Vienna House Innovative Affordable Housing Demonstration Project

Integrated Design Process Workshop No. 4

VIENNA HOUSE

BC HOUSING RESEARCH CENTRE

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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 encourage 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. Learn more about the Research Centre at www.bchousing.org. Sign up to receive the latest news and updates at www.bchousing.org/subscribe.

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Acknowledgments

Commissioned by BC's Forestry Innovation Investment Ltd., the findings and recommendations in this report are based on the information and feedback provided by participants in the workshops. These workshops are Integrated Design Process (IDP) charrettes being conducted to identify opportunities and establish the direction for achieving project goals for the Vienna House project with the guidance of the City of Vancouver, in partnership with BC Housing and the Vancouver Affordable Housing Agency.

Authors

This report was prepared by SCIUS Advisory.

Disclaimer

Contents

Summary

The cities of Vancouver and Vienna, Austria signed a Memorandum of Cooperation in early 2018 to rapidly advance green-building innovation in their respective cities. As a cornerstone of this collaboration, each city is developing a low-carbon, affordable housing project. Through these two projects, city staff, the project teams and industry experts in the two cities will exchange knowledge and experiences.

The City of Vancouver, in partnership with BC Housing and the Vancouver Affordable Housing Agency, is developing a high performance, mid-rise, social housing project in Vancouver that is at the early design stage.

Forestry Innovation Investment, in partnership with BC Housing, is funding four Integrated Design Process (IDP) charrettes with building experts and policymakers from the City of Vienna and the City of Vancouver. This process identifies opportunities and establishes the direction for achieving project goals for the Vienna House project in Vancouver, B.C. IDP is a method for realizing high performance buildings that contribute to sustainable communities. It is a collaborative process that:

- Focuses on the design, construction, operation and occupancy of a building over its complete life cycle.
- Is designed to allow the client and other stakeholders to develop and realize clearly defined and challenging functional, environmental and economic goals and objectives.
- Consists of a multi-disciplinary design team that includes or acquires the skills required to address all design issues flowing from the objectives.
- Proceeds from "whole building system" strategies working through increasing levels of specificity to realize more optimally integrated solutions.

The fourth workshop was held on March 25, 2021. It consisted of 40 participants working together over Adobe Connect, an online conference platform, and was facilitated by SCIUS Advisory Inc. and Light House Sustainable Building Centre. The workshop brought together the owner group comprising BC Housing, Vancouver Affordable Housing Agency (VAHA) and More Than a Roof Housing Society with industry experts, policy makers and researchers from Vancouver and Vienna.

This workshop focused on the Vienna House project in Vancouver and made comparisons to the project and process in Vienna which were discussed in the previous workshop. As the design phase of the project was getting underway, this workshop provided background information about the project and its participants as well as initial strategies. Passive House and Prefabrication were discussed historically and in terms of how they may be approached in this structure.

Project Context

The project is located at 2009 - 2037 Stainsbury Avenue (at the intersection with Victoria Drive) in Vancouver. Vienna House will be a six-storey social residential building with 106 rental units. Our vision is to demonstrate affordable, climate resilient, near-zero-emission (operational and embodied) housing through the exploration of different procurement models, prefabrication processes and community integration approaches. The rezoning process is underway and the operator, More Than A Roof Housing Society, is onboard. The design team at PUBLIC Architecture has been chosen and the construction manager will be selected in the coming months. There is a particular focus on state-of-the-art wood structural and envelope systems and prefabrication.

The Vancouver House project is located at Waldrebengasse 3, Vienna, Austria. The result of a developers' competition in 2018-2020, Vancouver House will provide innovative and affordable housing for single parents, and will include an in-home daycare provider on the ground floor, a nursery school, a central communal space, and a spacious area for bicycles and prams. It will be constructed with a hybrid solution of mass timber and concrete to optimize fire, noise and weather protection, utilizing prefabrication to provide economic and technical advantages. Heating will be provided with 100 per cent renewable energy sources through the use of ambient heat supplemented with a photovoltaic system.

Site map showing the location of the Vancouver House project at Waldrebengasse 3, Vienna, Austria.

Project Objectives

The project objectives are to provide an affordable social housing project that contributes to market transformation, improving availability, affordability of energy efficient and/or low-carbon building solutions.

The key focus areas, defined by BC Housing, VAHA and City of Vancouver, include:

1. **Low-Carbon, Affordable Housing**: The Vienna House project aims to achieve the lowest possible carbon emissions, while keeping the building affordable. The strategies adopted in this project are intended to be replicable in future affordable housing projects in Vancouver and the B.C. Lower Mainland. During the design process, the team will analyze the affordability of various energy reduction goals and choose the ones that best fit the project's need and budget.

2. **Resilient Design**: The impact of rapidly changing climate is already being experienced in all countries around the world. Authorities and industry leaders are exploring the ways in which buildings can be designed to adapt to these changes. Vienna House will explore solutions for a resilient design by considering future climate and post-disaster requirements in its design process. This project will demonstrate innovative mechanical system solutions to maintain thermal comfort in this social housing project in the face of climate change.

3. **Procurement Innovation**: To succeed in achieving the project's complex goals, City of Vancouver and BC Housing are committed to incorporating innovative procurement methods. To do so, all the partners' procurement staff will participate in the development process. Additionally, North American and Viennese experts will be consulted to identify the best alternative contracting methods for setting targets and creating commitments.

4. **Knowledge Transformation**: While the local experts will design and build the project, experts from Vienna will offer their experience in delivering affordable low-carbon housing in a large scale. Potential areas of contribution could include advice on: request for proposals, advanced building components, alternative approaches to mechanical heating, ventilation and air condition systems (HVAC), and envelope design.

Preparing for the Workshop

Normally, IDP charrettes are conducted in a highly collaborative fashion with the entire project team face to face in a large meeting space over the best part of a day. Due to travel restrictions arising from the COVID-19 pandemic, the Adobe Connect platform was used. Time zone differences between Vancouver and Vienna meant that only three hours were possible in one session.

Adobe Connect is not a commonly used platform, however many of the participants had experience using it in previous workshops. Additional technical support provided by Light House was available during the event in case of any issues with the platform.

Workshop 4

The fourth Vienna House Workshop brought together 40 participants from Vienna and Vancouver, including representatives from the owner group and industry experts. It provided an opportunity for enhanced collaboration between the projects in Vienna and Vancouver and highlighted benefits of digital project delivery for Passive House and prefabrication. At this time, the project design team – led by PUBLIC Architecture + Communication – has been selected and have started their discovery phase of the project. Representatives from BC Housing and the design team for Vienna House continued their collaboration to present ambitions and ideas for the next phase of the project. Collaborators from Vienna engaged in this discussion. The team shared the planned communications strategy demonstrating how the project will disseminate lessons learned to the broader construction community. There were seven presentations followed by a facilitated discussion during the course of the three-hour workshop. Slides for the presentations can be found using the links in the table below.

Presentation	Presenter	Links for Download
Communications Strategy and Brand Presentation	**James Glave** Glave Strategies	Link (Communications) Link (Brand)
BC Housing Standards	**Melvin Lee and Ren Bai** BC Housing	Link
Design Team Introductions	**John Wall** PUBLIC	Link
Vienna House Program and Site Conditions	**Brian Wakelin** PUBLIC	Link
Passive House	**Brian Wakelin and Jamie Hart** PUBLIC	Link
Mechanical Considerations	**Stuart Hood** Integral	Link
Digital Project Delivery and Prefabrication	**Guido Wimmers** Integrated Wood Design, UNBC	Link

Information Sharing

Details of the seven presentations listed above are provided on the following pages.

JAMES GLAVE
Communications Specialist, Glave Strategies

James is leading the communications strategy and outreach for Vienna House and presented the brand identity materials he developed with his team and the Communications Committee.

The audiences for the communciations strategy includes industry, government, and NGOs and advocates. The neighborhood is Kensington Cedar Cottage, which is an artistic neighborhood with a park and farmers market that includes necessities within a 15-minute walk.

VIENNA
HOUSE

Vienna House Logo

The branding has a wood grain version and a slate version. The wood grain version is planned to be physically produced out of wood and photographed.

Vienna House Core Themes

The core themes for the branding include innovation, economic diversification, affordability, knowledge transfer, and climate friendly.

