Guelph Deep Energy Retrofit

Sensitive renovation bridges gap between energy-efficient construction and affordability

1

By Christine Lolley

The vision of a car-free and sustainable lifestyle led the owners to an empty home in Guelph for its charm, walkability, and easy rail-link to Toronto. Originally, they assumed they would build new, but later realized that renovating was the best way to keep costs and environmental impact low. Previously province-owned council housing, the century-old bungalow was unused for years and is now one of the city's most efficient homes.

Three principles guided the design:

1) Restore the original (smaller) building footprint;
2) Preserve the exterior character of the home; and
3) Create a highly energy-efficient, low-impact building envelope.

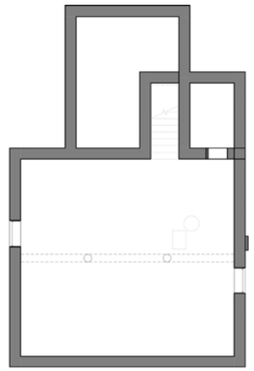
1. The owners wanted to keep things simple, preserve the building's original shape and character, and conserve materials and costs.
2. View from the kitchen/dining area back to the front door, and past the half-wall separation of the basement stair. Typically considered inefficient, baseboard heating in this case was low-cost to install, and very efficient thanks to the extremely efficient building envelope. All interior doors supplied by **Masonite Architectural.**

A key decision for this project was to create such an efficient, air-tight envelope that non-renewable resources weren't a necessity. The homeowners wanted to keep both construction and operating costs low, so active systems are solely electric.

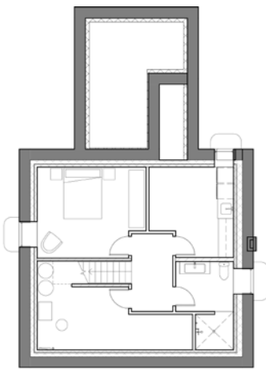
The design implements passive solar techniques to maximize daylighting, passive heat gain, and passive cooling. This is especially evident in the Great Room's new larger southern windows and rear French doors. 100% of the floor space is within seven metres of a window, and there are at least two windows in every room.

To promote natural ventilation, all windows are operable with tilt and turn capability. During inclement weather, an efficient Energy Recovery Ventilator (ERV) provides mechanical ventilation.

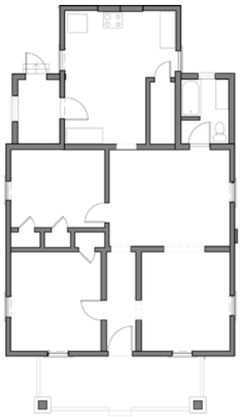
The floor plan corresponds with the flow of use, creating an effortless living environment. Lots of natural light and a centrally-located common area create serenity and intimacy. The basement was underpinned to allow for higher ceilings, and to accommodate a comfortable guest bedroom and full bathroom. The kitchen cabinetry is made with low-VOC and nontoxic materials. Constructed largely of high-quality materials that were easily accessible and found in Guelph, the house is built to last for decades.



