Village context

Shared garden patio

Electric vehicle charging

Project Description & Goals:

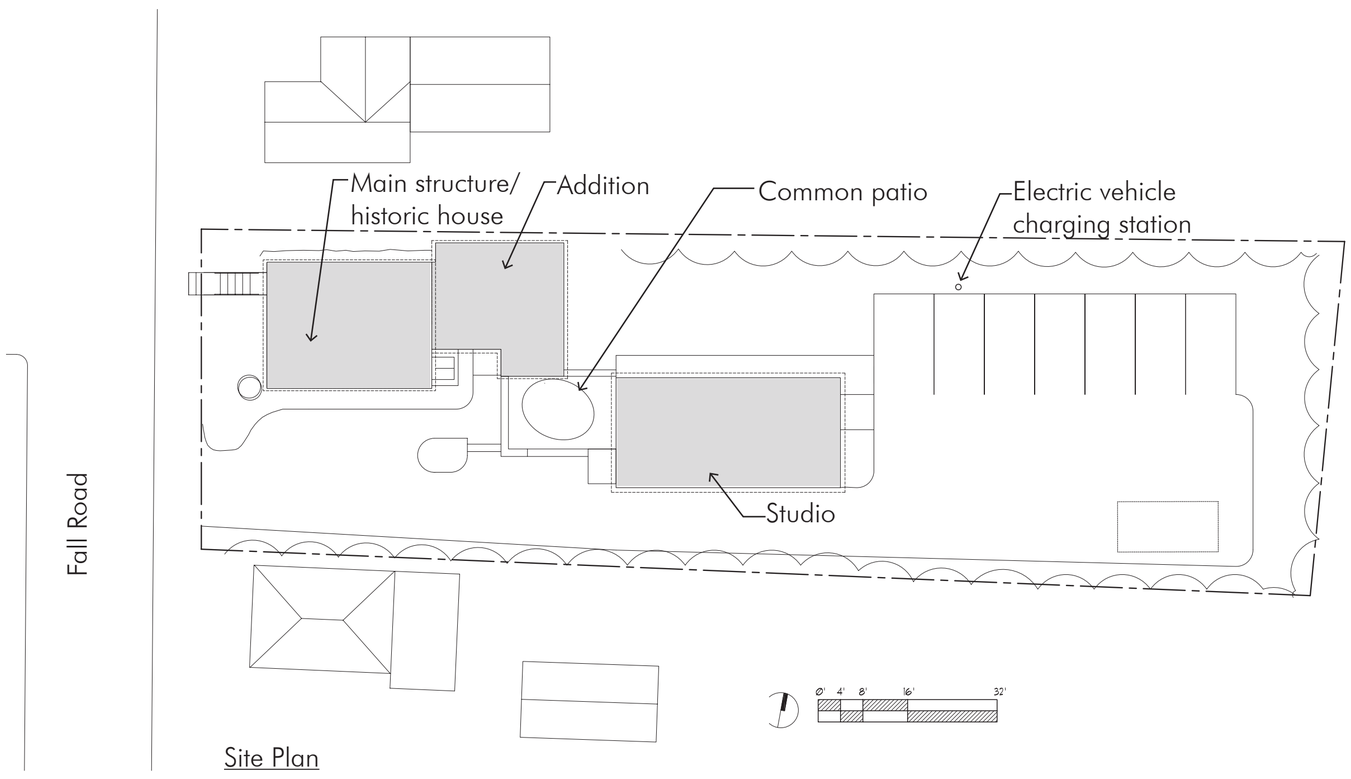
Our original vision was to find an existing property in need of repair and repurpose it to create a micro "office village" for a couple of businesses, including our own. We wanted this "office village" to have shared indoor and outdoor space and be within walking distance to all services. The property we found met all of our criteria. Our goal was to do a deep energy retrofit on the 2 existing buildings and dramatically reduce their energy use and carbon footprint, make them net zero energy ready, and maintain a high level of design and detail to fit within the historic Shelburne village context.

The principle structure at 53 Falls Road was a historical residence, listed with the National Register of Historic Places. The original structure, constructed in 1840 was in disrepair: structurally unsound, leaky with no insulation, and had major moisture infiltration at the foundation, windows, walls and roof. An addition was added to the principle structure in 1940, it was poorly constructed, not deemed historic and in need of replacement. A detached accessory structure was built in 2004 in the same style as the historic house to resemble a barn, and was being used as a retail shop. The building frame was sound but the thermal envelope was built using very poor methods and needed to be retrofitted.