The communications strategy has these overarching goals:

- All parties that might benefit from the lessons of Vienna House are aware of the project and its goals, and have ready access to plain-language information on the ideas, technologies, tools and approaches it is putting into practice.
- Industry audiences will understand the benefits of using prefabricated products in combination with other high-performance materials and components - as well as an integrated design process and building information management tools - in delivering net-zero-energy-ready, zero-emission projects.
- Policy makers will understand that the materials and strategies employed at Vienna House will reduce community emissions and improve resilience while addressing critical equity concerns. They will understand that these approaches can easily scale to drive market transformation, and they will ideally address policy barriers to doing so.
- Industry and government leaders will better understand the social impact of high-performance buildings.

Strategies include production of original content and social media. By sharing and amplifying the messages through the large network of partners on the project, they can reach a broad audience.

A website, viennahouse.ca will provide updated information about the project and include three videos. James showed a preview of the first one, a preliminary version (not the final cut).

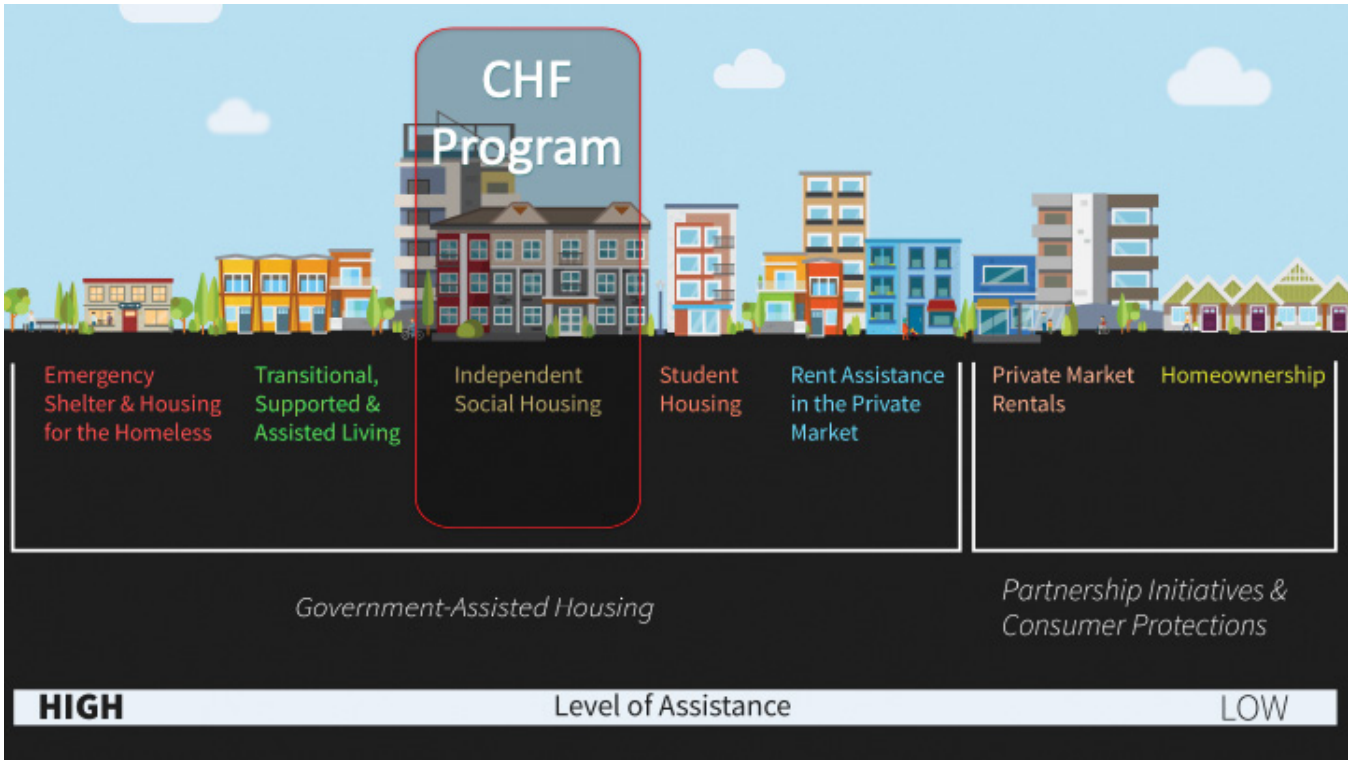
These activities are funded through grants, including the Green Construction with Wood (GC Wood) program. The communications outreach will begin following a public announcement about the project in the coming weeks. It will be sure to include the Vancouver House project in Vienna as well.

MELVIN LEE
Development Manager, BC Housing

BC Housing develops, manages and administers a wide range of subsidized housing options across the province. They work in partnership with the private and non-profit sectors, provincial health authorities and ministries, and other levels of government to develop a range of housing options across the housing continuum, which range from emergency shelter and rent assistance in the private market to affordable home ownership.

In 2018, the Government of British Columbia laid out a 30-point Housing Plan, which included several funding streams for affordable and subsidized housing, one of those funding streams has a focus on the "missing middle."

The Vienna House project falls under this program, called the Community Housing Fund (CHF). It applies a mixed-income approach to provide housing that is affordable for households with a range of income, with a particular focus on the "missing middle." BC Housing will be acting as the primary funder and financier for the project through the CHF program.



Affordable and subsidized housing available with Government assistance

The CHF funding program framework includes the following criteria and goals:

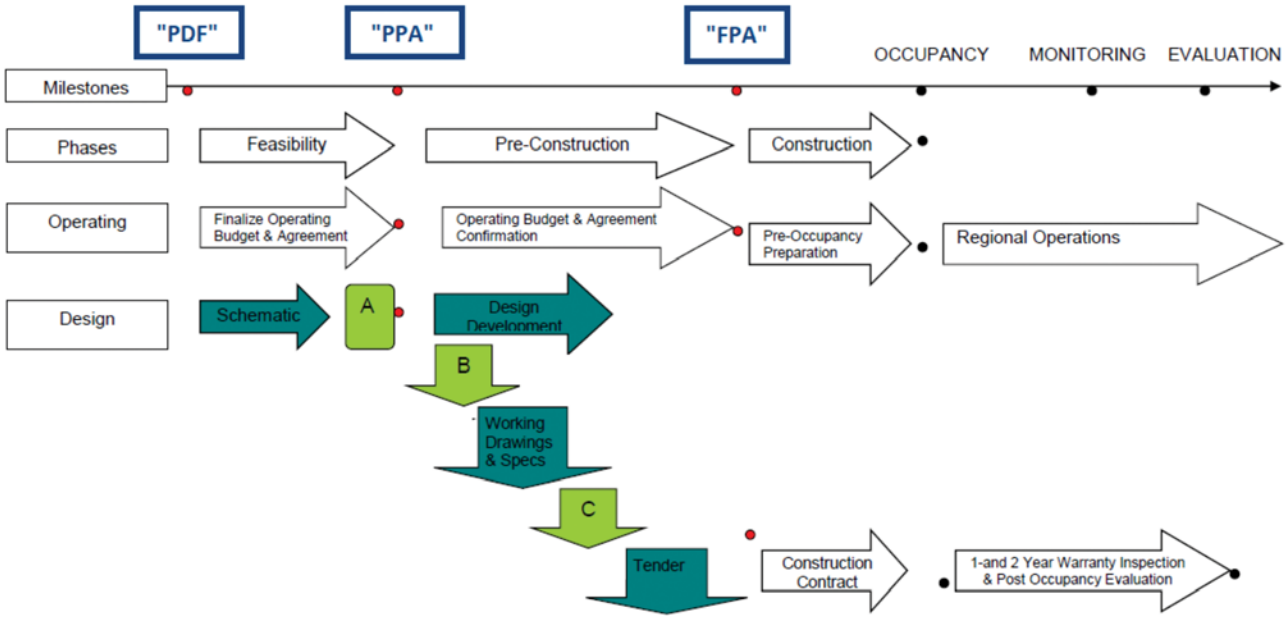
- The project is to be owned & operated by a non profit housing society, in this instance: More Than A Roof.
- The CHF funding program does not include housing with support services, or residential care components.
- The target population are families, seniors and persons with a disability capable of living independently without on-site supports.

- The program goal is to facilitate the development of new affordable housing projects of mixed income:
  - 30 per cent of units at affordable market rents
  - 50 per cent of units at rent-geared to income (RGI)
  - 20 per cent of units at deep subsidy RGI

To support the development of these affordable housing projects, the CHF funding program includes:

- A capital grant of approximately $100K per unit (based on the number of units within the project) that is secured by a 35-year forgivable mortgage that is registered on title.
- Low cost interim and take-out financing of up to 100 per cent of construction costs that is registered on title.
- An operating subsidy where required. The operating subsidy is evidenced within the BC Housing CHF Operating Agreement and Housing Covenant registered on title. The operating subsidy mitigates the financial risk to the housing owner and operator due to changing circumstances in residents' income and subsequent RGI rent payable.

