BUILDER INSIGHT

BC HOUSING
RESEARCH CENTRE

Bulletin No 1 | Vienna House

Overview of Innovation

Vienna House is a National Housing Strategy project that demonstrates sustainability and innovation in construction. The project will be Passive House certified. It is the first non-market multi-family housing project in B.C. to use Building Information Management (BIM). BIM was used throughout concept design, project delivery and facility management.

The seven-storey mass timber and lightwood frame hybrid building will provide 123 units ranging from studio to four bedrooms. It is an efficient mid-rise building type, with the potential for it to be recreated in B.C. and across Canada. The project has a counterpart housing project in the City of Vienna, Austria. This provides a unique opportunity to share knowledge and best practices in housing design. It will be subjected to acoustical and vibration testing prior to occupancy and will be monitored for ongoing environmental and structural performance.

FACTS AND FIGURES

Construction timeline: November 2023 – late 2025
Construction budget: $54.9 M
Residential Units: 123
Site Area: 2,968 m^2, 31,945 ft^2
Total Gross Floor Area: 13,039 m^2, 140,334 ft^2
Net Floor Area: 10,446 m^2, 112,433 ft^2
Building Height: 22.64 m, 74.29 ft
Volume of Mass Timber: 1,194.67 m^3 of CLT
Annualized Whole Life Carbon Emissions: 7.8 $kgCO_2e/m^2$/year
Total Energy Use Intensity: 49 kWh/ m^2/year

PROJECT TEAM

Owner: More Than A Roof Housing Society
Land: Non-Market Housing Development & Operations
Architect: PUBLIC Architecture
General Contractor: Kindred Construction Ltd.
Owners BIM Consultant: Summit BIM
Design BIM Consultant: BIMOne
Construction BIM Consultant: Modelo Tech Studio
Structural Engineering: Wicke Herfst Maver Consulting Inc.
Mechanical and Electrical: Introba
Fire Suppression: Introba
Energy Modeling: Introba
Passive House Consultant: Introba
Embodied Carbon Modeling: Introba
Civil: Core Group Civil Consultants Ltd.
Landscape: Matthew Thomson Design Ltd.
Building Code: GHL Consultants Ltd.
Building Envelope: Morrison Hershfield
Acoustical: BKL Consultants Ltd.
Passive House Certification: Steven Winter Associates, Inc.
Elevator: GUNN Consultants
Project Management: CPA Development
Research Management: Scius Advisory

KEY STAKEHOLDERS

City of Vancouver
BC Housing
City of Vienna
Rüdiger Lainer + Partner

Figure 1. Rendering of Vienna House from Stainsbury Ave. (source: PUBLIC Architecture).

This bulletin series describes innovative technologies and processes of the Vienna House project. Find them all in the BC Housing Research Centre Library.

These bulletins discuss the Vienna House project as construction is getting underway. Completion is expected in November 2025.

Innovations on Vienna House

As a National Housing Demonstration project, Vienna House is a platform to showcase innovations in construction. It highlights successful construction methods used internationally, as well as techniques to improve quality and affordability of sustainable and resilient housing across Canada.

This series of Builder Insight bulletins provides information about several of these innovations, including:

- Processes
- Use of Wood, Prefabrication and Mass Timber
- Digital Project Delivery
- Testing of Envelope Details
- Landscaping and Public Realm
- Sustainability and Resilience.

Those topics are discussed in detail in other bulletins in the series. This bulletin provides an overview of these and other topics.

