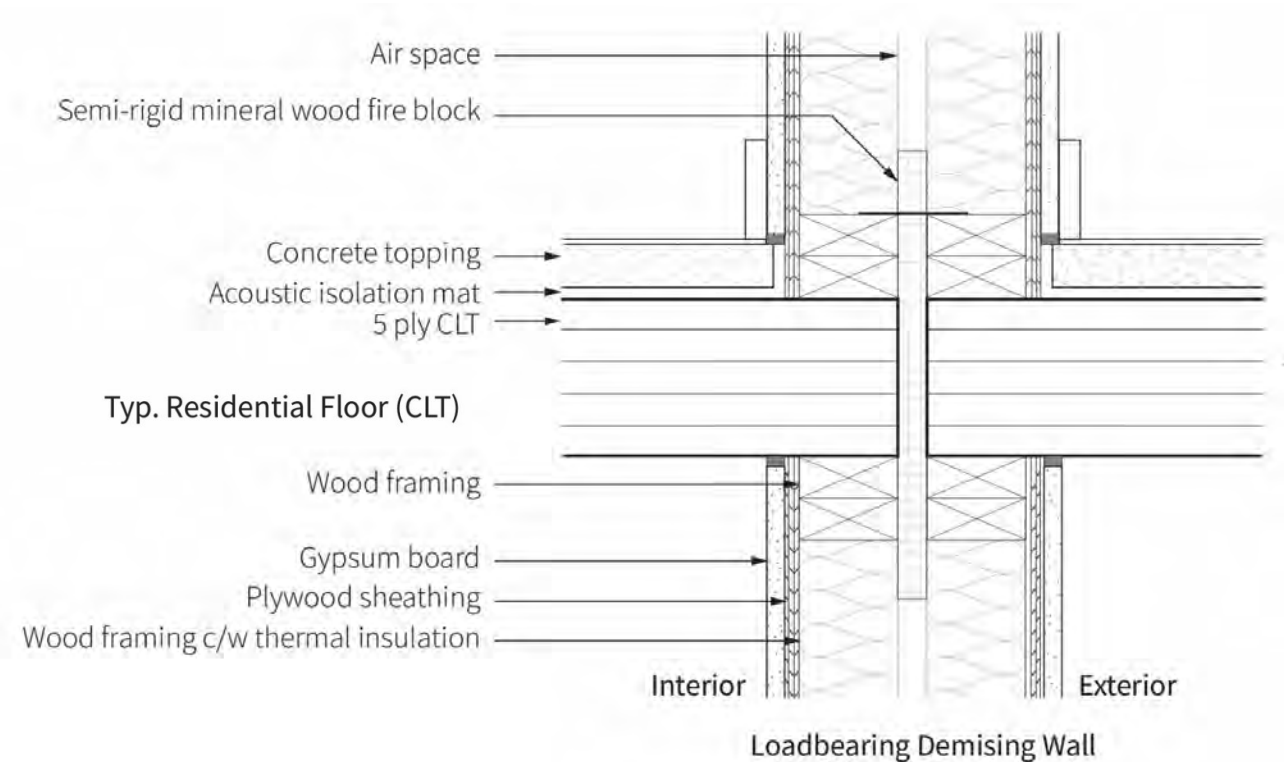


Structure

Hybrid structure:

- Foundation & parkade: cast-in-place concrete structure
- Ground floor: suspended cast-in-place concrete slab
- Floors: prefabricated 5-ply CLT panels with acoustic and concrete topping
- Interior walls: load-bearing light wood-framed
- Exterior walls: mostly non load-bearing prefabricated panel system