BC Housing has now issued two public funding calls for this program and the Vancouver Affordable Housing Agency (VAHA), the City of Vancouver's development arm, submitted a proposal in response to the call. BC Housing has Issued a "Notice of Award" to VAHA to proceed under this call.



Project Development Process and BC Housing Approval Process

The overlap of a project's development process and the BC Housing approval process is illustrated. As Development Manager at BC Housing, Melvin works with VAHA and MTAR to assess and refine aspects of the project to put forth to receive Provisional Project Approval (PPA) from BC Housing's executive team. This includes looking at the project from: design, capital budget, operating budget, program planning and sustainability perspectives. Following PPA, conditions and parameters are set out by BC Housing's Executive, providing a roadmap to BC Housing's next major milestone: Final Project Approval (FPA), where BC Housing funds are committed to the project.

The light green boxes (marked A, B and C) represent milestone reviews, including review from a design and budget perspective.

REN BAI
Project Technician, BC Housing

Ren's role in part is to provide technical services on behalf of the owner, or BC Housing at this stage. He introduced the BC Housing Design Guidelines and Construction Standards document, which is a working document that defines BC Housing standards and includes:

1. General design guidelines – Intent of the projects, for example unit sizes, amenities, etc.
2. Energy and environmental design – current BC Step Code and building code requirements.
3. CPTED – Crime prevention through environmental design.
4. Construction standards – Details such as cladding, roofing, etc.
5. Drawing requirements – documents and drawings required for each milestone review.

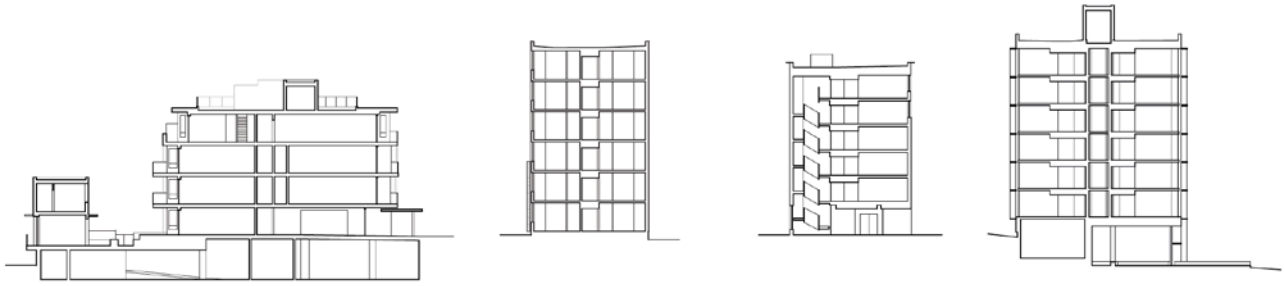
This document is constantly being updated, with revisions every two to three years. The next version is anticipated for 2022. Technical bulletins are issued in-between versions for important updates more frequently. For example, a bulletin was issued in 2020 regarding Energy and Environmental concerns, dealing with more stringent Step Code requirements and whole-building air barrier testing. Other guidelines also exist that address specific types of buildings such as Women's Transitional Housing, Commercial Retail Unit Design, Shelter Design, etc. They provide further information and are not intended to conflict with the main document.

Performance requirements are geared toward the Step Code and innovative pathways to meet those requirements are permitted.

Integrated processes are not standard. Due to the approval process constraints, construction and trades are usually brought in after the project is fully designed.

JOHN WALL
Architect, PUBLIC: Architecture + Communication

John Wall began by introducing the recently announced design team from PUBLIC. Leadership includes himself, Brian Wakelin, Susan Mavor, Robert Drew, and Shane O'Neill. This project fits well with the interests and goals of the firm. They like to keep the history of the communities in mind as they design projects, acknowledging their operations on the unceded territories of the Musqueam, Squamish and Tsleil-Watuth Nations. They work on a variety of projects from stamps and books to public realm improvements and large buildings. John spoke about the Wilson School of Design in Richmond, which is an innovative five-storey mass timber structure, which by code is required to be non-combustible construction. The wood for the project actually came from Europe because of the competitive industry there. Their relevant experience in residential projects includes:



Amber - LEED Gold | UBC - LEED Platinum | UBCO - PH | SFU - Step 4

Previoius PUBLIC projects relevant to Vienna House

1. **Amber:** A four-storey wood-frame market housing project which achieved LEED Gold, with one storey of underground parking, roof decks, views and community gardens. It has laneway-style townhouses, and is built on a busy arterial road.
2. **UBC - LEED Platinum:** A student housing project at UBC made of concrete construction which achieved LEED Platinum, and had to meet standards similar to Vienna House, such as durability, longevity, energy efficiency and providing good, suitable housing.
3. **UBCO - PH:** A project at UBC Okanagan which achieved Passive House standards. It is a six-storey wood frame structure. This project will be discussed later in the workshop in another presentation.
4. **SFU - Step 4:** An eight-storey concrete project at SFU on Burnaby Mountain, achieving Step Code 4.

Overall, these projects demonstrate increasing levels of energy performance, a mix of wood and concrete, with both market and non-market housing.

Key personnel active on the project

For Vienna House, Brian Wakelin will be leading the design of the housing. John Wall will be the overall project lead. Shane O'Neill as implementation lead will be coordinating the consultants and keeping the team all pulling together. Jamie Hart, as project architect, will lead the internal team to ensure documents and ensuring standards are met. Their consultant team includes individuals from Integral, GHL, WHM, CORE, Morrison Hershfield, BKL, Steven Winter Associates and Gunn as shown.

The workplan presented in the slides includes the anticipated stages between the execution of their contract and design permit review and issuance, anticipated by May 2022.

The design you see on many graphics was part of an initial study, but they will be starting fresh with a new design with the client group to meet all their needs. This design team is really just getting started and they are interested in hearing insights from the Vancouver House team in Vienna, including lessons learned, ideas, and things to consider during development.

BRIAN WAKELIN
Architect, PUBLIC: Architecture + Communication

Brian discussed the project site for Vienna House. It is located near a park and community center, two cultural centers, close to schools, well-serviced by transit, and within walking distance to groceries. The area historically has many detached single-family homes. Changes to the zoning bylaws have been made to accommodate conglomerated sites like this one. This results in many smaller buildings and the larger structures take more processing effort. The "missing middle" mid-rise housing is less common in part due to this effort. Larger high-rise buildings downtown are able to spread this cost among the higher density of the buildings. The Vienna House structure will be of similar scale to others immediately to the west. To the north are elevated trains that create a CPTED concern because of the shade and acoustic issues. Parking will likely be on that side because of the grade.

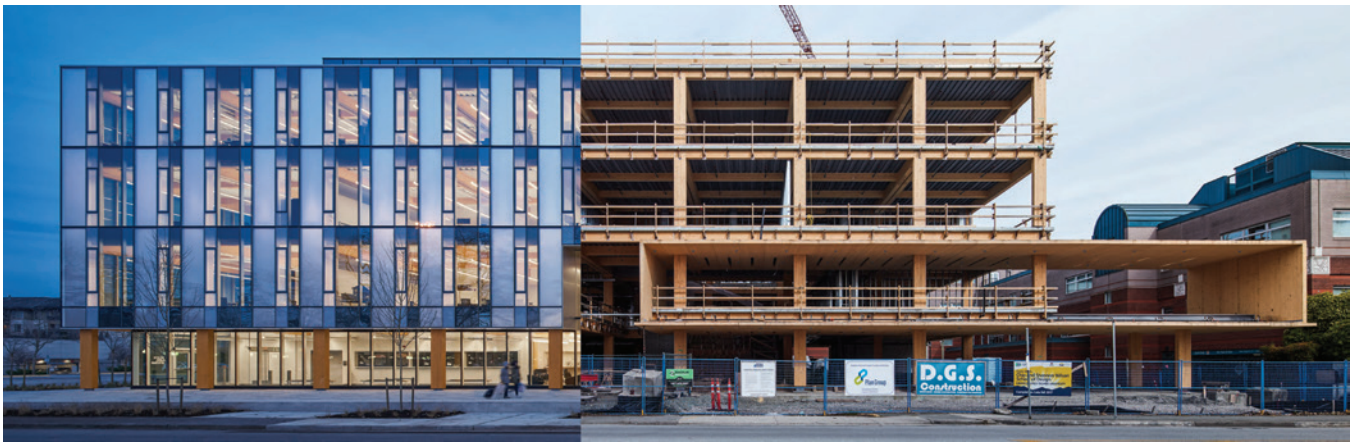
View of project site location (dashed red line)

Brian gave a breakdown of the specified 101 homes, with mostly one bedroom units, followed by two and three bedrooms and studios. This mix is subject to change and will adjust to provide homes for families as possible. There will also be a multipurpose room with kitchenette, laundry, mail area, office and janitorial space. There is a small allocation for storage and service space. Grouping will be optimized for services, with stacking of washrooms and kitchens where possible, but also mixing a range of household sizes within floors.