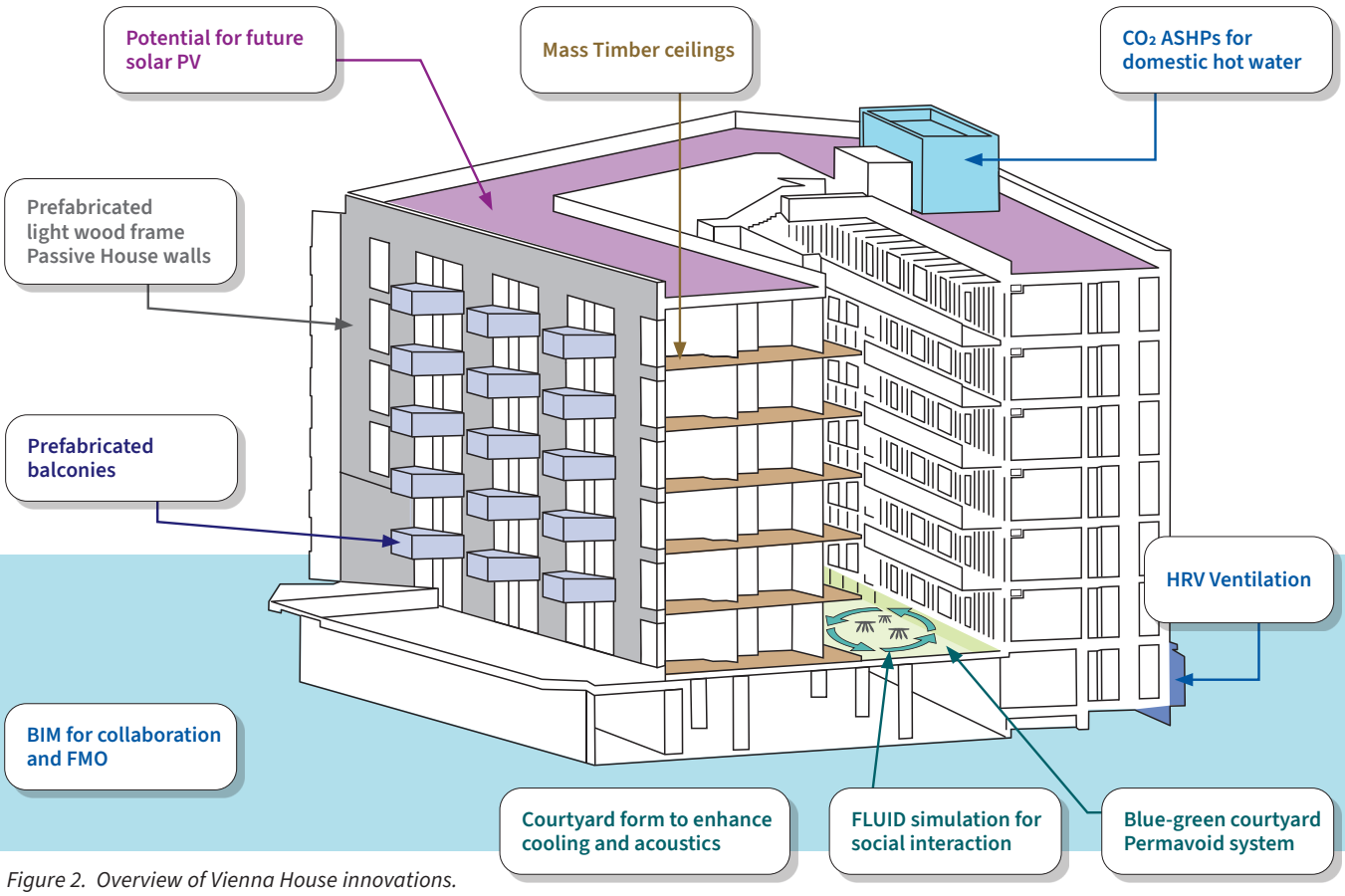

Figure 2. Overview of Vienna House innovations.

Working with Vienna

In 2018, the Cities of Vancouver and Vienna, Austria signed a Memorandum of Understanding to share best practices in innovative low-carbon affordable housing. Two building projects represent the commitment of each city to demonstrate leadership in pressing global issues. Vienna House in Vancouver and a sister project called Vancouver House in Vienna aim to showcase world-leading standards of living for residents while addressing challenges of climate change and creating economic opportunities.

Project Charter

A project steering committee (comprised of members of the City of Vancouver, Vancouver Affordable Housing Agency [VAHA], BC Housing, and More Than a Roof Housing Society) was formed during Vienna House's initial stages. The project charter set out how Vienna House would provide social housing that contributes to market transformation. Transformation that could be achieved through improving availability, acceptability, and affordability of energy efficient and low-carbon building solutions in British Columbia. Vienna House was developed with a climate resilient, Near Zero Emission Building design that takes advantage of offsite prefabrication and renewable construction materials. Further information is available in the Process Innovation insight report.

Knowledge Transfer

Sharing the research conducted and lessons learned was also a priority for Vienna House. With the support of Forestry Innovation Investment (FII), Canada Mortgage and Housing Corporation (CMHC) and Natural Resources Canada (NRCan), the BC Housing Research Centre put together a research program. The program gathered the latest in construction technology innovations, aiding in incorporating them into Vienna House, and sharing lessons learned with the construction community.