CLT floor and interior light wood-frame wall



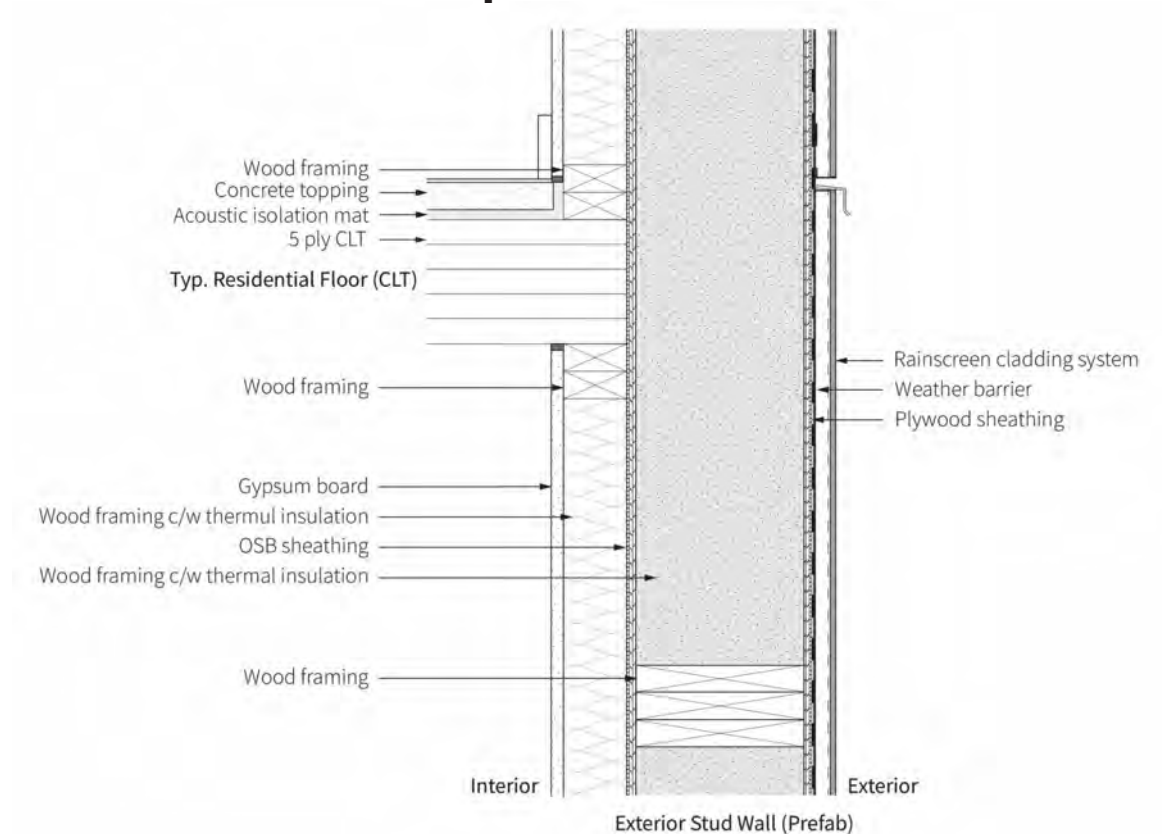
(Source: Public Architecture + Communication, redrawn by UBC for clarity)



Envelope

- Envelope designed to achieve Passive House requirements on:
 - Thermal insulation
 - Airtightness
 - No thermal bridges
- Wall R-value: 43
- Roof R-value: 72
- Window U-value: $<0.8 \text{ W/m}^2\text{K}$
- PH certified triple glazed coated windows, PH certified doors

