The Third Space
ARCHITECTURE

This project takes place on the unceded traditional territories of the xʷməθkʷəy̓əm (Musqueam), Sḵwx̱wú7mesh (Squamish), and səlilwətaɬ (Tsleil-Waututh) Nations.

Contents

Context

The impacts of the global climate crisis become more acute every year. From flash floods to forest fires to earthquakes, these 'unprecedented events' and 'once in a lifetime' disasters are occurring with frightening frequency. This is while resource depletion and geopolitical events are constricting material availability and significantly increasing material costs. Despite this, our carbon consumption continues to increase in face of all the evidence, and public awareness. Our team understands this as a systemic problem, which requires not just focusing on singular metrics such as energy efficiency but viewing it wholistically from total carbon to government infrastructure and settlement patterns. While this is a global crisis, the impacts are experienced locally, and an effective response must be contextualized locally.

Climate

The City of Vancouver has a moderate oceanic climate with warm dry summers contrasted by a rainy season between October and April. Vancouver receives, on average, 161 rainy days per year with 1189 mm – 2477 mm of precipitation per year and receives, on average, only 60 hours of sunshine in December and a total of 1938 hours of sunshine.

Society & Economy

Bounded by mountains and water bodies, Vancouver has the highest population density in Canada with 5,750 people/square kilometer, and an expected population increase of over 250,000 in the next 30 years (Census of Population, 2021). This density and limited land area, along with other systemic issues, contributes to Vancouver being the third least affordable housing market in the world, and the least affordable in North America. For the average Vancouver ownership of a 600 sqft condo is unobtainable let alone a single-family dwelling.