Brian continued with some examples of previous passive house construction by PUBLIC. He began with a six-storey student housing unit for UBCO, which is in an area with a northern desert climate, so more diurnal intensity and summer intensity. The structure used Building Information Modeling (BIM) for architectural, structural and mechanical design. The electrical design did not use BIM. This is the first passive house building that UBC has built, also the first one the general contractor built and the first one for PUBLIC, although Jamie Hart brought his experience to the team.

Passive House student housing at UBC Okanagan

The structure has a north-south alignment that makes sense for campus planning but is not optimal for passive house. Early in the process, the form factor was optimized to maximize envelope performance. It is a simple wood design so that as many qualified sub-trades could bid on it as possible, as many local trades are familiar with light wood frame construction. All vertical structural elements were prefabricated offsite. Horizontal assemblies were built on-site.

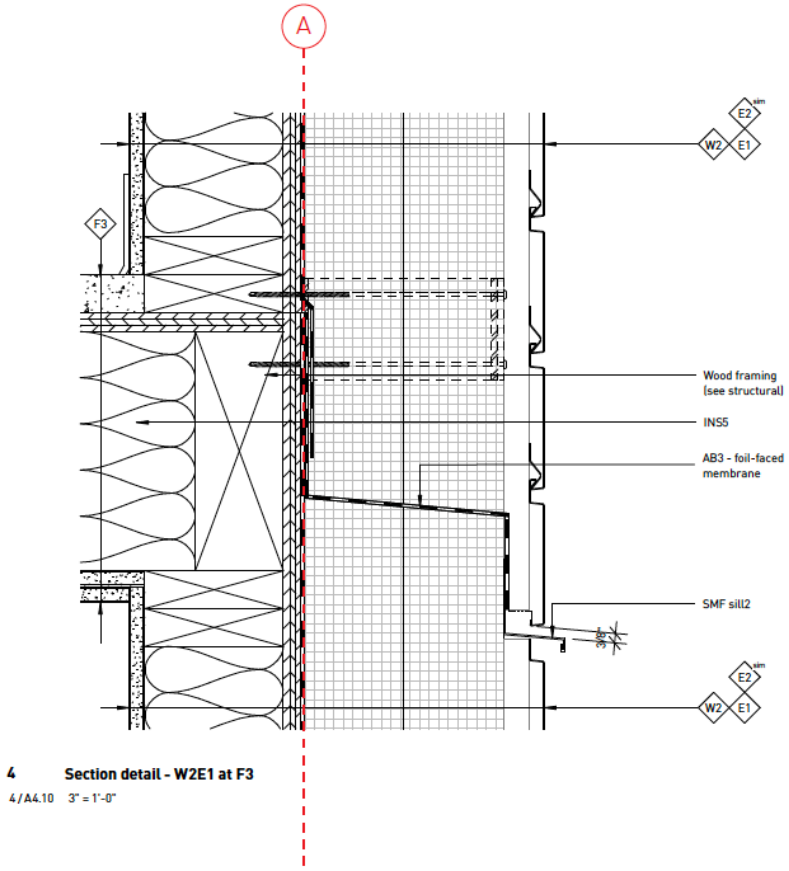


Wiilson School of Design, Richmond

Another building, the Wilson School of Design in Richmond, had access to more experienced erectors locally, and was able to have all vertical and all primary horizontal structure elements be glue laminated or cross laminated elements. At that time CLT floor elements were not economically viable and were switched to steel deck with concrete topping for a 25 per cent cost savings. CLT was kept for architecturally expressive elements. The wood was manufactured in Germany using Russian lumber because at the time, much of the connection technology was most competitively priced in Germany and it was economically

more viable for it to come from Europe rather than B.C. This has been common, as other designs they have done, including prefabricated bus shelters, have been more economically viable to source wood from Europe. They continue to try to tune designs to incorporate local projects.

Bus shelters using prefabricated engineered wood



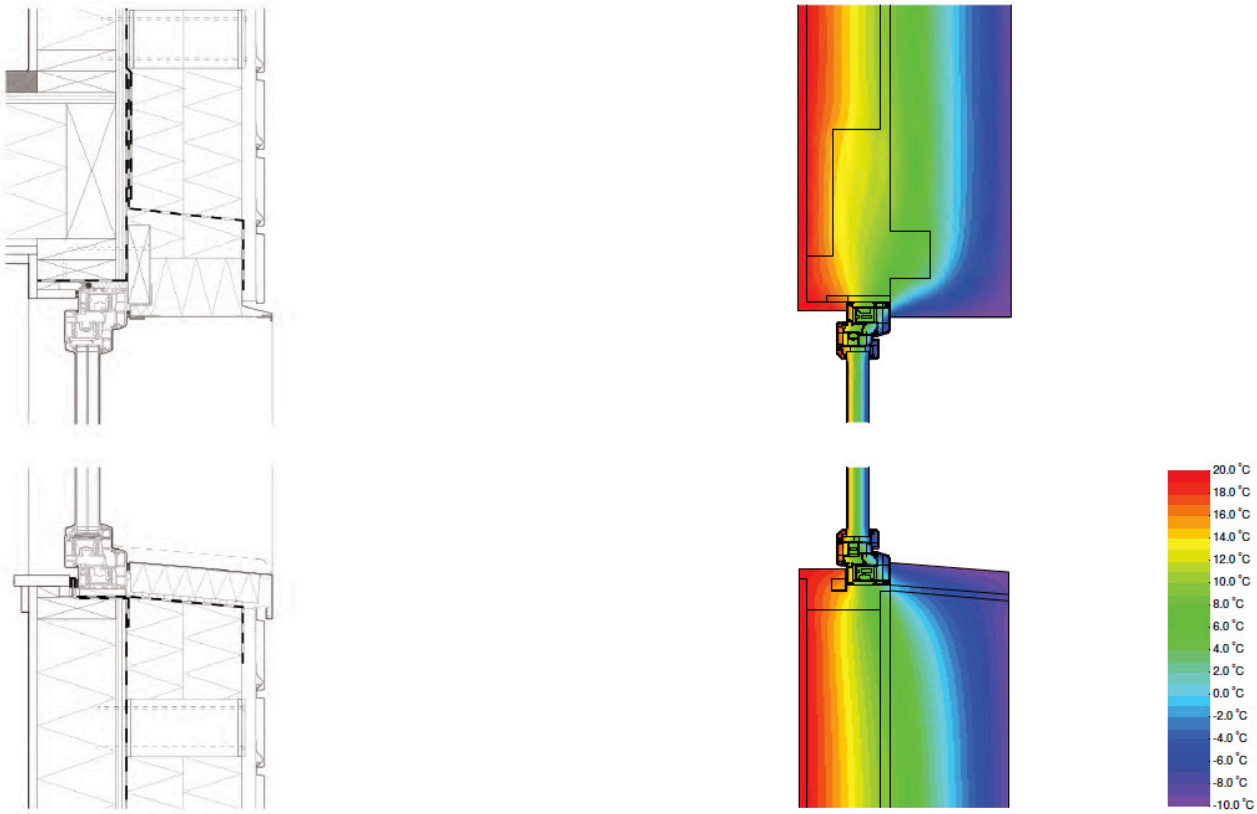
Detail of Skeena House exterior wall

This illustration shows a detail of Skeena House with all passive house features outside of gridline A. This allowed for more market participation in the bidding of the wood frame structure, lowering risk and pricing. The technical innovation on the exterior (right of gridline A) allowed construction to begin on the interior sooner. The detail design of the exterior structure is separate from the interior structure. The interior was built first and then all of the responsibility for the exterior was assigned to one subcontractor.

The owner's primary objective for this structure was for affordable construction and the secondary objective was passive house. Due to cost considerations for affordable housing, the decision for exterior insulation to meet passive house standards was not made until other costs were better known. They were able to add the desired insulation and there is 140 mm of insulation inboard of the plywood sheathing and 200 mm outboard.