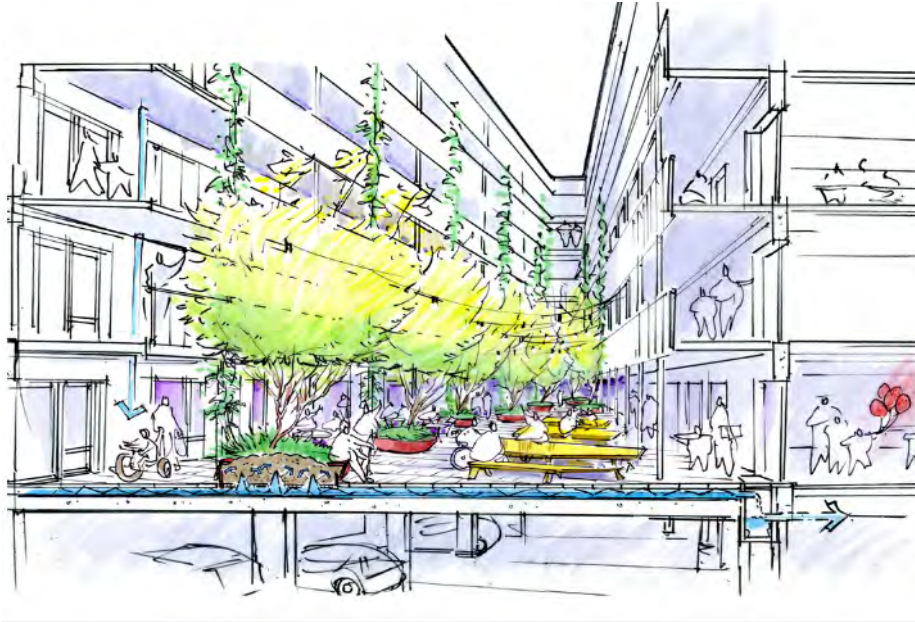
Exterior prefabricated wall



(Source: Public Architecture + Communication, redrawn by UBC for clarity)



Landscape



Courtyard Section



North Side of Site Adjacent to Skytrain

Landscape used native and adaptive species and designs to support:

- Climate resilience
- Social gathering and interactions
- Local ecology and biodiversity

(Source: Matthew Thomson Design)



Rainwater Management

Integrated rainwater management systems includes courtyard and landscaping:

- Permeable pavers and Permavoid layer in courtyard detains and stores rainwater
- Used for passive irrigation of planters
- Landscape contours to slow infiltration and minimize risk of flooding



Permavoid System (Source: Public Architecture + Communication)





Innovations Overview

Passive House Certification



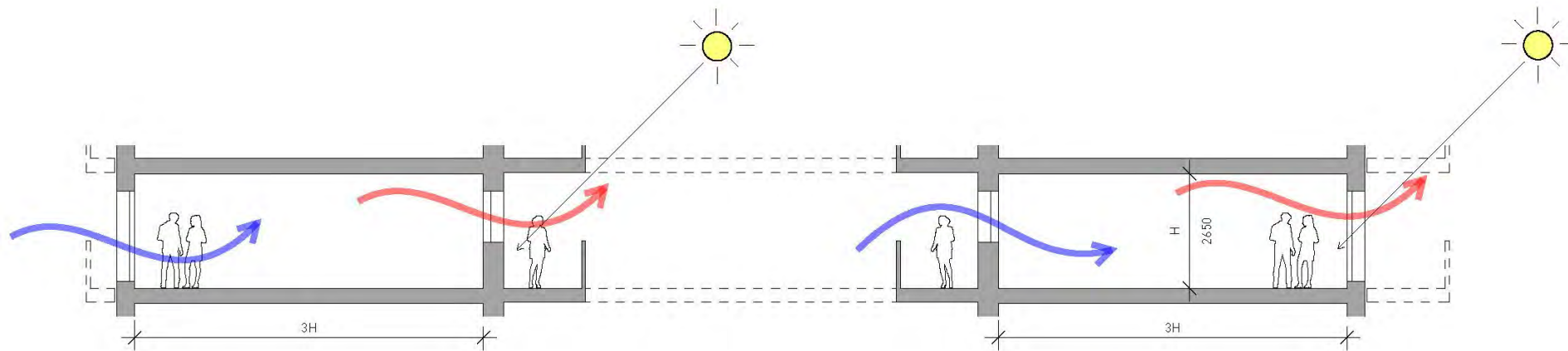
Passive House Certification
(Source: PassiveHouse Canada)

- Vienna House demonstration of affordable high-performance building with Passive House certification.
- Motivations for pursuing certification:
 - Understand cost implications of design choices and certification process
 - Ensure high-quality design and construction practices in a cost-effective manner
 - Reduced energy costs; improved climate resiliency and resident comfort