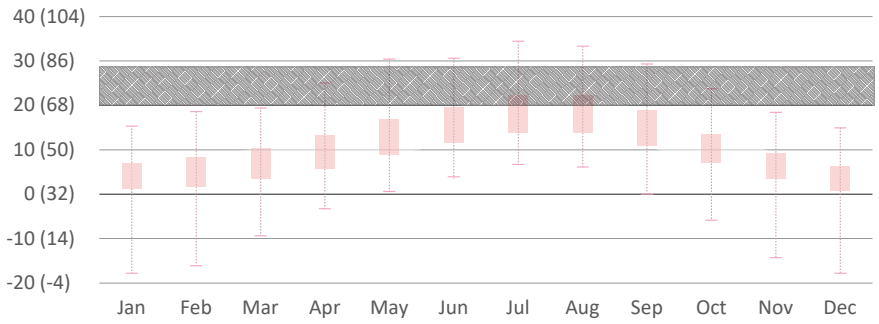


Figure 1- Average Temperature and Maximum

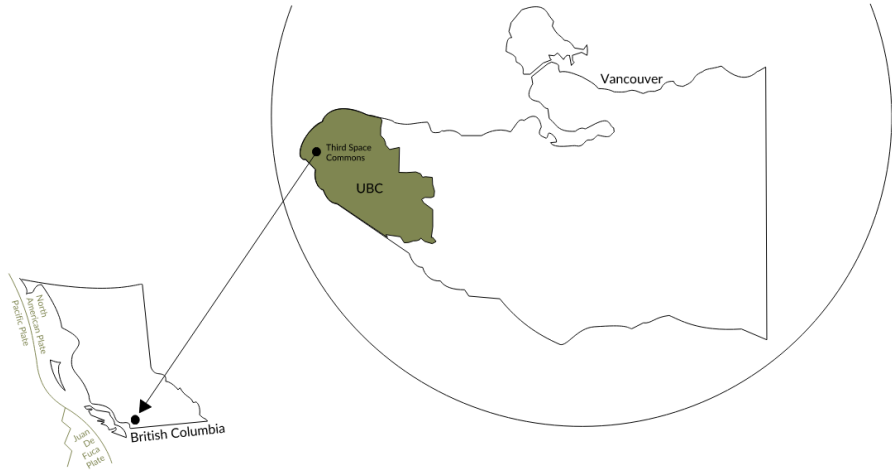
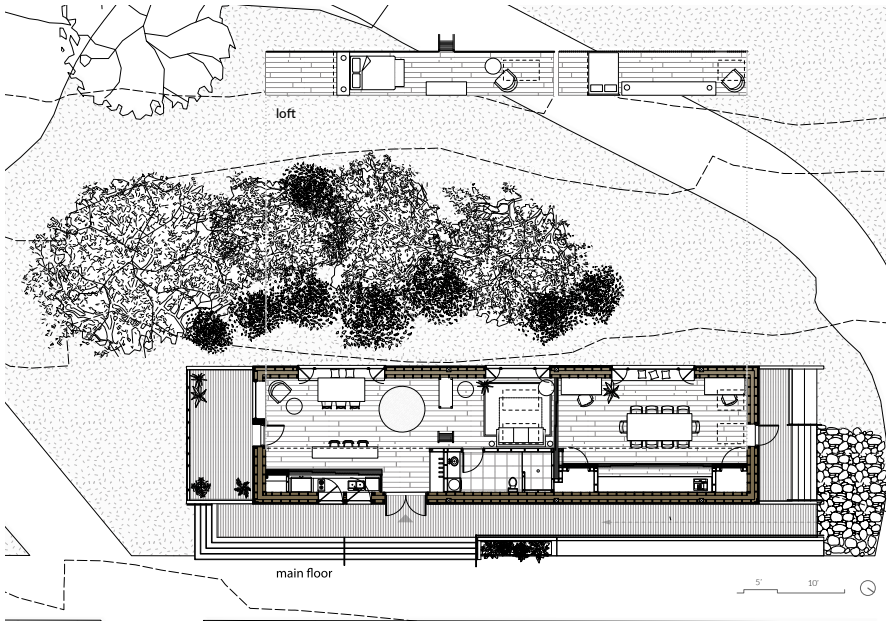


Figure 2- Content map

Adaptable Programming

Our design began with an interesting programmatic challenge due to our recognition that a single-family home is not the sustainable solution for Vancouver, and our resulting plan for an institutional life of the building post competition. Given our carbon minimalism objective, we sough to minimize any renovation post-competition which meant that the space would inherently need to be adaptable and flexible to different uses from seminars to exhibitions to a live-work residential unit. To accomplish this we aligned service spaces, (kitchen, bathroom, closets) along the east wall, anchored by a large service 'bulkhead'. This allowed the west footprint to be open and adaptable with modular furniture, and a singular east-west divide along the valley using reclaimed cedar pocket door partitions, that will serve as future pin-up boards.



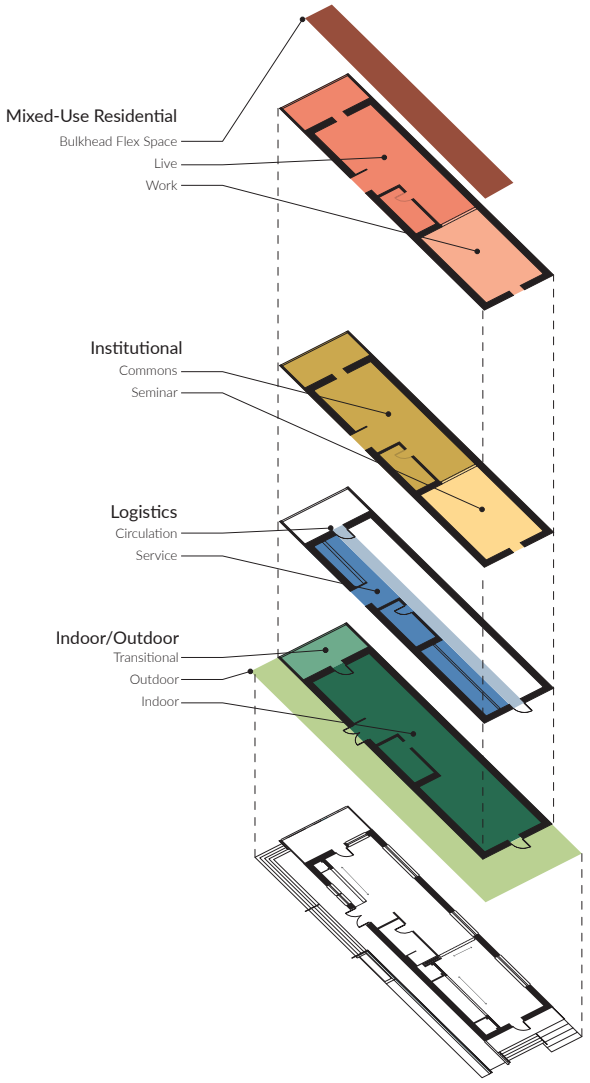


Figure 3- Programming Layers

Speculative Residential Use

As a residential typology this building could take on many different forms due to it's adaptable design, from a single residential unit to a live-work space with lofts to a mirrored two-storey duplex with a rental unit in the north peak.

