Achieving Step-Code:
A High Performance Single Family Spec Home

Regional District Central Kootenay

Regional District of Kootenay Boundary

STEP CODE 5 EXCEEDED

This home meets the Step 5 requirements based on airtightness, low thermal energy demand intensity (TEDI) and low mechanical energy use intensity (MEUI).

KEY BENEFITS

This speculative (spec) build uses the inherent insulating and airtightness characteristics of ICF allowing this home to reach Step 5 with minimal building additions. The high-performance envelope, combined with efficient mechanical systems, focuses the building construction on elements which will provide the greatest impact to the finished home.

BUILDING SYSTEMS

Space Heating and Cooling	In-floor radiant heating and cooling provided by an Air-to-Water heat pump (ASHP)
Mechanical Ventilation	Energy-Recovery-Ventilator (ERV) with a ground source loop to pre-condition outdoor air
Domestic Hot Water Heating	Electric resistance water heating tank with supplemental storage tank
Glazing	Triple-pane, Low-E, argon filled windows with uPVC frames, 19.3% fenestration-door-to-wall ratio
Foundation	4″ insulated concrete slab on grade and reinforced ICF foundation wall

BUILDING TYPE
Single Detached Family Dwelling

LOCATION
Nelson, BC

ORIENTATION
Northeast Facing
(solar panels oriented south)

CLIMATE ZONE
5

SIZE, FLOORS
1,990 ft^2 / 148.8 m^2 – 2 Floors

YEAR BUILT
2022

ROOMS
3 Bed / 3 Bath

KEY FEATURES

Uses insulated concrete form (ICF) construction to provide an extremely efficient and long-lasting home with a major focus on indoor environment quality and occupant comfort.

Architectural details:

- Open kitchen and large living room on the main floor to maximize living space.
- Radiant floor heating and cooling uses the thermal mass of concrete floor slab to improve occupant comfort.
- Second floor master bedroom with ensuite washroom and deck access.
- Covered carport and second floor outdoor deck on southern exposure.

ESTIMATED COSTS

Total build cost:
\$540,000 (\$271/ft^2)

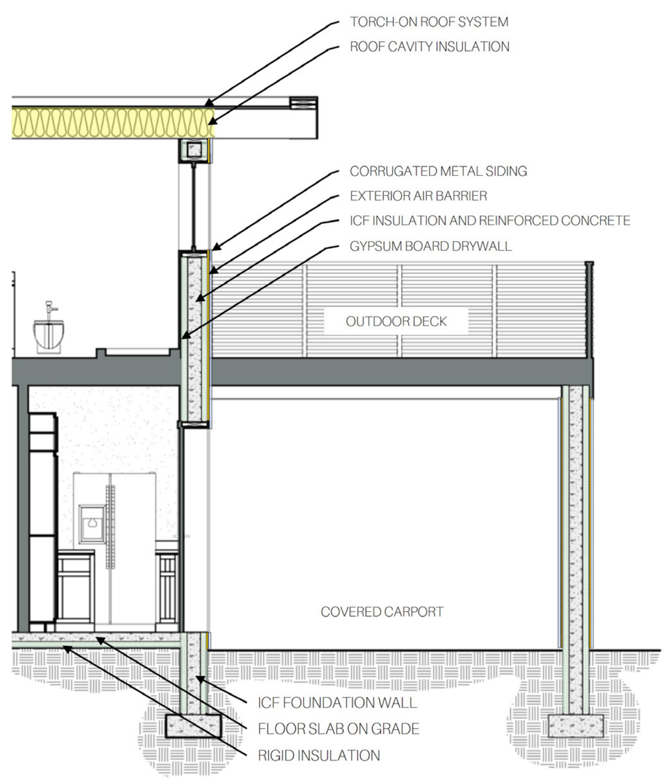
Step Code cost premium:
Somerson Homes has been building exclusively to Step 5 to 4+ years. As a result, a cost premium could not be provided.

Modelled annual energy cost:
\$1,520

Building Envelope

CEILING DETAILS	
Roofing System	Torch-On near flat roof system
Roof Underlay	1/2″ plywood
Framing	Prefabricated engineered trusses @ 19.2″ on-centre (OC)
Insulation	R-60 cavity insulation
EXTERIOR WALL DETAILS	
Cladding	7/8″ corrugated metal siding
Air Barrier	6 mil poly (ICF wall)
Exterior Insulation	2 5/8″ rigid insulation (ICF wall)
Cavity	6″ or 8″ reinforced concrete (ICF wall)
Interior Insulation	2 5/8″ rigid insulation (ICF wall)
Interior Finish	1/2″ gypsum board drywall
FLOOR AND FOUNDATION DETAILS	
Floor Slab and Insulation	4″ reinforced concrete slab with 4″ expanded polystyrene (EPS) rigid insulation
Foundation Wall	6″or 8″ reinforced ICF concrete

TYPICAL WALL SECTION



Air-to-Water heat pump (AWHP) outdoor unit providing heating and cooling to the building.