JAMIE HART
Architect, PUBLIC: Architecture + Communication

The windows on the Skeena House structure were installed directly in plane with the wood frame fall minimizing significant thermal issues as compared to a concrete or steel one. Recessed windows allowed for more overlap of the insulation to improve performance. The windows face east and west, so the design to have them set in with about 300 millimetres of reveal on the sides provides fixed solar shading. You can see the shadows cast on the cladding below the windows.



Window detail of Skeena House

As part of a research project at the University, monitors are placed in the building to assess performance, along with annual surveys of occupants. There are two test buildings on either side, one is LEED Gold and one is conventional construction, offering a good comparison for research on passive house.

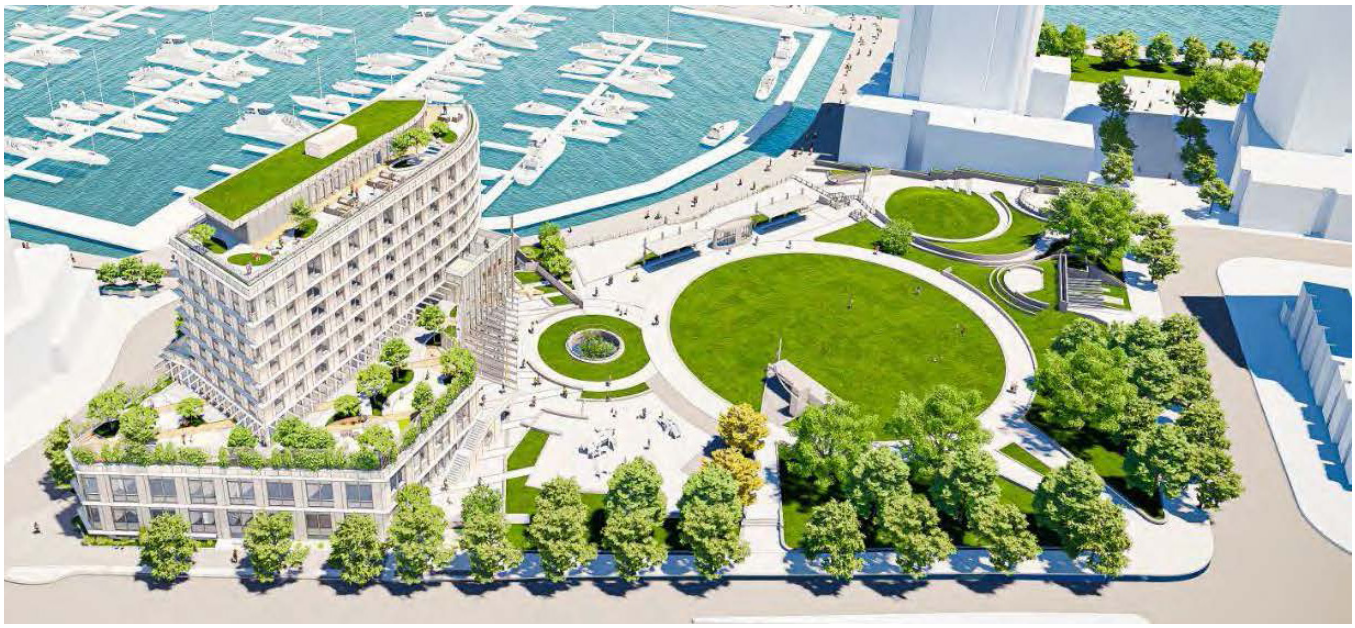
With the air barrier in place, there is a high degree of verification of air tightness, reducing air leakage and moisture ingress into the structure. There is continuous vapor open mineral wool insulation on the outside to allow the building to dry to exterior if there is ever a moisture issue. The passive house elements are part of a system designed to create a durable, long-lasting structure that remains warm and dry for as long as possible.

Air barriers on Skeena House

In addition to differences in the enclosure, certain elements within the building are also treated differently for passive house. Each student room has a hydronic fan coil providing heating and cooling, with an individual thermostat control for each student. This creates a lot of hydronic pipe work going into each room, and then the domestic hot water system is insulated to a greater thickness and over a much greater length than it would be otherwise. This leads to consideration of the types of internal partitions used. Wood framing is easier to manipulate because you can cut through a header if needed. But it requires good planning upfront for the real world dimensions of these types of systems.

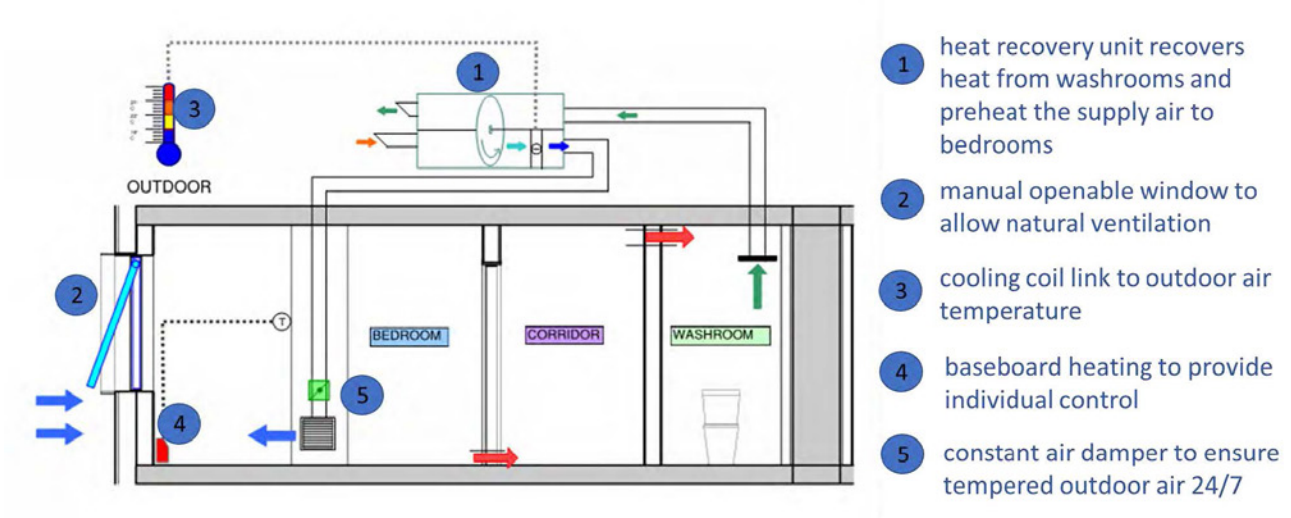
STUART HOOD
Engineer and Passive House Expert, Integral

Stuart Hood discussed mechanical concepts of passive house projects they have been involved with amidst difficulties getting high performance mechanical equipment imported from Europe.



Passive House project in Coal Harbour

The first project is in progress in Coal Harbour and has a school/childcare in the podium level and six storeys of social housing. The roof deck on the building is an amenity, which has an impact on the mechanical systems. It has a relatively straightforward centralized ventilation system with a heat recovery wheel, which does peak recovery of about 85 per cent. The difference here is a heating and cooling coil in the discharge of the supply that will heat or cool depending on the season.