Passive House Design

- **Building form:** courtyard design, all units have dual exposure and natural cross-ventilation
- **Envelope:** prefabricated panelized system with double insulation.
- **Windows:** triple-glazed with vinyl frames and low-emissivity coatings.
- **Mechanical Systems:** mixed-mode ventilation system
 - **Mechanical ventilation system:** two energy recovery ventilators and one air source heat pump
 - **Domestic hot water heating system:** one heat pump with CO2 refrigerant



Passive cooling strategies through cross-ventilation and shading. (Source: Public Architecture + Communication.)



Prefabrication Exploration

Motivations for exploring prefabrication:

- Increase regional industry capacity for prefabrication in affordable low-carbon construction
- Increase building quality and precision
- Reduce on-site construction time, cost, waste
- Address onsite space limitations e.g. access, storage.
- Achieve performance required for Passive House certification
- Integrate mass timber structural components



Prefabrication facility (Source: BC Housing)



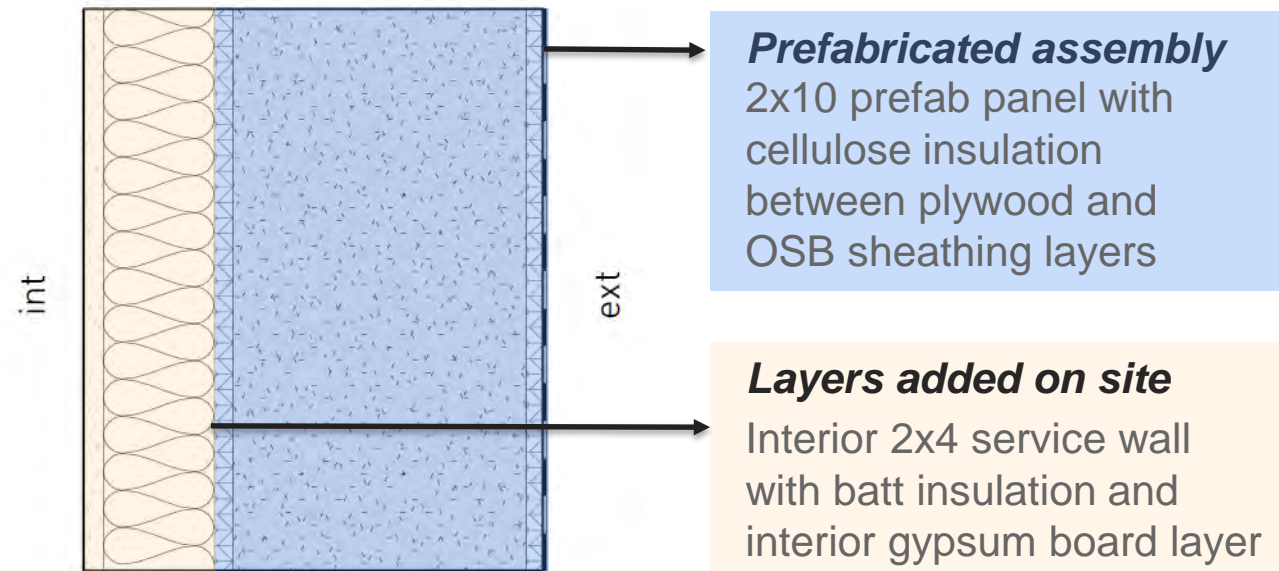
Prefabrication Design – Exterior Wall Panel

**Design at 90% Construction Drawings*

Prefabricated exterior wall panel:

- Passive House requirements for thermal insulation (R-value 43), minimal thermal bridging
- PH certified windows and doors installed as part of the prefabrication process