In-floor radiant heating and cooling system, supplied by the AWHP, utilizing the inherent thermal mass of the building.

7.7 kW rooftop solar photovoltaic array connected to a grid tie-in for net metering.

Increased roof overhangs provide shading to reduce heat gain through the windows in the summer months, improving occupant comfort.

Balancing Design + Efficiency

When prioritizing architectural and mechanical design considerations of a spec built home, it can be important to balance different aspects which go in to designing a desirable home while also considering energy efficiency.

This home is an example of prioritizing envelope quality and mechanical system performance in a spec build. Upgraded mechanical systems such as ventilation improve the indoor environment and save energy costs for homeowners.

Installation of a 7.7 kW rooftop solar array further reduces the home's energy use. The solar array is able to provide energy to the home as well as dispatching energy back to the electrical grid when generated power exceeds the electrical load of the home by using a net metered grid connection.

Builder's insights

"When we build these homes I want to have confidence that the work we have done is high quality and I'm proud of it, so we balance that with the financial aspects of the project. As you come to know the product you can bring costs down through improved techniques, minimizing wastage and time saving. I also feel that the market knowledge will catch up and appreciate the returns of a high efficiency house."

Jeb Whiteside – Somerson Homes

Tips for success

Prioritize High Performance Ventilation

The importance of mechanical ventilation in a home increases as the envelope becomes more airtight. When building to Step 5 the builder emphasizes the importance of a high-efficiency ERV to provide outdoor air while minimizing heating and cooling load. In this house, the ventilation air stream is also pre-conditioned by a ground source loop for further energy savings.

Consider Window Performance

When working with a house with a significant southern aspect exposure it was important to consider summer heat gain, particularly solar gain through the building's windows. Selecting high efficiency triple-glazed windows and increasing overhang on the building's southern aspect helped reduce the impact of solar gain and improve the building's cooling performance.

Apply Lessons Learned

When working with any new building technique or material there are valuable lessons. With familiarity and experience builders can improve efficiency, eliminate material waste and reduce overall project cost. In this case there were specific building lessons learned to improve the process of ICF construction. Refining building techniques, improving scheduling and designing the homes around the dimensions of the ICF material have all improved construction efficiency.

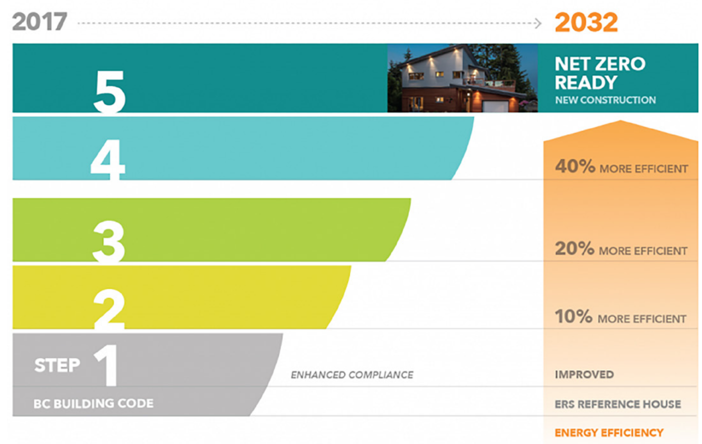
> "Ventilation is one of the biggest things. You're going to have an airtight home if you want the building to perform, so the ventilation system provides the air you're breathing."
>
> JEB WHITESIDE – SOMERSON HOMES

The building's Energy Recovery Ventilator (ERV) unit which provides fresh air and heat recovery to maximize energy efficiency.

ENERGY ASSESSMENT RESULTS

PERFORMANCE CATEGORY AND METRIC	TARGET (STEP 5)	ACHIEVED (STEP 5)
Building Equipment and Systems Compliance Metric: Mechanical Energy Use Intensity (MEUI)	45 kWh/(m²·yr)	33 kWh/(m²·yr)
Building Envelope Compliance Metric: Thermal Energy Demand Intensity (TEDI)	20 kWh/(m²·yr)	16 kWh/(m²·yr)
Airtightness Compliance Metric: Air Changes per Hour at 50 Pa (ACH@50PA)	1.0 ACH	0.53 ACH
Energy Use Reduction vs. EnerGuide Reference House		58%
Annual Energy Consumption (Estimated from Energy Model)	Electricity	12,200 kWh
	Natural Gas	None

ENERGY STEPCODE
BUILDING BEYOND THE STANDARD



Mechanical Energy Use Intensity (MEUI) is the sum of energy used for space heating, cooling, domestic hot water and ventilation. Measured per square metre of heated floor area per year. – kWh/m²/yr

Thermal Energy Demand Intensity (TEDI) is the annual heat energy needed after accounting for internal heat gain and solar heat gain. Measured per square metre of heated floor area per year. – kWh/m²/yr

Air Changes Per Hour (ACH@50Pa) is the metric used for blower door airtightness testing. Measured per hour at a 50 Pascal pressure differential.

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