As residential space, you would enter the private space from the east under an exterior cedar soffit that visually continues into the interior. To the south the kitchen is divided with a slate wall while a north nook clad in cedar invites you to take off your shoes. As you process further into the space you are welcomed into an open space with a large-vaulted ceiling beautiful light quality draws you to 3 operable skylights. Along the west wall large occupiable windows visually expand the space to the vegetation beyond.

As a live-work space the valley partition provides separation from the office or studio that is accessible with a separate north entry (Figure 4). Alternatively the north peak could serve as the 'refuge' space with sleeping areas, or even the addition of stairs to a tree house like bed-room for children (Figure 3 & 5).

Figure 4- North peak 'Refuge' render

Figure 5- Live-Work Section Perspective

Figure 6- Single-Family Section Perspective

Passive System Integration

Given that Third Space is located within a temperate climate, passive performance within the building was prioritized to minimize active system requirements. The site was assessed to optimize for sun paths and seasonal changes. Our building form is a direct response to these elements.

Envelope

To maintain a tight envelope which would reduce heating demand we utilised high R-value assemblies, a low window to wall ratio, and high-performance penetrations. Our hempcrete walls are estimated to provide an R-43 value but will be tested and validated over the building life through sensor data as part of the living lab programming. Cellulose provides an R-58 roof and an R-50 floor. Additionally, thermal bridges were calculated and mitigated with proper detailing.

With a low window to wall ratio, thoughtful window placement was key to our envelope design. Given the winter prevailing winds from the east, we limited penetrations in this direction, while west and south facing penetrations were maximized for passive heating in the winter. Additionally, the sunroom acts as a passive buffer space which allows solar heat gain in the winter. Our windows have a U-value of 0.105.

Rainwater Collection

The sawtooth roof provides ample area for rainwater to be collected and diverted into rainwater storage tanks located on the south-west end of the building. Rainwater that is harvested will be used to water plants in the sunroom and any vegetation planted in future landscaping activities. A greywater system was outside of our scope, but the existing system could be upgraded to include greywater integration in the future.