BC Housing arranged multiple workshops that followed an Integrated Design Process to identify opportunities for resilience through MBAR workshops, and prioritize resources through Value Toolkit workshops. They convened monthly technical research meetings that brought together local expertise and the Vienna House project team on topics such as prefabrication, acoustics, thermal bridging, stormwater management, air quality, and how buildings can contribute to health, sociability, and livability for those of all abilities.

Reports from these workshops, research on innovations relevant to Vienna House and other topics, and blogs about technical research meetings and other events have been posted on the Vienna House website. Social media posts, a newsletter, and engagement with media sources have helped to share knowledge to date. Additional information will be posted to these platforms as the construction phase progresses.

Design for Health and Sociability

The focus on housing that is comfortable and livable for all residents has been an underlying component of many aspects of design for Vienna House. As detailed in the Sustainability and Resilience insight, the courtyard design, use of wood and prefabrication, combined with mechanical ventilation will help to maintain comfortable temperatures and good air quality through heatwaves and smoke from forest fires.

Use of wood, access to fresh air and vegetation all contribute to biophilic health benefits that include stress reduction, improved cognitive performance, and enhanced moods.

Technical research meetings for Vienna House included a session focused on accessible design and another on health, design for inclusivity, and a unique software project called FLUID that predicts interactions between residents based on building layout. The following considerations and parameters were considered important for the Vienna House project:

- **Accessible design** includes a great deal more than wheelchair ramps and restrooms. It requires consideration of others to provide spaces where people feel intended and recognizing where physical limitations, cultural differences, certain textures, sounds or light levels can make people feel unwelcome, unsafe, or anxious.

- **Requirements for residents with cognitive or mental health issues** are also an important design consideration, as a person's home can either encourage community participation or act as a barrier resulting in social isolation. Adaptive features need to be customized to the needs of the resident. When vulnerable residents are identified, supportive relationships can be developed to help evaluate what adaptive features work best. This may be an iterative process but will promote inclusion. Best practices should be shared with other communities.
- **Healthy indoor and outdoor environments** can play a significant role in population wellbeing and have a major impact on chronic and preventable diseases. Factors include air and water quality, access to parks and green spaces, quality affordable housing and access to active transportation. The design of communities and buildings, including transportation infrastructure, land use, access to green space, pedestrian environments, and the degree to which they foster social interaction and physical activity can affect human behaviour. Exposure to harmful environmental impacts (pollution, unsafe spaces) can also trigger biological responses, such as obesity, systemic inflammation, and anxiety, which can ultimately lead to chronic disease. Reducing exposure to all of these stressors can be addressed through building design.

Early in the design development phase, the Vienna House team had the opportunity to test two different building form options through a web-based software simulation tool that compares sociability likelihoods quantitatively. One option, 'J', represented a typical double loaded corridor-type building which is commonly found in Vancouver (Figure 3). The other option, 'O', was an early design option for Vienna House in its current form (Figure 4).

The FLUID Sociability platform attempts to address the detrimental health effects of social isolation using digital agents to simulate activity inside a 3D digital model of a

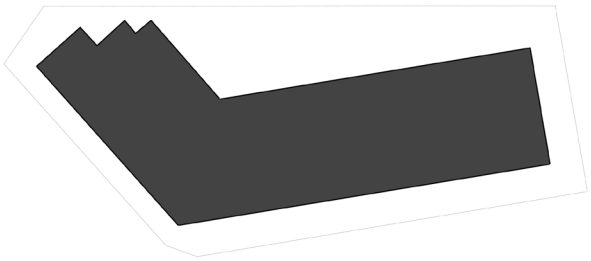

Figure 3. Approximate footprint of 'J' option.

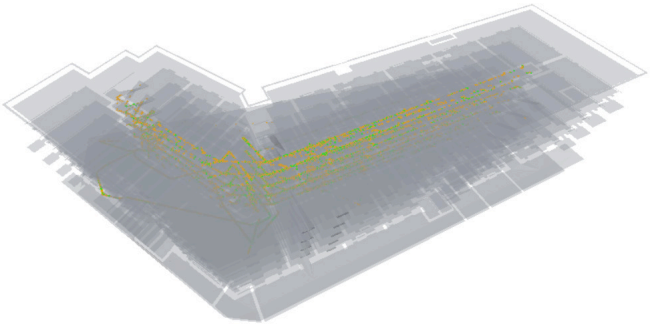

Figure 5. FLUID Sociability encounters and greetings simulation for the 'J' option (source: Human Studio).