Basement, pre-renovation



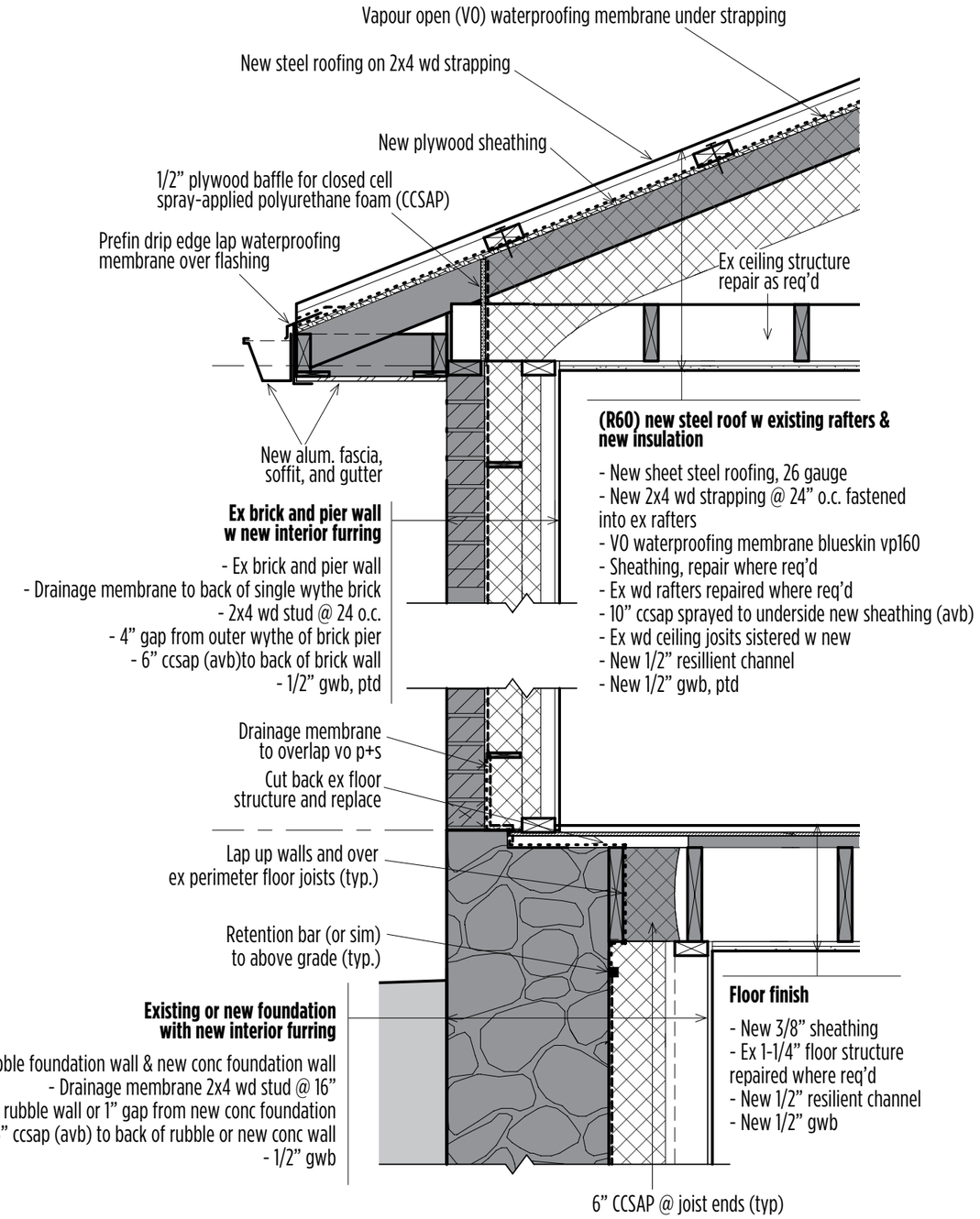
Basement, renovated



Main Floor, pre-renovation

Main Floor, renovated

2



Typical wall section

The structure of the house is called "Brick and Pier", an old style of construction typical to Guelph. It comprises one wythe of brick with a double-wythe pier at 4 ft. intervals. The brick on the interior was furred with 2x4 framing offset from the piers by 1", then spray foam insulation was applied to the inside face of the brick, behind and between the studs. The ceiling joists were replaced because partition walls were moved on the main floor. The roof rafters were left intact with spray foam applied to the underside of the roof sheathing.

PROJECT CREDITS
Architect: Solares Architecture Inc
Structural Engineer: Moses Structural Engineer
Mechanical Engineer: ReNu Building Science
General Contractor: Evolve Builders Group
Photos: Derek Monson

PROJECT PERFORMANCE
EnerGuide Rating: 82
Walk Score: 72
Air Tightness: 1.3ACH@50pa

3. Age-in-place considerations were incorporated by placing all of the living spaces on the ground floor, with a compact design that maintains the feeling of openness.


3

The sloped steel roofing guides rainwater to the two rear corners of the house, allowing for grey-water collection and irrigation systems to be installed with ease in the future when budget allows. Steel roofing material was chosen because it collects much less aggregate than conventional roof shingles, which keeps collected rainwater as pure as possible. All shower heads, faucets, and plumbing systems are low-flow units.

The structure is conventional stick framing, with six inches of Insulthane spray foam insulation in the walls. The Insulthane product by Elastochem has an ultra-low global warming potential of 1.0, nearly unheard of in spray foam products. The highly insulated home has R-values of R35 in the walls, R20 in the basement slab, and R60 in the roof.

Air-tightness was achieved by performing multiple blower door tests throughout the construction process so that all air leaks were found and sealed before drywall installation. The final test revealed an air change rate of only 1.3ACH@50pa.

Baseboard heating, though unconventional in a sustainable home, was the most effective choice for this project given that the efficient, air-tight building envelope drastically minimizes energy loss.

The ability of Evolve Builders to generate precisely accurate cost models for each architectural iteration or energy model proposition disproved its own anecdotal sense that an air source heat pump (ASHP) would have a better payback over a 25-year term than electric baseboard heaters. An ASHP would have a better carbon outcome but the baseboards, each with individual room thermostat control, reduced construction and operating cost, and eliminated fossil fuel use. Evolve's accurate costing for both scenarios permitted the owners to make decisions that were right for them.

Air conditioning is provided by a highly efficient Fujitsu air source heat pump, made affordable by the former GreenON rebate program. The equipment complements the home's passive solar design and natural ventilation, keeping the house cool on the hottest summer days.

Energy consumption data for 2017, 2018 and 2019 of 12,822 kWh, 13,362 kWh and 11,216 kWh per year, respectively, shows that the house uses only half the energy of the average Ontario household.

Described as the city's most energy efficient home, the Guelph Deep Energy Retrofit is garnering attention for its success at bridging the perceived gap between energy-efficient home construction and affordability.

Christine Lolley is a principal at Solares Architecture Inc.