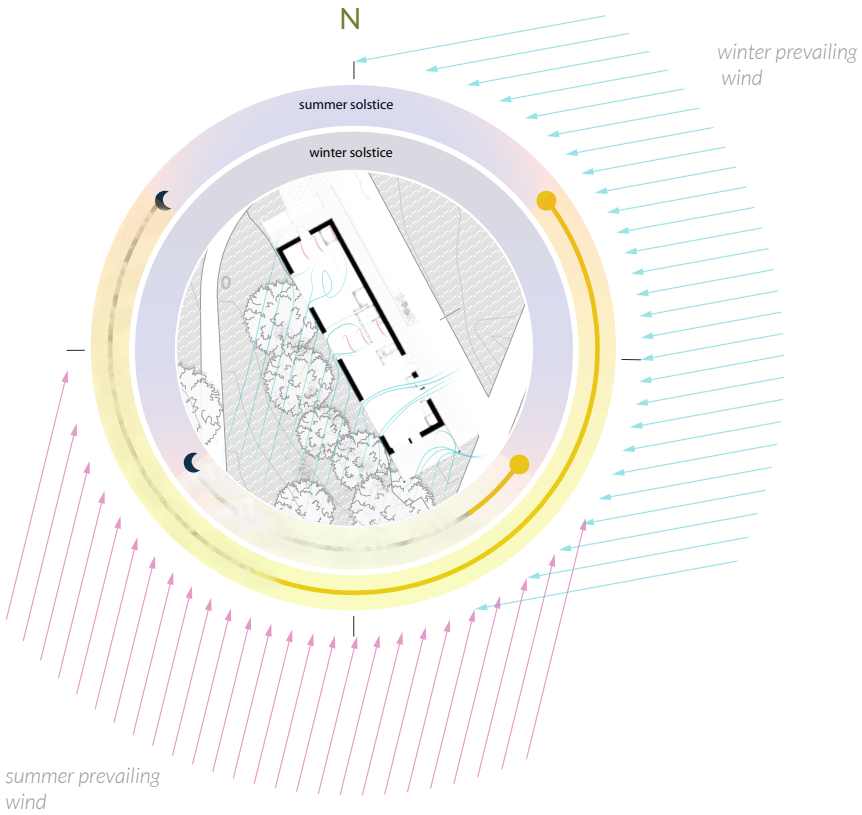


Figure 7- Site Impacts on Passive Design

Natural Cooling

A bright-white roof minimized heat gain to the building surface in the summer to reduce the ambient temperature around the building. We then oriented most of the openings along the south-west side of the building which receives summer wind through the landscaping. This allows the landscaping to act as evaporative biophilia cooling for our natural ventilation. The two openings to the east allow for cross ventilation in the main living area while the operable skylights allow for stack ventilation. The thermal mass provided by the hempcrete allows the enclosure to flush heat and regulate interior temperature at night when the ambient temperature naturally cools.

Daylighting

Our primary daylighting is provided from the north facing skylights with a splayed bottom designed to invite diffused light into the space without summer overheating. In the winter, additional daylighting is provided through the west windows which have deciduous vegetation, and the low sun-angle in the south through the sunroom poly-carbonate roof. Additionally, our surfaces are painted white and our lime render will be tinted white to reflect more light within the space.