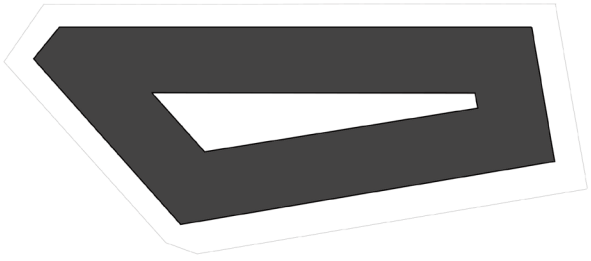

Figure 4. Approximate footprint of 'O' option.

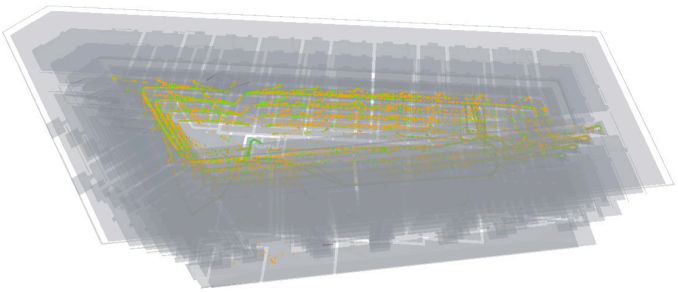

Figure 6. FLUID Sociability encounters and greetings simulation for the 'O' option (source: Human Studio).

building or neighborhood, guided by artificial intelligence. Figures 5 and 6 visualize the occurrences of encounters (orange) and greetings (green) for the 'J' and 'O' options, respectively, based on a 30-day simulation.

Using a combination of video game technology and building information modelling (BIM) software, FLUID simulates predicted frequencies of interactions, (i.e. social encounters and greetings). Encounters occur when a person sees another and there is an opportunity for voice and eye contact. Greetings are interactions between people and can include a short "hi", a wave, or eye contact.

The courtyard form of the 'O' option greatly increased the likelihood of encounters (57%) and greetings (35%) between residents (Table 1). While there are many social dynamics that will come into play between neighbours who build relationships, this simulation demonstrates that the building form will contribute to fostering community interactions. It supports the experience of More Than a Roof Housing Society, which operates another courtyard property which is among their most popular and where they have noticed a particularly strong sense of community.

Table 1. Estimated encounters and greetings for each building form (source: Human Studio).

Building Form	Encounters	Greetings
'J'	16656	1773
'O'	26192	2398
% greater likelihood with 'O'	57%	35%

Use of Wood, Prefabrication and Mass Timber

Vienna House is designed with a hybrid mass timber and light wood frame structure. Cross Laminated Timber (CLT) is exposed in the ceilings of living areas (Figure 6) and used for all floors, with a concrete topping for acoustic absorption. CLT is also used in the elevator shaft. Prefabricated light wood frame interior open panels support the structure. Prefabricated light wood frame exterior closed panels provide an airtight enclosure designed to meet Passive House specifications. Lightweight prefabricated aluminum balconies work well with the wood building and install quickly and safely. Further information is available in the Use of Wood, Prefabrication and Mass Timber insight report.

Digital Project Delivery

Digital project delivery using Building Information Modelling (BIM) provides opportunities for collaboration, early identification of construction issues, and facilitation of maintenance and operations activities. BIM allows project team members, including the owner, architect, engineers, operator, and others to share data about how a building is built. It is a process that defines who has responsibilities for different data, data formatting, and how information is communicated.

Digital project delivery provides a coordinated approach that has resulted in faster delivery, higher quality, better transparency, and cost savings, especially during the maintenance and operation phase of a building's lifecycle. For prefabricated components, the upfront planning and clash detection is vital to prevent rework and limit waste. It shifts tasks to earlier phases of the design process, but results in material and labour efficiencies that ultimately save time and reduce cost overruns.

