Achieving Step-Code:
Comfortable, cost effective traditional framed single family dwelling

Regional District of Kootenay Boundary

STEP CODE 4 EXCEEDED
This home is 42% more efficient than 2018 BC Building Code (exceeding the requirement for Step Code 4 by an additional 2%).

KEY BENEFITS
The construction process was completed with minimal cost premiums or disruptions. Since moving into their new home, the homeowners have been enjoying noticeably lower energy bills and increased comfort of in-floor heating.

BUILDING SYSTEMS

Space Heating and Cooling	Air-Source heat pump (ASHP): 2 outdoor unit and 4 indoor units, providing both heating and cooling. Additional heating by natural gas combi-boiler radiant in-floor heating. Backup heating by 2 natural gas fireplaces (requested by homeowner).
Mechanical Ventilation	Heat-Recovery-Ventilator (HRV)
Water Heating	High-efficiency natural gas combi-boiler also provides water heating to a domestic hot water storage tank.
Glazing	Triple-pane, Low-E, argon filled windows, 18.7% fenestration-door-to-wall ratio
Foundation	Slab on grade, 4" extruded polystyrene (XPS) insulation underneath

BUILDING TYPE
Traditional Framed Single Family Detached Dwelling

LOCATION
Grand Forks, BC

ORIENTATION
West Facing

CLIMATE ZONE
5

SIZE, FLOORS
2,450 ft^2 / 228 m^2 - 1 floor

YEAR BUILT
2021

ROOMS
3 Bed / 2 Bath / 3-Car Garage

KEY FEATURES
Single family home designed with occupant comfort and energy adaptability at the forefront of the design process.

Architectural details:

- Open kitchen, dining room and living areas connect the master bedroom and two secondary rooms.
- Covered patios on east and west aspects.
- Large arched windows on the east and west aspects provide natural light and views of the surrounding property for occupants.

ESTIMATED COSTS

Total build cost:
$650,000 ($265/ft^2)

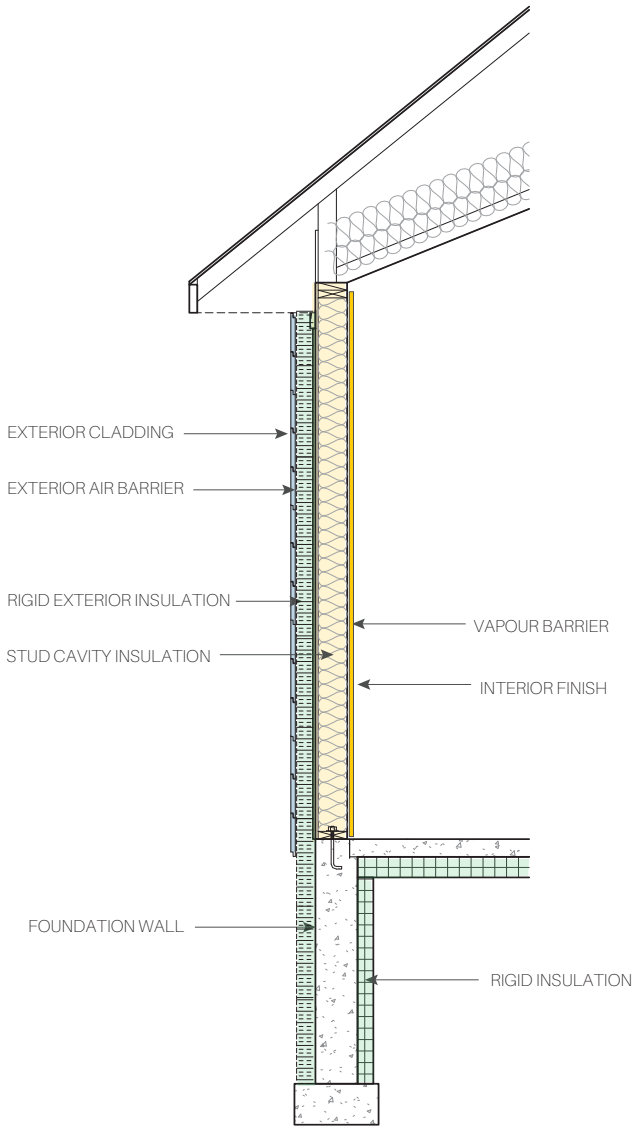
Step Code cost premium:
Approx. $25,000 (4%) over a traditionally built house