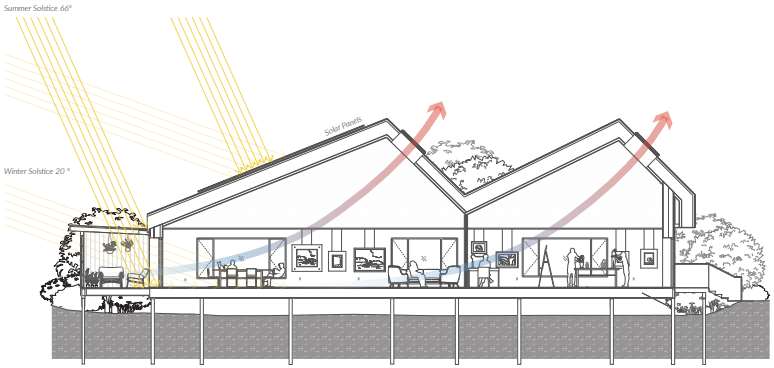


Figure 8- Longitudinal Section Looking West

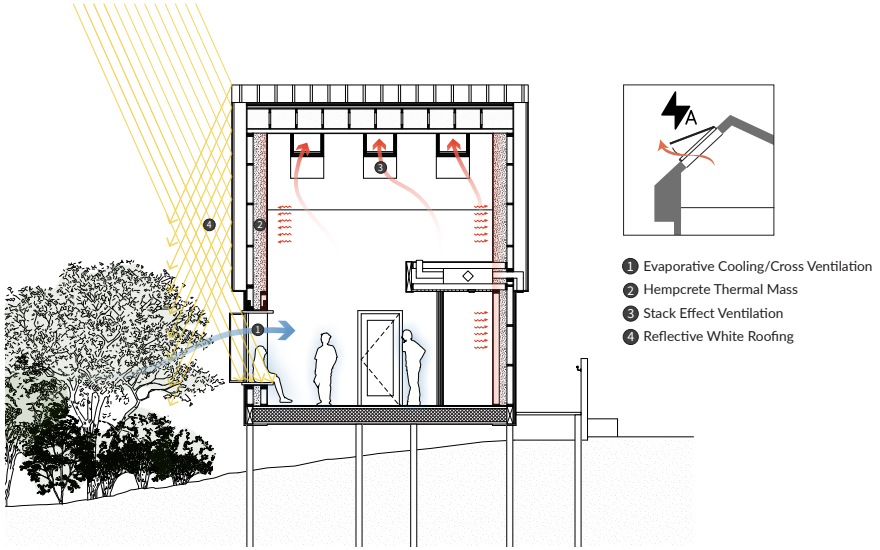


Figure 9- Thermal Comfort- Summer Day

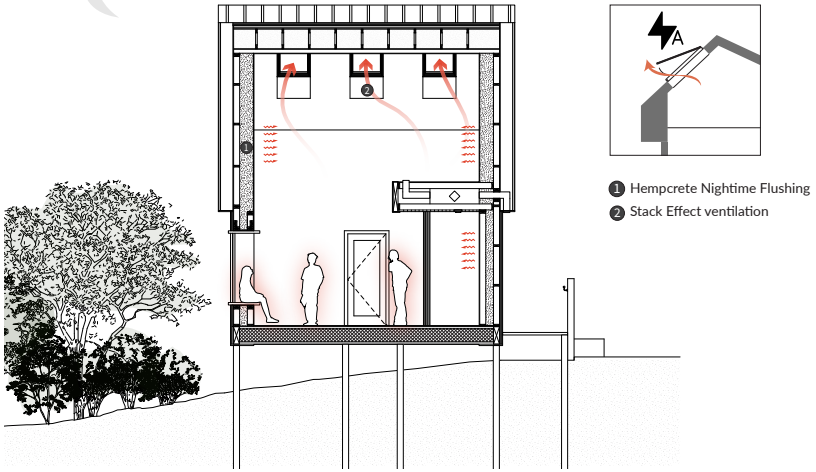


Figure 10- Thermal Comfort- Summer Night

Active System Integration

By integrating the active systems in the building with the architecture, it maximizes occupant comfort.

Solar PV

Our roof form is a response to the demands for balancing passive daylighting with active energy generation through solar. We sloped our roof on the south to optimize the energy generation of our reused solar panels.

Bulkhead

The key architectural feature of our active systems is the service bulkhead that runs along the east portion of the building. This serves as a programmatic, architectural and performative feature of the space. Programmatically it divides space by service areas (service closets, bathroom, and kitchen) and the flexible open program area. Architecturally, it acts as a datum line which brings the service spaces such as the kitchen and bathroom to a comfortable scale and allows for the experience of expansion and contraction as one enters the space. Performatively, with mechanical and electrical services running through the bulkhead, runs through our envelope are limited, protecting our effective R-value while allowing future adaptability. (For example, with future mechanical system testing and plans to possibly retrofit a cooling system this bulkhead means that these retrofits should be simple and without demolition.) This is also accomplished through our decentralized electric radiant floors which ensure comfortable temperatures even in our high-volume space.

Active Lighting

The primary lighting is provided through linear LED lights along the east and west sides, with center lighting provided in the skylights. Additional pot lights are provided in the bulkhead to provide task light within the kitchen, bathroom, and between the mechanical and electrical closets. None of these lights penetrate our air barrier as they are run through the bulkhead or a ceiling chase.

Our lighting was designed to create layers of lighting options that could be adapted to multiple tasks and uses. They are connected to the Home Control Center that our team created which allows the light levels to be set for different uses. When the building will be used for exhibitions, the lights should be able to go up to 800lx like a gallery space, however, for the residential configuration they can be set to a comfortable 300lx.

Figure 11- West Linear Lights

Materiality

The materiality of The Third Space is reflective of our Carbon Minimalism and Passive Design strategies and is intended to highlight these objectives to future occupants. Our material strategy was divided into 3 major material categories: reuse, low carbon, and high performance.

Reused Materials

By understanding the material supply chain as an ecosystem, our primary objective was to use materials which already existed as these would not release new carbon in production and sequester the previous embodied carbon longer by diverting them from landfill. This was realized in two ways; repurposed materials and surplus and/or errors.

Re purposed Materials

To highlight to the potential of repurposed materials we created a glazed mosaic of reclaimed single-pane wood windows along the public-facing south façade. While these could no longer be used within a performative envelope, they allow us to create a buffered greenhouse like space for shoulder seasons.

We also sourced our cedar soffits, cedar paneling, kitchen cabinetry from local home deconstruction while our appliances and furniture were sourced second-hand from local homes and businesses. The moveable partitions are made from reclaimed wood and are fastened together with wood nails.