Partially prefabricated typical exterior stud wall



Source: Public Architecture + Communication; University of British Columbia



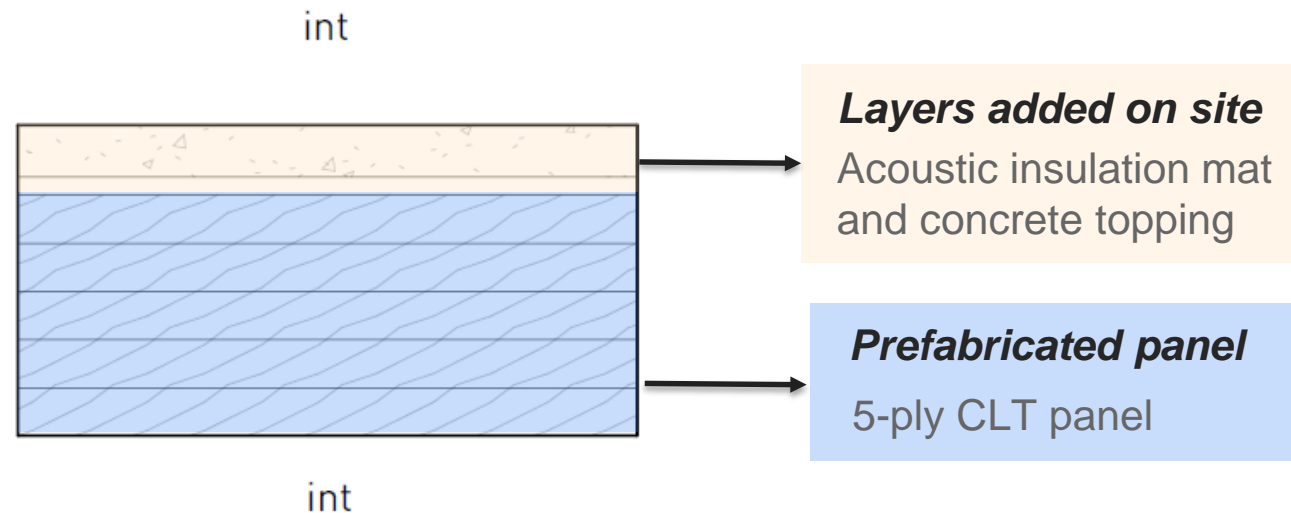
Prefabrication Design – Typical Residential Floor

**Design at 90% Construction Drawings*

Typical residential floor

Prefabricated CLT floor panel:

- 5-ply cross-laminated timber (CLT) panel
- Cut-outs and penetrations at factory
- Optional ceiling (installed on site)



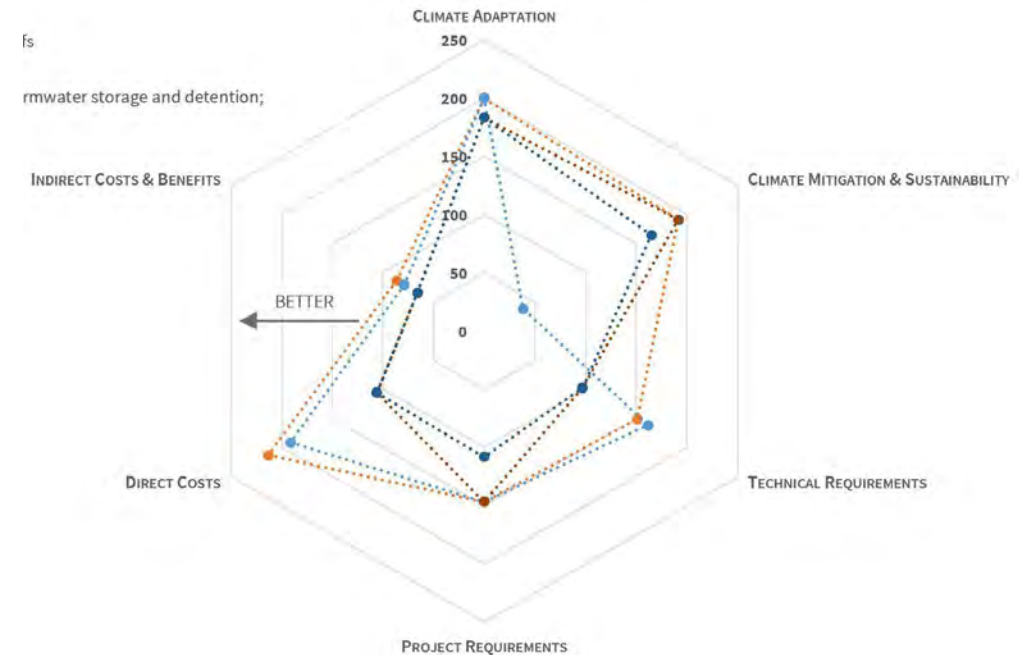
Source: Public Architecture + Communication; University of British Columbia



