BUILDER INSIGHT

BC HOUSING
RESEARCH CENTRE

Bulletin No 3 | Vienna House

Use of Wood, Prefabrication and Mass Timber

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.

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

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

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.

Connection with Vienna

Vienna House gets its name from the agreement between Vienna, Austria and Vancouver resulting from a 2018 Memorandum of Understanding between the two cities to share best practices in innovative low carbon affordable housing. The partner project, Vancouver House, in Vienna, Austria is being constructed with input from timber construction methods and low carbon policies in British Columbia.

In Vienna, subsidized housing is created with a four-pillar model of Economy, Social Sustainability, Architecture and Ecology. For Vancouver House, this model was used to realize a progressive project of timber construction with high energy efficiency and use of energy sources that did not include fossil fuels. Vienna House references the four-pillar model as an affordable housing project that supports a strong sense of community, uses prefabrication and Passive House technologies, and is an all-electric building.

The cooperation between the two cities allows Vienna to learn from Vancouver's action plan for zero-emissions buildings and the use of timber construction to improve the overall ecological balance of buildings. Vienna is known for its strength in providing social housing. Austria is a global leader in automation and prefabrication. The exchange of knowledge on these topics is an important component of the project.

Use of Wood in Vienna House, Vancouver

Vienna House has been designed with a mass timber light wood frame hybrid structure. Mass timber construction is supported by the City of Vancouver as part of its strategy to lower embodied carbon emissions. It also has the potential to significantly reduce costs of housing construction. Mass timber is fire resistant and meets high standards for structural performance.

To address potential noise transfer issues, the 5-ply Cross Laminated Timber (CLT) floors in Vienna House are topped with a 12 mm acoustical isolation mat and layer of regular weight concrete (Figure 2). The vinyl flooring comes with a built-in cork pad that sits on the concrete layer and helps to reduce sound transmission between units. Maintaining a thick layer of CLT, using regular weight concrete, and the acoustic isolation mat between the two is designed to dampen noise. Further, the CLT does not span across party walls where two adjacent living rooms with exposed CLT ceilings are located to reduce acoustic flanking (Figure 3).

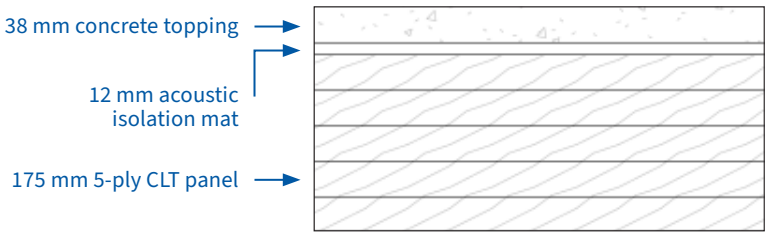

Figure 2. Layers of typical floor/ceiling of living areas of Vienna House. Note flooring is not shown. *(source: PUBLIC Architecture).*

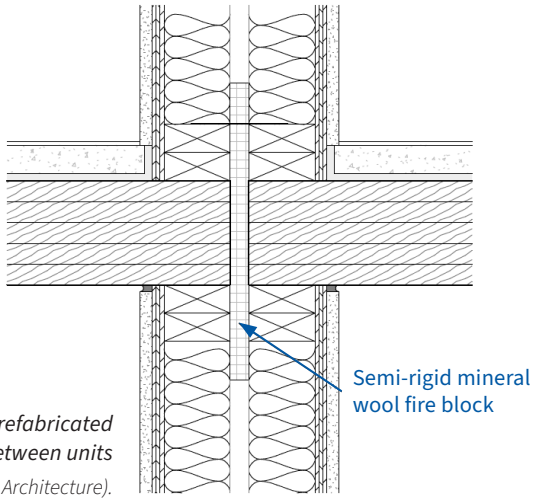

Figure 3. Detail of interior prefabricated wall with discontinuous CLT between units *(source: PUBLIC Architecture).*

Use of Wood in Vancouver House, Vienna

The use of wood was a priority for the Vancouver House project as it addresses decarbonization of Vienna's built environment, and a shortage of alternate materials in Austria.