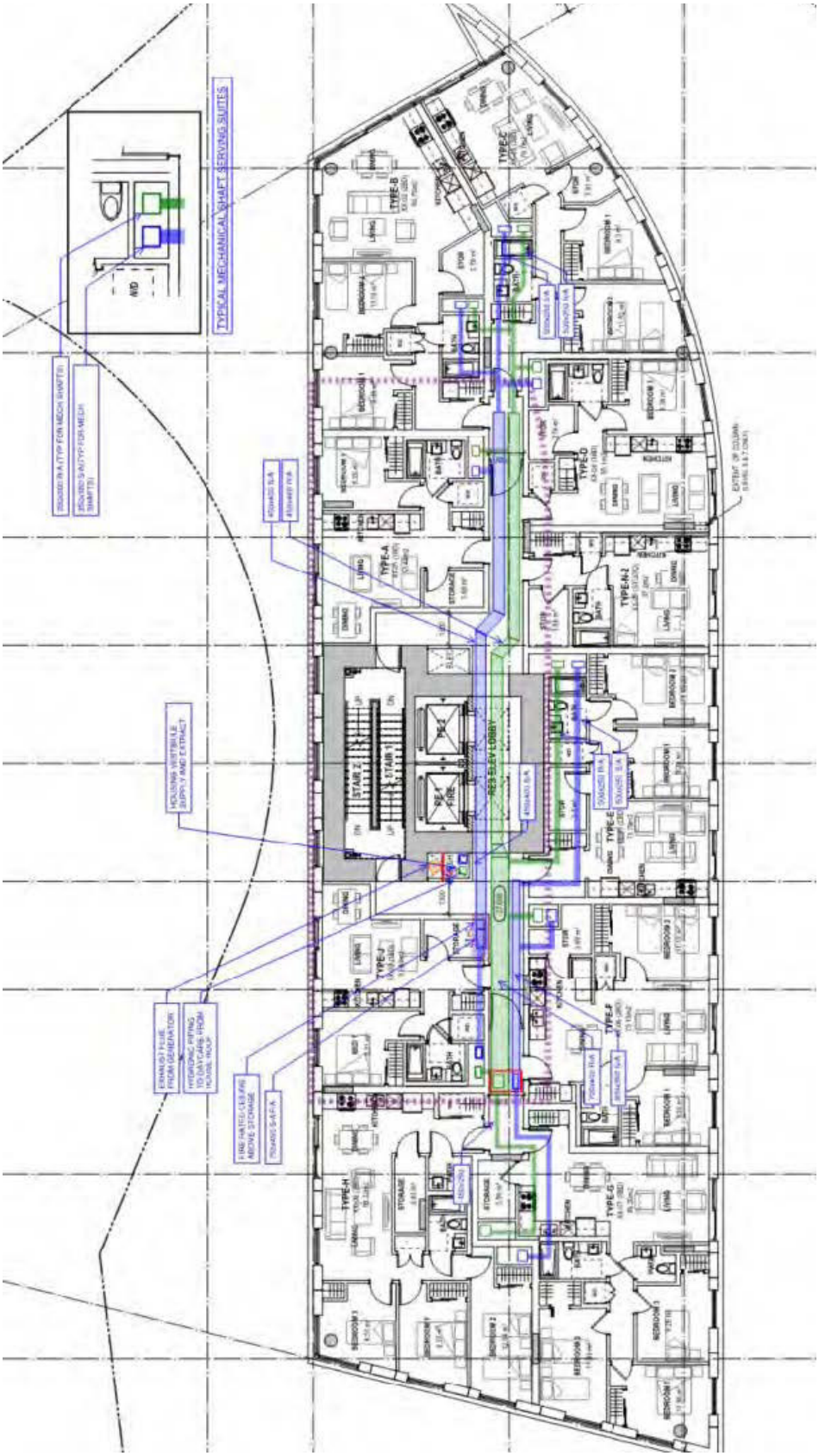


Centralized ventilation system

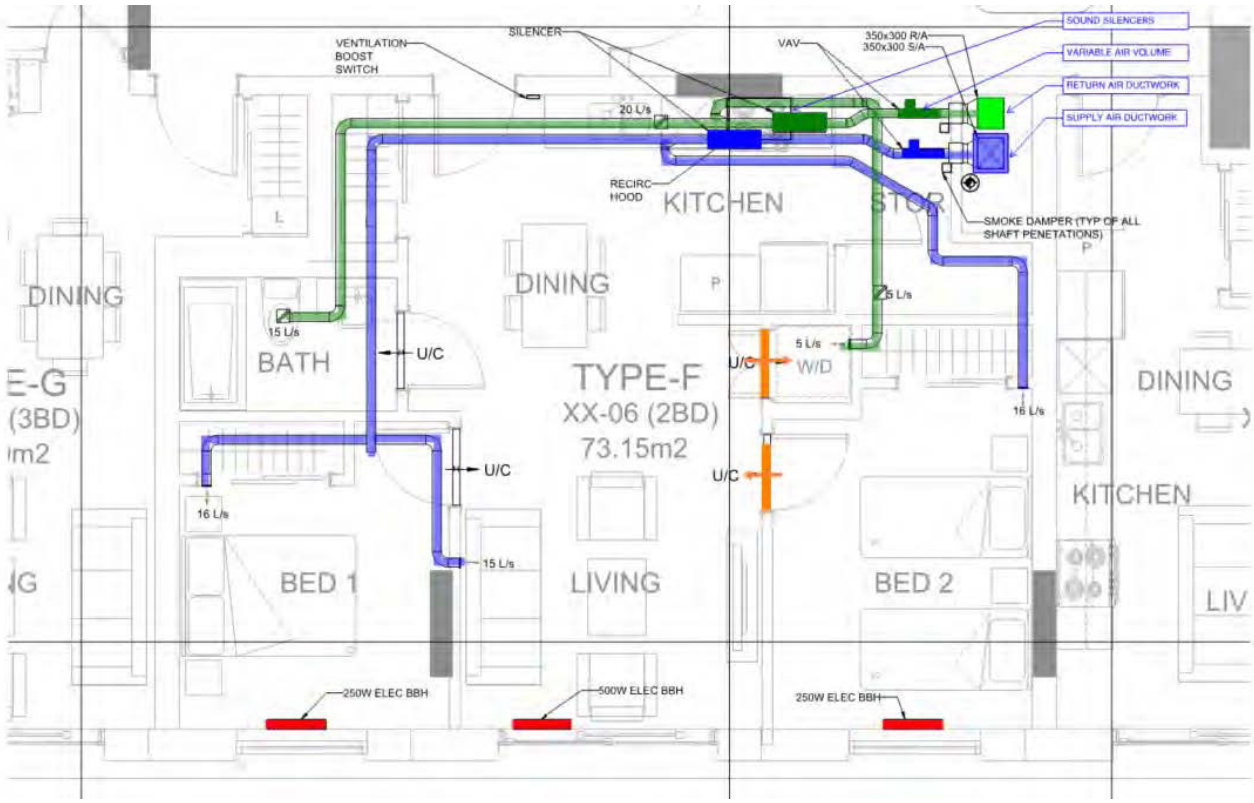
Layout of mechanical systems on roof, with amenity space

The heating strategy is electric baseboard heating, which works well in these areas as there is no district energy system and there is an abundance of hydroelectric energy available. The amount of heat needed is very small for passive house. This illustration shows the layout, with mechanical systems in color. The small mechanical room has three energy recovery ventilators, one for the north side, one for the south, and another for the corridors. The units are all inside so as to reduce noise and problems for people enjoying the amenity.

The illustration on page 20 shows the top floor supply and exhaust in blue and green. This is a header duct, which is only on this floor, and then drops down in shafts. For the suites, there are stacked supply and exhaust shafts that drop down to the six levels. Extra ceiling height of 30-40 cm is added on this floor to accommodate the ducts.



Layout of floor just below the roof



Suite layout showing mechanical systems

This illustration shows a typical two bedroom suite layout. The red shapes show the electric baseboard heaters, with 250 watt heaters in the bedrooms and a 500 watt heater in the living room. The blue ducts show the supply wrapped around to allow for higher ceilings in main living spaces. The smoke fire dampers have a variable volume damper on the shaft to allow for increased ventilation rates during cooking or use of the bathroom. There is a boost switch interconnected to the range hood or light switch.

Domestic Hot Water Strategy Option - Sanden CO_2 Heat Pumps

The majority of energy used in passive house is for domestic hot water, typically heat pump systems. The image above shows a system they built in Pemberton, B.C. using heat pumps that are designed for single family homes. They are ganged together here for a 45 unit multi-family building.