Climate Resiliency

Climate resilient design: core approach to affordable, low-carbon housing.

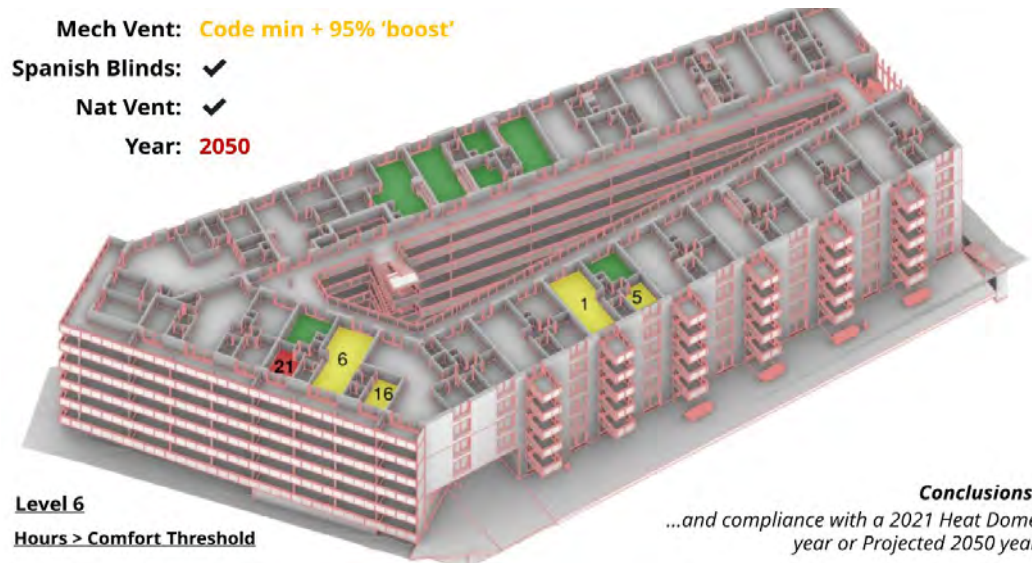
- Exploration of adaptive building design strategies through design phase:
 - Mobilizing Building Adaptation and Resilience (MBAR) pilot program
 - Integrated Building Adaptation and Mitigation Assessment (IBAMA) framework
- Designed for future climate:
 - Used predictive climate data for 2050 to design the building's system.
 - Maintain thermal comfort under more severe future climate conditions.



IBAMA climate hazard results (Source: Ilana Judah)



Climate Resilient Design



Natural Ventilation Modeling (Source: Integral Group)

- **Passive House standard:** warmer in winter and cooler in summer
- **Summer cooling:** passive cooling strategies + tempered ventilated air
- **Winter Heating:** electric baseboards for heating individual spaces
- **Storm water:** integrated rainwater management philosophy
- **Microclimate:** landscaping strategies
- **Solar Photovoltaic:** lightweight PV arrays in roof (TBC)



Social Performance – Livability



Design characteristics:

- Residential units are accessibility or adaptable to accommodate future accessibility features
- 46% of units are 2+ bedrooms and studios are 10% larger than BC Housing standard
- Improved natural light, ventilation, acoustics and thermal comfort
Indoor environment



Interior unit renders (Source: Public Architecture + Communication)