Estimated annual energy cost:
$1,300

Building Envelope

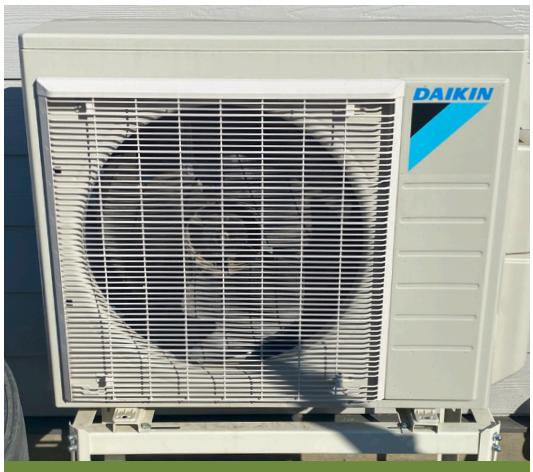
CEILING DETAILS	
Roofing System	Asphalt shingles with 10:12 slope and synthetic underlayment
Air Barrier	1/2″ roof sheathing with self-sealing roof membrane
Framing	High heel engineered roof trusses @ 24″ on-centre (OC) (2x4 Cord with R12 Batting Insulation)
Insulation	R-50 blow-in cellulose insulation
Vapour Barrier	6mil poly vapour barrier
Interior Finish	5/8″ gypsum board
EXTERIOR WALL DETAILS	
Cladding	Hardie wall siding panels with exterior air film and 3/8″ capillary break rainscreen
Exterior Wall Insulation	R-12 1 1/2″ ROCKWOOL® comfortboard rigid insulation
Air Barrier	1/2″ plywood wall sheathing, TYPAR® building wrap
Stud Cavity Insulation	R-24 ROCKWOOL® batt insulation
Framing	2″ x 6″ @ 24″ OC
Vapour Barrier	Two layer 6mil poly vapour barrier
Interior Finish	1/2″ gypsum board drywall with interior air film
FLOOR AND FOUNDATION DETAILS	
Floor Slab and Insulation	5″ concrete slab with interior air films, 6 mm poly vapour barrier and 4″ R-16 extruded polystyrene (XPS) rigid insulation
Foundation Wall	8″ concrete with R-16 3″ extruded polystyrene (XPS) insulation

TYPICAL WALL SECTION



Mechanical room showing underfloor heating piping, HRV unit and backup gas boiler.

Wall penetration detail with additional ROCKWOOL® insulation to mitigate impacts of air leakage and thermal bridging.



Daikin Air-Source heat pump providing heating and cooling via four interior fan coil units.

Added exterior wall insulation as visible during construction.

Balancing Design + Efficiency

When finalizing architectural and mechanical design considerations, often traditional Owner 'wants' will have an impact on energy efficiency and mechanical system costs or performance trade-offs, particularly when trying to achieve Step Code Requirements:

- The client desired gas-fired in-floor radiant heating, a gas range and gas fireplaces. This gas-fired equipment detracted from overall building efficiency and performance. To meet Step Code it was important to offset this with additional exterior insulation and triple glazed windows.
- The builder found it was important to convey the increased comfort and financial savings realized by upgrading the building envelope at minimal cost when compared to the overall project. Ultimately, the improvements in insulation helped to achieve the Step 4 energy consumption reduction of 40% over 2018 building code, despite a higher Thermal Energy Demand Intensity.

Builder's insights

"My strategy with clients is to explain how Step Code can help the client save money on their energy bills while increasing their home's comfort level. I approached the client with the estimated incremental costs for things like exterior insulation and upgraded windows to reach Step 4. When viewed as a percentage of total costs, they wanted to move ahead with it."

Stephen Danshin - MSC Enterprises Ltd.

Tips for success

Education and accountability
Builder education on modern codes, standards and best building practices allow for effective design, material and equipment choices. Courses such as those delivered by BC Housing allow the builder to provide value and education to homeowners seeking energy efficient homes.

Proactive attention to detail
Details really do matter. Airtightness needs to be a consideration from the very beginning for the whole team. There is value to having trades on site for pressure testing to see what construction elements may be causing air leakage issues and loss of efficiency.

Building for the future
Areas which do not currently include Step Code or other efficiency benchmarks in local building requirements should anticipate these standards becoming more widespread in coming years.

"I've been taking the initiative on promoting Step Code. As a builder I knew that in the coming years to it was going to become mandatory. We are trying to stay ahead of the industry and provide a quality product that keeps clients happy."

STEPHEN DANSHIN - MSC ENTERPRISES LTD.

> “What stands out to me about working with Step Code is just the attention to detail required. It’s how I was brought up and taught that way. It was what ultimately led me to working with custom homes. If simplified and applied to each step during the build process, it saves time, money, and makes the job much easier.”
>
> **STEPHEN DANSHIN - MSC ENTERPRISES LTD.**

ENERGY ASSESSMENT RESULTS

PERFORMANCE CATEGORY AND METRIC	TARGET (STEP 4)	ACHIEVED (STEP 4)
Building Equipment and Systems Compliance Metric: Mechanical Energy Use Intensity (MEUI)	55 kWh/(m²·yr)	49 kWh/(m²·yr)
Building Envelope Compliance Metric: Envelope Improvement vs. Reference House	20%	37%
Airtightness Compliance Metric: Air Changes per Hour at 50 Pa (ACH@50PA)	1.5 ACH	1.5 ACH
Energy Use Reduction vs. EnerGuide Reference House		42%
Annual Energy Consumption (Estimated from Energy Model)	Electricity	11,600 kWh
	Natural Gas	11.65 GJ

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.

ACKNOWLEDGEMENTS

Builder	MSC Enterprises Ltd. mscenterprises.ca
Designer	Winton Homes and Cottages wintonhomes.ca
Energy Advisor	3 West Building Energy Consultants Inc. 3westbec.com

CONTACT US

Regional District of Central Kootenay

1-800-268-7325
info@rdck.bc.ca
Box 590, 202 Lakeside Drive
Nelson, BC V1L 5R4
rdck.ca

Regional District of Kootenay Boundary

1-800-355-7352
info@rdkb.com
202 – 843 Rossland Ave
Trail, BC V1R 4S8
rdkb.com

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