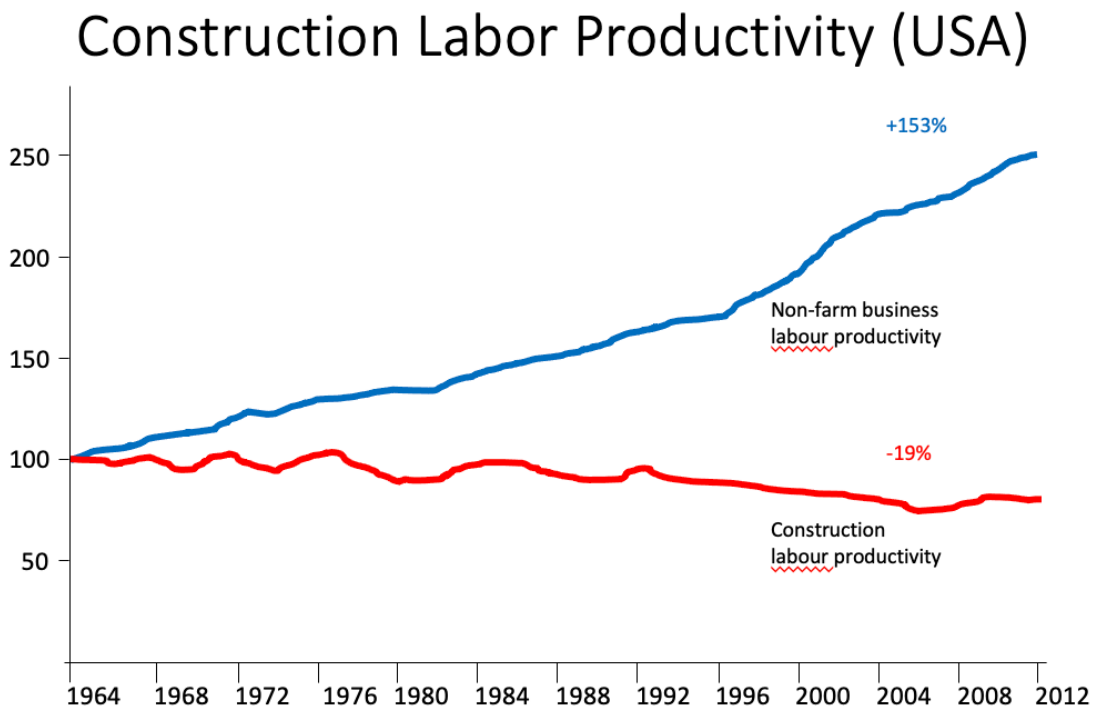
On the Coal Harbour project, they looked at several options and decided to use water to water heat pumps which are slightly larger, non-residential heat pumps and are extracting heat from the large electrical room. With the advent of electric vehicles, the electrical infrastructure is quite large and they are able to use heat coming off the transformers.

GUIDO WIMMERS

Integrated Wood Design Program, University of Northern BC

Passive house and affordability are somewhat synonymous if you look at the monthly cost of ownership instead of just initial investment. This presentation will focus on affordability in relation to prefabrication. Prefabricated houses have been around for centuries and some have lasted for a very long time. In the 1990's the European industry changed, led by Austria and other countries in central Europe. New energy efficiency codes gave the wood construction sector a new idea on how to position themselves as the sustainable option. The invention of CLT and later DLT changed the course that we continue on today. In the 2000's wood construction in Europe converted primarily to prefabrication. In 2009 the Austria House for the Olympic Games was built in Whistler, B.C. using CLT and DLT for the first Passive House in Canada. The perception of prefabrication in North America is that of low quality, but in Europe it is high quality. The same goes for modular construction, where buildings are more architecturally appealing in Europe. Automation for manufacturing in construction is not widespread in Canada. Some components are mass produced but homes are not. To move to modern manufacturing systems we would move beyond automation to cyber physical systems.

Guido showed a chart from the World Economic Forum in 2016 comparing USA labor productivity in non-farm businesses and in construction. The former has risen 150 per cent since 1964, where the latter has fallen 20 per cent.



Peer set based on US companies with engineering, construction and service-related standard industrial classification codes. Financials are inflation-adjusted and indexed to 1964; output per working hours. Source: Global Vantage; Compustat; Bloomberg; www.aecbytes.com/viewpoint/2013/issue_67.html; www.nber.org/papers/w1555.pdf; S&P Capital IQ; BCG ValueScience Center; World Economic Forum

Construction Labor Productivity

Example of offsite construction in a controlled environment

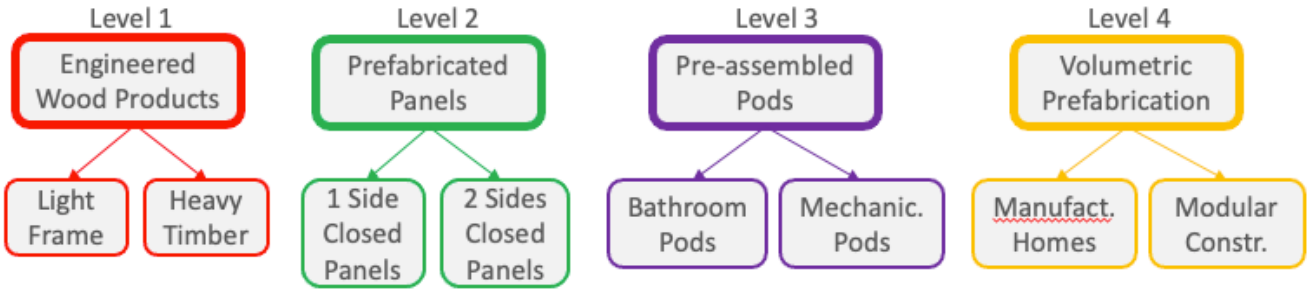
An efficient setup that allows for offsite construction in a controlled environment will improve productivity but require integrated project delivery. This allows design work, etc. to be moved to the front, allowing for higher quality. It's not necessarily mass production, more mass customization. Every building can be different but the way we build it can be more efficient. BIM is one of the tools that allows us to do this. It provides a shared digital representation of the physical and functional characteristics. It is a rich information model consisting of potentially multiple data sources, elements of which can be shared across all stakeholders and be maintained across the life of a building. The real advantage of BIM is the ability to carry over the information into operation. The output of the design is not so much the drawings but the information embedded into the drawings. The drawings are simply a tool to carry multiple layers of information models that support the design, the construction process, the commissioning and the operation, including potential alterations at any given time over the lifetime of the building.

Digital project delivery and the integrated process is not an absolutely necessity but saves costs and allows for complex or parametric designs that would be very difficult otherwise.

Two big driving factors for prefabrication in British Columbia are the ability to construct tall buildings up to 12 storeys and the energy efficiency requirements in the Step Code. Thicker construction for energy efficiency is more cost efficient with prefabrication.

Complex designs possible with digital project delivery

In colder climates, the envelope for Step Code 5 (not yet Passive House) requires 50 per cent more weight and is almost 100 per cent thicker. That is difficult to do onsite.



Classification of Prefabrication

Prefabrication can be classified as shown. The first level is Engineered Wood Products, the second is Prefabricated Panels, third is Pre-assembled Pods and fourth is Volumetric Prefabrication.

Level 1 Engineered Wood Products

Level 2 Prefabricated Panels

Level 3 Pre-assembled Pods

Level 4 Volumetric Prefabrication

Prefabrication Level 1 can be differentiated into light wood frame (precut or preassembled) and heavy timber (glulam, CLT, NLT, DLT, precut, predrilled). Level 2 can be differentiated into one side closed and two sides closed, depending on if you have all the electrical and plumbing, etc. inside the wall. This is more efficient, but manufacturing now needs several different stages: more room, more investment, more automation, potentially. Level 3 is pods, which could be bathroom pods, mechanical pods, depending on the project. Investment is relatively high. Level 4 is manufactured homes (which are the ones that have generally generated a bad reputation over the last 50 years) and modular construction. This is a more significant overall investment because now everything is integrated into one module.

A traditional analog construction process that is simply executed to order on a one-off basis under cover is not - technically prefabrication. It does not benefit from the efficiencies of mass production. Prefabrication is the optimization of the processes themselves, finishing the panels in an ergonomic environment up to the highest level possible with an optimized process, putting them together into a three dimensional module and then either shipping them as panels or assembling them before shipping.

Involving prefabrication into the project phases of planning and design, structural and envelope, services, and finishes, provides a huge opportunity to grow and optimize processes and make them affordable and cost efficient.

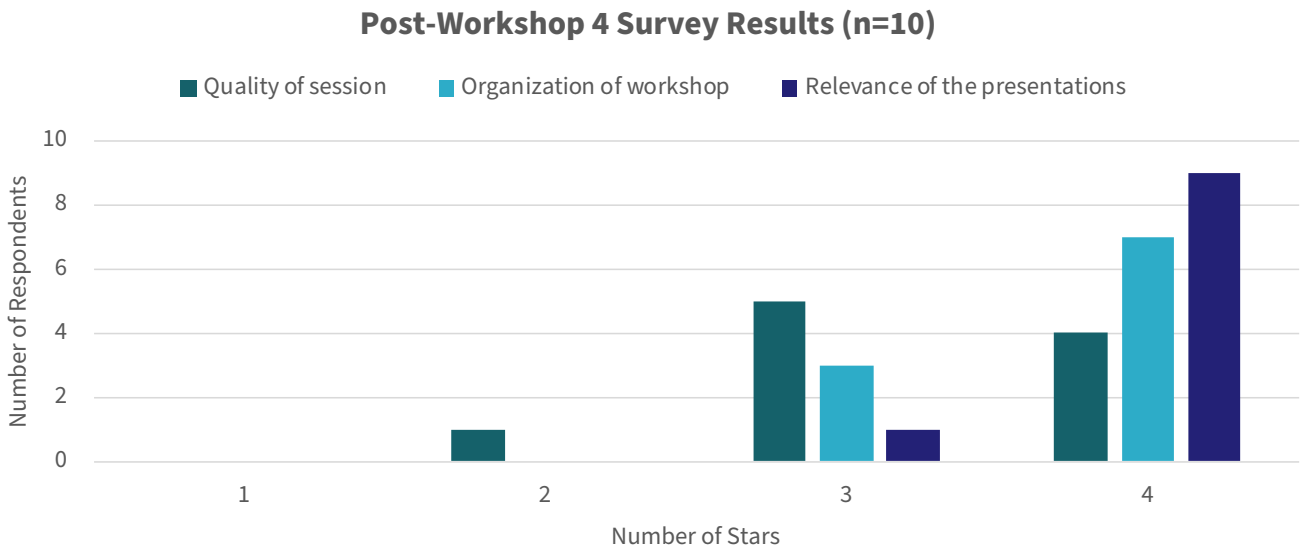
Facilitated Discussion

Following the information sharing session, participants were able to ask further questions of the presenters and engage in more in-depth discussions. The discussion is summarized below.