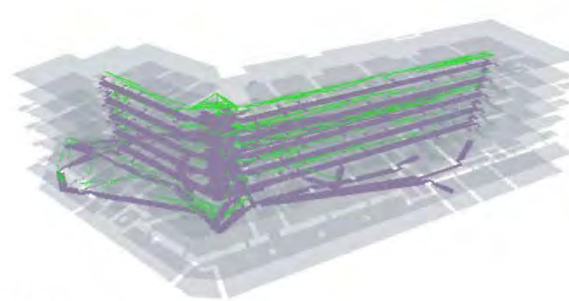


Social Performance – Sociability

- Courtyard used for formal and casual gatherings (capacity: 250)
- Courtyard and open walkway facilitate interactions
- FLUID sociability study: model number and frequency of personal interactions between residents
- Compared J vs O layout in schematic design

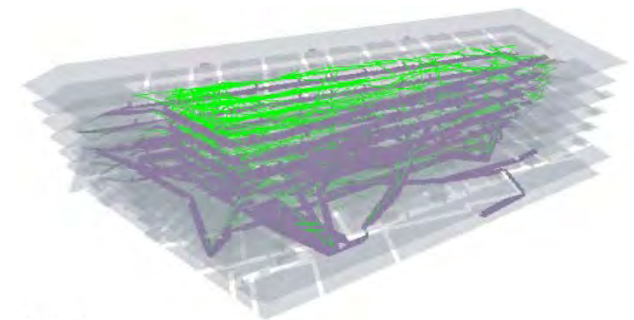


Courtyard as a gathering space (Source: Public Architecture + Communication)



Option J	
Encounters	16,656
Encounters / person / day	2.51
Greetings	1,773
Greetings / person / day	0.27

FLUID sociability model - 30 day period
Human Studio



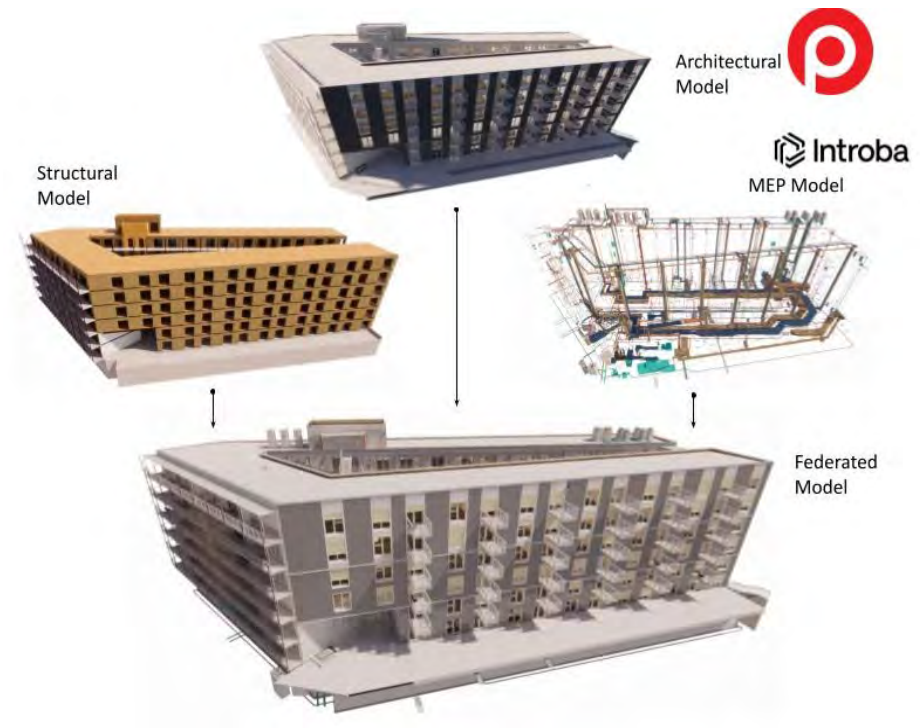
Option O	
Encounters	26,192
Encounters / person / day	3.88
Greetings	2,398
Greetings / person / day	0.36

