

### Project Summary

The City of Vancouver, like many cities in North America, is experiencing a housing crisis. According to the Canadian Rental Housing Index, 39% of renters in Greater Vancouver spend over 30% of their income on rent and utilities. Of those renters, 18% (105,000 households) are spending over 50% of their monthly income on rent and utilities, deemed by the Canadian Housing Index to be in a housing crisis with increased risk of homelessness. The province has made large investments in affordable housing and is passing several laws to incentivize housing and increase density, including a recent re-zoning bylaw allowing up to 6 units to be built on single-family lots.

In the 1960s, amid an immigration boom, the “Vancouver Special” typology was invented as a way to fit two units on one single-family home lot. Because of their replicability, affordability, constructability, and streamlined approval process, over 10,000 of these houses were built in the Greater Vancouver area. Third Quadrant Design’s proposed project uses one such Vancouver Special as a case study to propose a small-scale densification project. Through renewal rather than demolition, the proposal will provide four housing units with high-performing living spaces, a very high degree of replicability, and low embodied carbon. The project hopes to empower homeowners, first-time home buyers, or non-profit housing providers to become small-scale developers, and add to the urban fabric, rather than relinquish their place in it.

In order to frame our design work, the team came up with four design goals that we carried through all of our decisions:

1. **Affordability & Availability:** We worked to provide equitable housing for immigrants, students and new families in our design. Having four units on one lot provides more affordable options for potential homeowners.
2. **Replicability:** The non-intrusive retrofit design means this densification is accessible to anyone. By designing within bylaws for a Vancouver Special specifically, our design provides a streamlined process for homeowners to accommodate a new market of tenants.
3. **Resilience:** This retrofit improves resilience against extreme climate and seismic risks and thus provide safety and comfort to its occupants. Accommodating for Vancouver’s unique climate was a priority.
4. **Net-Zero:** Our final design goal was to embed net-zero energy and carbon into the design. As a retrofit, we designed our proposal to work with existing systems and provide energy and resources back to the city.

### Design Strategy

We focused on leveraging the strengths of the original Vancouver Special. The flexible layout allows us to propose a structurally and spatially efficient design, with strategic interventions to minimize the embodied emissions of the project. The team explored strategies to enhance envelope performance efficiently and at minimal cost, which is coupled with an HVAC system retrofit. Electrical design efficiency tactics such as energy-efficient lighting, smart controls and smart building devices was also explored. The result is a new, highly replicable housing archetype targeting net-negative carbon emissions over its lifetime.

### Project Data

- △ Location: Vancouver, BC, Canada.
- △ Climate Zone: 4C.
- △ Lot Size: 4026 sf.
- △ Building Size: 2552 sf.
- △ Occupancy: 10 people (255 sf/person).
- △ Construction Cost: \$182.58/sf.
- △ Energy Performance:
  - HERS without PV: 41.
  - HERS with PV: -26.
- △ Average Utility Cost: \$251.52/month.
- △ Annual Carbon Emissions: 0 tCO<sub>2</sub>e/sf/yr.

### Technical

- △ R Values:
  - Wall: R-42.
  - Foundation: R-21.
  - Roof: R-52.
  - Windows: U-0.2.
- △ HVAC:
  - ASHP with VRF system.
  - Decentralized HRVs fitted with MERV-13 filter.
- △ On- Site PV: 18.2 kW panels

### Partners

- △ Dialog, Third Space, City of Vancouver, Stantec, WSP, Pontem Group.



## **Architecture**

The Vancouver Special Housing typology is an architectural expression of Vancouver's bylaws and the population increase in the 1960s to 1980s. Our architecture proposal aims to retrofit a Vancouver Special home in response to new legislation that densifies single family residential lots. The design would maintain the original character of the Vancouver Special, while updating it to meet housing and environmental requirements of the 21st century. To achieve this, we will maintain and enhance the two-floor arrangement and bisecting wall that are common features of the Vancouver Special House, adding two extra units. Additionally, by converting existing stairs at the front entrance into a shared foyer, our design will welcome front-to-back access for each unit, activating front and back yards as communal space. Our design proposal will demonstrate replicable strategies and interventions across the thousands of Vancouver Specials in the city, highlighting the value and versatility of existing housing stock in Vancouver.

## **Engineering**

The structure prioritizes seismic resilience by using Simpson Strong Tie hold downs for wall-to-roof and wall-to-floor anchorage. Domestic hot water and space heating is provided using air source heat pumps, while rainwater is harvested and reused as grey water for toilets and irrigation. The electrical system incorporates solar power, occupancy sensors, and daylight harvesting for maximum energy efficiency and providing a backup power source.

## **Envelope**

Similar to any other building renewal, upgrading the envelope was a primary focus towards achieving a net-zero energy target. In our case, the challenge was to design an easily replicable, high-performing envelope which can be installed efficiently at a low cost. The existing envelope performance was improved with cavity insulation, and continuous insulation was added to the exterior to provide a layer with no thermal break and upgrade cladding systems.

## **Efficiency**

Given the climate of the site, the overall project efficiency relies mainly on achieving high efficiency in space and water heating through air source heat pumps and a variable refrigerant flow distribution system. All appliances and plumbing fixtures were also selected with efficiency in mind, using Energy Star and WaterSense guidelines.

## **Grid-Interactivity**

The Vancouver Special 2.0 uses photovoltaic panels to fully offset the project's electrical demand and provide resilience against grid failures. The significant energy surplus provided by the panels feeds back into the BC Hydro electric grid through the net-metering program and provides energy for potential expansions, EV chargers, or other applications.

## **Life-Cycle**

A life cycle assessment evaluated the building's environmental impact. Significant reductions were identified when compared to an equivalent new build. Materials were selected to lower embodied impacts, but also to prioritize wide availability and ease of use. Trade-offs were considered to ensure the project achieves net-positive emissions within the building's lifetime.

## **Health**

Our design is characterized by sustainable construction practices and design strategies, which significantly enhance the health and quality of life for occupants. We integrated low-emission materials, efficient ventilation systems, and smart technologies to achieve superior indoor air quality, energy efficiency, low environmental impact, and safety. In addition to acoustical design strategies, we prioritized considerations for daylighting harvesting and views, enhancing the aesthetic and architecture, and ultimately contributing to mental well-being of residents and neighborhood.

## **Market**

Our Vancouver Special 2.0 benefits both people in need of a home and homeowners burdened with mortgages. Combining the replicability of our design and the availability of Vancouver Specials across the city, we have the potential to increase the housing supply significantly. The City's "Vancouver Plan" is a long-term strategy that includes goals for densification in the next 30 years. In liaison with the Planning Department at the municipality, we were affirmed that our design vision is well-aligned with the objectives of the Vancouver Plan.

## **Community**

In a local context, target occupants including students, professionals and small families will benefit from living in the Sunset Neighbourhood because of its local amenities including walkability, public transportation, and public facilities. Within the design, a sense of community will be fostered among residents through communal areas and shared garden spaces. On a larger scale, the replicability and affordability of our design will provide equitable and sustainable housing for the population, and citizen-developer options for homeowners to alleviate financial stress.