- The key for successful prefabrication is understanding the workstations and how to optimize the process itself before automating.
- There are opportunities for access to prefabrication in the rural areas because that is where the CLT is produced, not in the Lower Mainland.
- Regarding strategies to explore prefabrication options given the current environment for mass timber in B.C., CLT production must start with a stable supply from a sawmill to remove price volatility. Right now there is one CLT producer in B.C. with its own sawmill. CLT prices are more expensive than usual because lumber prices seem to be very high in North America. Prefabrication companies need to optimize processes to expand, there are a couple of companies just getting started.
- With prefabrication where there is repetition and/or standardized production, there is cost certainty and it speeds up the process. However if you have to change something it will be expensive. Mistakes can be costly, but most of the time money is saved because of a lack of changes. In Austria they have some parts of the prefabrication that are changeable and can be produced to level 2a. But it's hard to have elements to level 3 or 4, except in hospitals or student housing, perhaps. Panelized construction offers more flexibility and is more efficient for transportation but are not widely accepted in the B.C. market yet. Modular has a place, but it is a small market.
- Passive House is not standard in the building code in Vienna. The efficiency criteria for new building envelopes are quite high. Often the buildings do not have ventilation systems because they are not essential with the way they cool and heat buildings. The system Stuart presented is most likely the method that will be used in Vienna House because it is cost effective. Overheating often comes when people don't want to open windows because of smoke from nearby wildfires or noise considerations. Solar shading features with balconies and blinds in Vienna have been able to keep temperatures down, but for five to ten days a year active cooling would be more comfortable.
- The BC Housing approval process is not conducive to bringing in trades early and is not well set up for prefabrication because of the way the contracts are structured. There is one pilot project exploring integrated project delivery contracts to explore new processes. Lessons learned will be applied to future projects, but Vienna House will not be able to use that approach.
- Design for disassembly is not easily accommodated, but we are slowly improving the circularity aspects, being able to reuse materials. More and more renewable materials are being used for insulation. A life cycle assessment done before the design and construction process can better reveal the impacts of small changes.

Participant Feedback

At the end of the workshop, participants were asked to complete an online survey. There were ten responses (25 per cent response rate).



"Relevant conversations surrounding affordable housing in B.C. and in the expected building process of Vancouver House."

Participants enjoyed the content and found it engaging and informative, however they continued to express dissatisfaction and difficulties with the Adobe Connect platform in a technical capacity.

Key takeaways mentioned by respondents include:

- The differences between the social housing and allocation in Vancouver, contrasted with Vienna
- Prefabrication in B.C. discussion
- BIM distinction
- Types of prefab levels presented by Guido
- Construction types
- Long way to go :-)
- Presentation of and discussion with Guido!
- The barriers to BIM adoption, cost and perception
- Prefab options
- Heating systems

- Passive house approach
- How to bring optimization to industry, incentives needed
- My appreciation for the project grows exponentially with each workshop
- Overview of BC Housing processes
- Prefab. constructions
- BC Housing standards

Participants were also asked to provide suggestions about what they would like to address in future workshops. Responses were:

- How Vienna House will be ensuring accessible design is integrated into common spaces and individual rooms. Will there be any different efforts made in comparison to previous projects in terms of maintenance. Is there a plan in place for how to renovate or upgrade the building later on? Is BIM or RenoBIM included in those plans?
- Livability of the PH environment for the residents - it has been touched on but a deeper dive would be great. Perhaps have someone from an operator of a PH and a resident of a PH share their experiences.
- Research

Appendix 1: Workshop Agenda

IDP Workshop No. 4 Agenda

Thursday March 25, 2021 Vancouver: 8:30 - 11:30 am PDT, Vienna 5:30 - 8:30pm GMT +1

Time	Item	Facilitator
8:30 - 8:35	**Welcome** › Workshop overview › Rules of the road	Helen Goodland **SCIUS** Sarah Radi **Light House**
8:35 - 9:00	**Communications and Outreach Strategy** › Strategy and examples of assets › Discussion	James Glave **Glave Strategies**
9:00 - 9:10	**BC Housing** › Community Housing Fund Program › Approval Process › Design Guidelines and Construction Standards	Melvin Lee and Ren Bai **BC Housing**
9:10 - 9:20	**Design Team Introductions** › PUBLIC Architecture › Consultants	John Wall **PUBLIC**
9:20 - 9:50	**Vienna House Program and Site Conditions** › Comments and Critique from Vienna encouraged › Discussion	Brian Wakelin **PUBLIC**
9:50 - 9:55	**Break**	
9:55 - 10:25	**Passive House - local approach** › Comments and Critique from Vienna encouraged › Discussion	Brian Wakelin and Jamie Hart **PUBLIC**
10:25 - 10:55	**Opportunities and Benefits of Digital Project Delivery and Prefabrication** › Relation to performance (Passive House) and affordability › Discussion	Guido Wimmers **University of Northern BC**
10:55 - 11:30	› **Facilitated Discussion**	Brenda Martens **Light House**

Appendix 2: Participant List

Name	Position / expertise	Organization
Adam Terris	Research Centre	BC Housing
Allahyar Raza	Development Manager	VAHA
Andrew Matterson	Procurement Manager	City of Vancouver
Brenda Martens	Workshop Facilitator	Light House
Brian Wakelin	Architect	PUBLIC
Casey Wickham	Operator/Owner	More Than A Roof
Cindy Moran	Research Centre	BC Housing
Denisa Ionescu	Research Centre	BC Housing
Devarsh Bhonde	Researcher	UBC
Diana Lopez	Researcher	UBC Sustainability
Geraldine Rayner	BIM FM and Digital Hand-over	Summit BIM
Graham Plant	Development Consultant	CPA Development
Guido Wimmers	Integrated Wood Design Program	University of Northern BC
Gustavo Tsay	Researcher	UBC Sustainability
Helen Goodland	Workshop Co-facilitator	SCIUS
James Glave	Communications Specialist	Glave Strategies
Jamie Hart	Architect	PUBLIC
Jieying Wang	Researcher	FPInnovations
Jim Lowood	Contracting Specialist	City of Vancouver
John Wall	Architect	PUBLIC
Kelly Walsh	Documentation and Reporting	SCIUS
Kira Pederson	Energy and Sustainability	BC Housing

Name	Position / expertise	Organization
Kurt Hofstetter	Social Housing	City of Vienna
Lee-Anne Michayluk	Operator/Owner	More Than A Roof
Lynne Embury-Williams	Executive Director	WoodWORKS! BC
Melvin Lee	Development Manager	BC Housing
Michelle Lee	Energy Efficiency	BC Housing
Oliver Sterl	Architect of the Vancouver House in Vienna	Rüdiger Lainer + Partner Architekten ZT GmbH
Pedram Faghani	Technical Manager	WoodWORKS! BC
Puyan Zadeh	Researcher	UBC
Rachel Morse	Documentation	SCIUS
Ren Bai	Project Technician | Construction Services	BC Housing
Robert Drew	Architect	PUBLIC
Robyn Gerry	Development Coordinator	CPA Development
Sarah Radi	Adobe Connect Hosting	Light House
Scott Chatterton	BIM, Digital Strategy	AEOS Consulting
Shagufta Pasta	Organizational Initiatives | Executive Office	BC Housing
Shane O'Neill	Architect	PUBLIC
Stefan Sattler	Energy Efficiency/ Passive House	City of Vienna
Stuart Hood	Engineer	Integral Group

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