The building structure comprises 140 mm thick CLT bearing walls with 180 mm CLT floor panels with a 120 mm concrete slab on top. The core is reinforced concrete.

As shown in Figure 4, the design for Vancouver House uses wide-span (7.5 m) floor panels oriented perpendicular to the façade to a wall or beam in the central axis and does not include load-bearing transverse walls. This, combined with prefabricated long-span wood-concrete composite slabs, provides a flexible layout. The use of mixed construction principles and prefabrication optimized the potential for flexibility and affordability.

Vancouver House has a wooden curtain wall façade of vertical wooden planks with different widths and proportions to give a warm appearance on the exterior. Internally, there is a visible wooden surface in the interior on the ceiling and walls. The interior wall elements are not structural and walls in lofts can be adjusted to provide a variety of spaces.

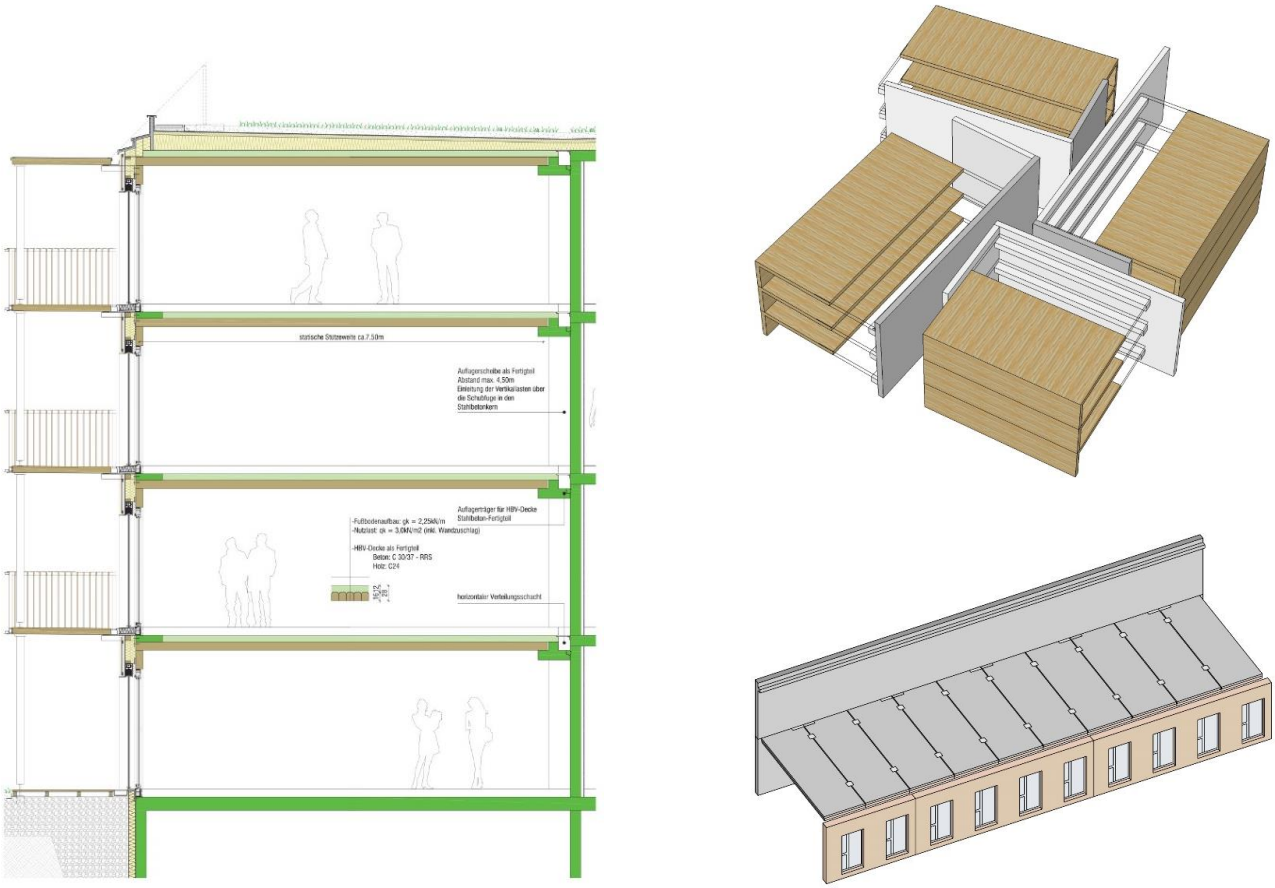

Figure 4. Diagrams demonstrating construction approach for Vancouver House in Vienna (source: Rüdiger Lainer + Partner).

Use of Wood in Vienna House, Vancouver

Biophilia Benefits in Vancouver and Vienna

Biophilia is the innate tendency people have to seek a stronger connection with nature and suggests that this connection is crucial for our physical and mental well-being. In both the Vancouver House project in Vienna, and the Vienna House project in Vancouver, the use of wood offers biophilic benefits. Using wood in architectural and interior design can promote biophilia by invoking a sense of natural warmth and texture, and offers visual and tactile cues that evoke feelings of comfort, relaxation, and harmony with the environment.

Vancouver House has a strong biophilic element as shown in the renderings of the interior (Figure 5) and exterior (Figure 7), with wood visible on most large surfaces. Vienna House will incorporate biophilic effects with exposed CLT ceilings in the main living area of each unit as shown in Figure 6.

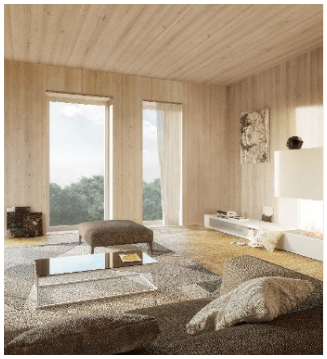

Figure 5. Rendering of interior of Vancouver House *(source: Rüdiger Lainer + Partner).*