Surplus and/or Errors

Triple-pane glazing was made available to us because of errors made on local Passive House projects. These glazing units were destined for landfill, allowing us to have high performing glazing while also reducing construction waste somewhere else in the material ecosystem. These windows posed an interesting design challenge of integrating another project's custom components work for our space. This strategy was also used for our engineered wood floors and tiling.

Engineered wood floors are lower embodied carbon than solid wood floors because scrap wood can be used on the unexposed part of the planks, reducing the number of full-size trees that need to be harvested.

Figure 12- Reclaimed Window Sunroom

Low Carbon Materials

Our definition of a 'low-carbon' material is one that minimises the release of carbon early in the supply chain compared to otherwise equivalent alternatives, which led us to using materials with biogenic or recycled content.

HEMPCRETE

Hempcrete, also called hemp lime biocomposite, is a hydrated mixture of hemp hurd, an agricultural by-product, and calcium hydroxide, a mineral product readily available in the Pacific Northwest region. Hempcrete is a carbon minimal material because of the biogenic carbon sequestered by the agricultural hemp and because of the carbon that is sequestered during the carbonation process which starts as it cures and continues for the rest of the building's life. At the demolition stage, hempcrete can be broken up and reused as part of another hempcrete mix or it can be composted, making it low carbon at all stages. The hempcrete in Third Space acts as insulation, thermal mass and interior finish.

The hemp wall will be exposed within the peaks of the building with a lime plaster on the lower 10' to protect it from damage. There is also a demonstration wall featured on the interior east facade between the mechanical and electrical closets to allow for future occupant interaction.

The other strongest low carbon materiality decision was using high density blow-in cellulose instead of alternative insulations such as foam or mineral wool. The cellulose used is made of more than 80% recycled paper products while still providing a generous R-3.7/inch. The choice of cellulose went hand in hand with lightwood trusses for the floor and roof. We used locally sourced lightwood material wherever structurally possible as it is the lowest embodied carbon wood material.
The chosen wood siding is also a low carbon alternative to a fiber cement board that is often favoured in Vancouver's wet climate. The Accoya wood products we used for our siding and decking undergoes an eco-friendly modification process called acetylation which makes it more resistant to water than pressure treated wood.

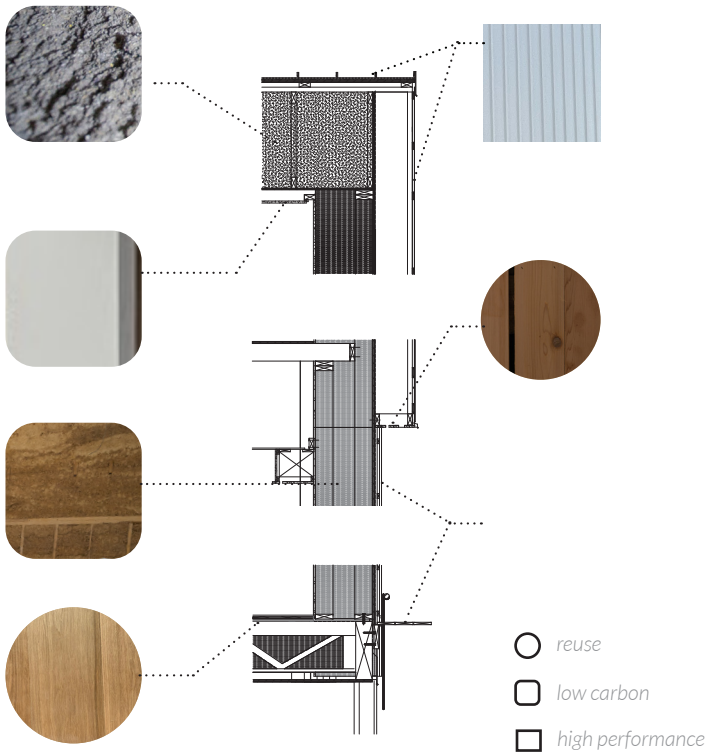


Figure 13- Materiel Envelope

Renders for Future Use

Figure 14- Front Elevation

Figure 15- Center of Commons

Figure 16- Pin-up Space

Figure 17- Seminar/Meeting Configuration

Photographic Appendix