FLUID Sociability Model (Source: Human Studio)



Building Information Modelling (BIM)

- BC Housing used Vienna House as a Pilot project to explore BIM for new construction and facilities management.
- BIM consultants engaged by BC Housing:
 - Developed BIM Requirements
 - Assisted project team in model set up and early development
- Project design team:
 - Created Project Execution Plan
 - Used BIM for virtual coordination, clash detection, communication and visualization

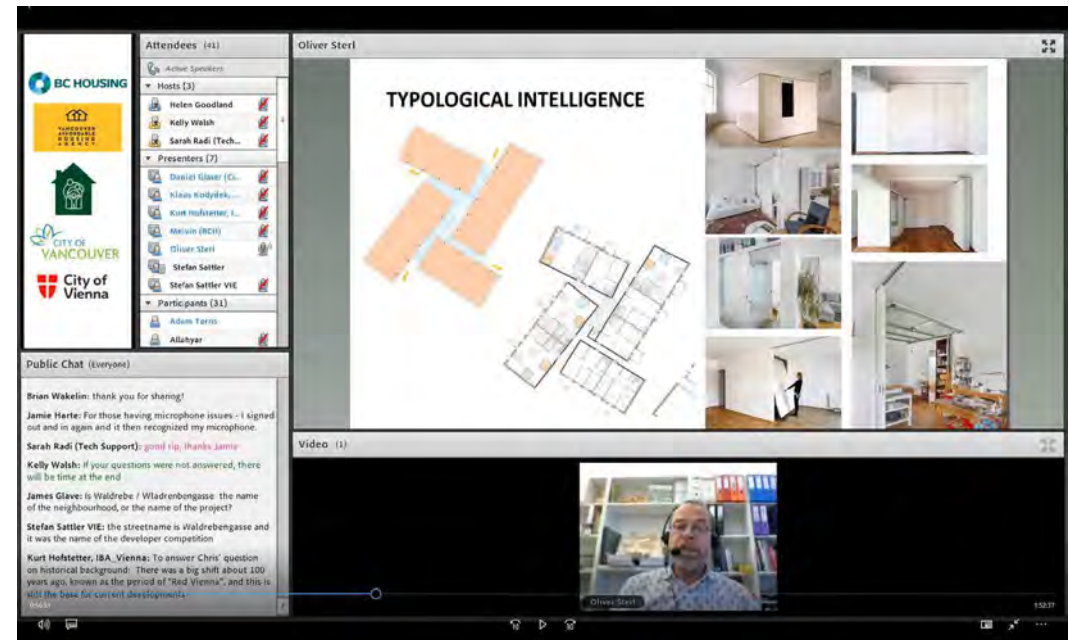


Integrated model from different disciplines (architectural, structural and MEP) (Source: Introba and Public Architecture + Communication)



Vienna-Vancouver Knowledge Exchange

- Vienna-Vancouver Memorandum of Cooperation
 - Advance building decarbonization
 - Share knowledge on respective projects and best practices
- Workshops throughout design phase
- Notable design influence:
 - Courtyard-style building in Vancouver (popular in Vienna)



IDP Workshop Screenshot (Source: BC Housing)



Knowledge Transfer Strategy

- Study the design and construction of Vienna House
- Create opportunities for learning on innovation related to affordable, social, low carbon housing
- Activities include:
 - Communications and outreach
 - Technical research
 - Case study

Vienna House Knowledge Transfer Team

BC Housing Research Centre

Scius Advisory

UBC Sustainability Hub + BIM Topics

Bright Future Studio

FP Innovations

LightHouse Sustainable Building Centre



Future Outlook

The planning and design phase for the project is completing in spring 2023. The information provided in this presentation is only representative of the design phase.

The full experience of the performance and project delivery innovations can not be understood until the construction is completed, or the building is in operation. These slides should be considered part of the story of Vienna House, waiting for the second chapter.



(Source: Public Architecture + Communication)





For additional information and updates on the project please visit:

ViennaHouse.ca