Figure 6. Rendering of interior of Vienna House *(source: PUBLIC Architecture).*

Figure 7. Rendering of the exterior of Vancouver House in Vienna *(source: Rüdiger Lainer + Partner).*

Prefabricated Walls

Both Vienna House and Vancouver House are using a high degree of prefabrication, albeit in different ways. Prefabricated panels offer many benefits to the construction of multi-family housing. Manufacture off-site in environmentally controlled factory conditions improves the consistency and accuracy of the panels. It also shortens schedules in speed of panel production and installation. Panels can be manufactured while foundations are prepared, and assembled in days instead of weeks. Manufacturing panels offsite minimizes waste and energy consumption during construction and is a safer environment for the workforce.

While Vancouver House will use prefabricated CLT panels for exterior walls, Vienna House will use prefabricated light wood frame panels for both exterior and interior walls. The exterior walls are double stud, with an exterior structural wall frame, taped OSB sheathing and an interior service wall frame. The exterior frame will be fully enclosed when delivered from the offsite manufacturing facility. Interior walls are prefabricated stud panels that provide structural support. Panels that will receive mechanical and electrical services will be shipped as open panels so that plywood sheathing can be attached after internal components are installed.

For Vienna House, offsite manufacture of the exterior panels is expected to provide more precise assembly to meet the Passive House airtightness requirements of 0.6 air changes per hour at a pressure difference of 50 Pa. Design of the panels, quality of materials and workmanship play a role in air barrier performance. The factory setting and the completion of closed panels before delivery to site limits accidental penetrations in the air barrier system. Figure 8 displays a cross section of the exterior wall panels as they connect to the CLT floors on the interior. The exterior panels will be attached following completion of the assembly of the interior panels and CLT for each level.

