

Technical Appendix – Building Science & Performance Overview

Arkell Village Deep Energy Retrofit

This home was renovated using high-performance building principles that treat the house as a complete system. The focus was placed first on the **building envelope**, followed by mechanical ventilation, durability, and indoor environmental quality.

Building Envelope Strategy

- Envelope-first approach prioritizing insulation continuity, airtightness, and thermal bridge elimination
- Exterior walls and roof rebuilt with **thick, continuous insulation assemblies** using mineral wool
- Continuous air barrier and weather-resistive barrier installed and detailed across walls and roof
- Rainscreen wall assembly providing drainage, drying potential, and extended cladding lifespan
- Roof assembly rebuilt and insulated to modern high-performance standards

Insulation & Thermal Performance

- **Exterior wall assemblies:**
 - 2x8 structural framing fully insulated with mineral wool (approx. **R28**)
 - Additional **4.5" continuous exterior mineral wool insulation (approx. R18)**
 - **Total effective wall insulation: approximately R46**
 - Significantly exceeds typical residential construction standards and is roughly **double the effective insulation of conventional code-built homes**
- **Roof assemblies:**
 - 2x8 roof rafters fully insulated with mineral wool (approx. **R28**)
 - Additional **4.5" continuous exterior mineral wool insulation (approx. R18)**
 - **Total effective roof insulation: approximately R46**
 - Continuous exterior insulation reduces thermal bridging and improves year-round comfort

- Multiple staggered layers of exterior insulation used to minimize thermal bridging
- Warm, dry structural assemblies designed to reduce condensation risk and material fatigue
- Consistent interior surface temperatures throughout the home

Airtightness & Moisture Management

- Fully sealed air control layer across the entire building enclosure
- Carefully detailed penetrations, window interfaces, and transitions
- Reduced air leakage improves comfort, durability, and energy efficiency
- Assemblies designed to dry outward and manage seasonal moisture loads

Windows & Doors

- European triple-pane tilt/turn windows and doors
- High solar performance, excellent airtightness, and superior acoustic control
- Deep window installations aligned with insulation layer for thermal continuity
- Significant reduction in exterior noise transmission

Ventilation & Indoor Air Quality

- Mechanical ventilation system with energy recovery (ERV)
- Continuous supply of fresh, filtered air to living spaces
- Improved indoor air quality, humidity control, and occupant comfort
- Reduced reliance on window opening for ventilation

Acoustic Performance

- Thick wall assemblies, airtight construction, and triple-pane glazing deliver exceptional sound attenuation
- Interior environment remains quiet and calm despite proximity to traffic and village activity

Energy Performance

- Dramatically reduced heating and cooling loads compared to conventional renovations
- Lower operational energy costs and reduced environmental impact

- High-performance envelope minimizes temperature swings and cold spots

Durability & Longevity

- Assemblies designed to stay warm, dry, and stable year-round
- Reduced thermal cycling minimizes expansion and contraction stresses
- Improved moisture control protects structure and finishes
- Home designed to perform reliably for generations, not just decades

Design Intent

While not formally certified, the renovation closely aligns with **Passive House–inspired principles**, including:

- Continuous insulation
- Airtight construction
- High-performance windows
- Mechanical ventilation with heat recovery
- Minimized thermal bridging

The result is a home that delivers **measurable performance benefits** — comfort, quiet, health, durability, and efficiency — while preserving architectural character and design integrity.