Vienna House is serving as a digital project delivery pilot project for several project team members. Part of the implementation process meant that BC Housing has had to adjust some operational processes. For example, the procurement team had to consider how to best introduce BIM requirements for the project without restricting responses to Requests for Proposals (RFPs) or adding costs to the project. BC Housing hired a BIM consultant, Summit BIM, to prepare a BIM Requirements document that was appended to the RFPs for architectural and construction service. This document was developed in collaboration with BC Housing and used to describe expectations of the project team, how data could be shared and used to benefit the project. This process is ongoing, and the construction phase and operations will demonstrate how the project benefitted, what could be done better, and what specifically can be adjusted for future success. Further information is available in the Digital Project Delivery insight report.

Testing of Envelope Details

The requirement to achieve airtightness of 0.6 ACH at 50Pa as required by the Passive House standard meant that attaching balconies to each unit would require attention to not disrupt the air barrier. The design team worked with scientists at FPInnovations to test the proposed design by simulating the conditions with a mock-up of the assemblies in a laboratory setting. Different configurations were tested for both airtightness and watertightness. Results and further information are available in the Testing of Envelope Details insight report. These results are not specific to Vienna House and can be applied to other construction projects.

Figure 7. Rendering of interior of Vienna House (source: PUBLIC Architecture).

Landscaping and Public Realm

The landscape design at Vienna House supports healthy living by providing access to nature, public spaces, and community amenities (Figure 8). It provides biodiversity for birds and pollinators, reduces the heat emanating from paved spaces (the “urban heat island” effect), and manages the amount of water and pollution entering municipal stormwater systems. Features include a children’s play area, raised planters for urban agriculture, a proposed swale-like earthworks structure along Victoria Drive, and a blue-green roof in the courtyard to aid in managing stormwater and provide irrigation to trees and plants in that space. The project is implementing strategies that have been identified by Salmon-Safe, a non-profit organization based in Portland, Oregon that seeks to protect water quality, maintain watershed and restore habitat, and is seeking certification through their program. Further information is available in the Landscaping and Public Realm insight report.

Sustainability and Resilience

As a Mass Timber Demonstration Project and a National Housing Demonstration project, Vienna House is constructed from sustainable materials in a manner that is resilient to a changing climate. The use of wood, the courtyard form, Passive House certification, and the innovative methods to provide cool and fresh air to residents contribute to the sustainability and resilience of the building. The resulting Vienna House project establishes a model for how to provide comfortable spaces for new housing construction that considers the effects of a changing climate. Further information about these innovations is available in the Sustainability and Resilience insight report.

Figure 8. Overview of Vienna House form, showing planting areas (source: Matthew Thomson Design).

Insights from Vancouver House in Vienna, Austria

In Vienna, the "developers' competition", through which the design contract for Vancouver House was awarded, required the use of modularization and BIM to minimize costs and optimize planning and construction methods. The resulting design is a hybrid building with a concrete core and CLT walls, with composite concrete/CLT floors. Use of digital design processes and BIM helped provide layouts that are flexible and can adapt to different styles of units. Prefabrication eases issues with limited space at the construction site.

Vancouver House takes advantage of geothermal energy below ground and solar energy from 90 kW peak photovoltaic panels on the roof which also provide shade for an outdoor area. Additional panels may be incorporated in the future on the façade or balconies to improve shading.

The DoTank Circular City project in the City of Vienna is linked to the Vancouver House project, which will foster the goals of resilience, prosperity, and livability.

- Resilience focuses on reduced reliance on raw materials and balancing local production with global supply chains.
- Prosperity includes reducing congestion through better logistics and mobility, eliminating waste by using it as a resource, reducing life cycle costs by following an integrated programming and planning approach, and decoupling value creation from the use of finite resources.
- Livability aims to enhance social interactions, improve air quality, and reduce pollution.

NATIONAL HOUSING STRATEGY

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Acknowledgement

BC Housing gratefully acknowledges funding support from Canada Mortgage and Housing Corporation (CMHC) for this bulletin series. Our sincere appreciation to More Than a Roof Housing Society and the entire project team for their cooperation.

About BC Housing Research Centre

BC Housing's Research Centre works in collaboration with housing sector partners to foster excellence in residential construction and find innovative solutions for affordable housing in British Columbia. Sharing leading-edge research, advances in building science, and new technologies encourages best practice. The Research Centre identifies and bridges research gaps to address homelessness, housing affordability, social housing challenges and the needs of distinct populations. Mobilizing knowledge and research expertise helps improve the quality of housing and leads to innovation and adoption of new construction techniques, Building Code changes, and enhanced education and training programs. Sign up to receive the latest news and updates from BC Housing's Research Centre at **www.bchousing.org/subscribe**.

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