Prefabricated Balconies

The prefabrication strategy for Vienna House also includes the use of prefabricated aluminum balconies (Figure 9). While prefab balconies are unusual in Vancouver, they were selected for their safety and ease of installation, with minimal impact on the construction schedule. The balconies are made of aluminum and are strong and lightweight. The materials have a 19% reduction in embodied carbon (LCA stages A1-A5) when compared to steel or concrete balconies.

The balcony “boxes” attach to the exterior of the building with mounting brackets bolted onto the structure. Support rods extend from the steel balcony support flanges on the level above to a connection about two-thirds down the length of the balcony. The balconies are thermally broken from the building at the bracket connectors (Figure 10), making them more energy efficient than traditional balconies.

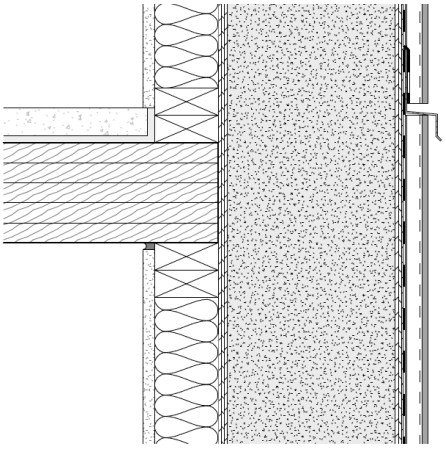

Figure 8. Cross section of design of CLT floor and exterior prefabricated wall panel
(source: PUBLIC Architecture).

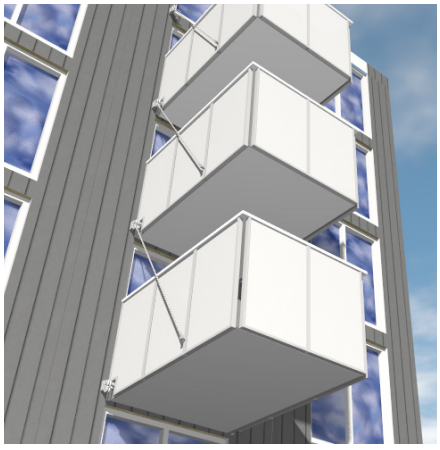

Figure 9. Rendering of Vienna House south-facing balconies
(source: Sapphire Balconies Ltd.).

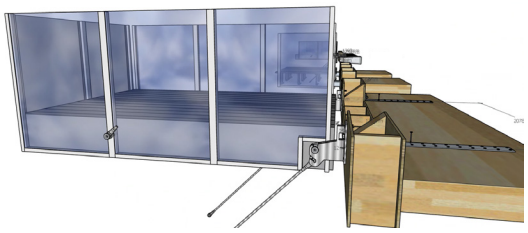

Figure 10. Illustration of the south-facing balconies for Vienna House with thermal break at connection (source: Sapphire Balconies Ltd.).

RIGHT: *Figure 11. Rendering of west side of Vienna House showing balconies* (source: PUBLIC Architecture).

The design of these balconies aligns with the objectives of the project. They provide an innovative method to attach balconies to wood buildings, use energy efficient connections, require limited time and labour onsite, and improve the safety conditions for those doing the installation.

Prefabricated aluminum balconies along Victoria Drive to the west will attach with a different mechanism. Steel brackets will extend horizontally from the building, where the balconies will slide on and be secured. These brackets are used because there is more clearance along the west side of the building and the balconies are wider. They are also thermally broken from the structure.

All of the balconies will be prefabricated, assembled at a nearby location, and delivered to site ready to attach to the building. Timing of this activity is not critical to other work being completed and can be scheduled when convenient.

NATIONAL HOUSING STRATEGY

The Vienna House Multi-Unit Affordable Housing Demonstrations Initiative received funding from Canada Mortgage and Housing Corporation (CMHC) under the National Housing Strategy Demonstrations Initiative. The views expressed are the personal views of the author and CMHC accepts no responsibility for them.

Acknowledgement

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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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