We took a holistic approach on this project to reduce its energy impact in all ways. The property was initially selected for its proximity to all services. There is public transportation, food, post office, banks etc. all within less than a ¼ mile. In addition to this we added an EV charging station for employees and future wiring for another. The studio has been prepared for a roof mounted PV system that should allow this small office complex to achieve net zero energy use in the future.

Much attention was paid to the building envelope in both buildings. We developed and detailed a system for air sealing and insulating the existing building envelopes that would give us the best cost to benefit ratio. The techniques we used were easy to execute and gave us the best possible thermal bridge free performance, while using low global warming potential insulation. Triple glazed windows were used in all locations, including the historic part of the house. While we were not allowed to change the configuration of the windows on the historic structure we were very thoughtful about window design and placement in the other areas to allow for as much natural light as possible.

The mechanical heating and cooling systems in both buildings are all electric using cold climate heat pumps. The historic house uses the existing gas fired boiler and radiators as back up. Point source HRVs provided the most cost effective and efficient approach for ventilation because of existing building constraints. All lighting is LED and exterior lighting dark sky friendly. Materials and finishes were all selected for durability, low or no volatile organic compounds (VOCs), high recycled content and we used local manufacturers and products when possible.



Site Plan

Key Energy Efficiency Measures

Envelope: Insulation & Air Sealing

Much care was taken to retrofitting the existing envelope. **Walls:** On the studio we increased the wall R value from 19 to 47, a 147% increase. The existing house went from R2 to an average of R30, a 1400% increase. In both buildings we maintained R24 of continuous insulation. **Roofs:** On the studio we went from R30 roof to R46, a 53% increase, and on the house we went from R5 to R54, a 980% increase. We maintained continuous insulation of R24 on the house and R 12 on the studio. **Foundation/Basement**: The studio had an existing slab on grade with existing R10 on top of the slab, we overlapped the exterior insulation to overlap the slab edge. The house basement walls went from R0 to R26, a 2600% increase. **Methods:** Our envelope design allowed us to apply a continuous layer of zip wall sheathing from foundation to roof ridge over the continuous layer of rigid insulation. This provided us with a very simple air barrier and water resistant barrier. We paid very close attention to the connection and transition details of the air barrier at windows, bottom and tops of walls, penetrations etc. The result is a continuously insulated tight envelope.

Lighting: Indoor & Outdoor Lighting, Controls

Lighting: Because of the small scale of this project we chose very simple lighting and controls but made sure that all lamps are LED. All outdoor lighting is dark sky friendly with timers and photo cells. Because of the design, scale and occupancy of these spaces, occupancy and daylight sensors were not necessary.

HVAC: Equipment & Controls

HVAC: **Equipment & Controls:** Both buildings use heat pumps for heating and cooling. The Studio uses a mini-split which is a cold climate ASHP rated to -18 F with an effective COP of up to 4.1 (depending on outdoor temp.) In the historic house the small rooms warranted better distribution and it was more cost effective to go with a ducted ASHP. This unit is rated to 0 F and has a COP of 3.6 (depending on outdoor temp.) In this building we used the existing boiler and forced HW system as back up. **Ventilation:** Because of the size and scale of both buildings we used Lunos point source HRV's to deliver fresh air to the spaces, this provided the best cost to benefit ratio. These are rated at 90% efficiency and were very easy to install into the existing building infrastructure. Low flush toilets and low flow faucets were also installed in the bathrooms

Other Equipment

EV charging station: An electric vehicle charging station was installed in the parking area with wiring for another future station. **Renewable energy:** A wiring chase was installed from the main panel to just below the roof of the studio for a PV system, allowing this project to attain net zero energy use in the future. Energy Star appliances: **Energy Star rated** compact refrigerators were provided for kitchenettes.

Energy Management Practices

Education and awareness: Because of the small scale of this project there are no energy management controls, however this small scale allowed us to educate all of the occupants on measures for energy conservation, including efficient use of the controls for the heat pump, outdoor lighting timers etc. Tenants were also educated about the efficient way the building was renovated and are invested in the concept not only from an environmental standpoint but also knowing that their operating costs will be lower.

Building Information:

Name: High Performance Micro Office Village

Size: Historic house -1800 sf.

Studio - 1200 sf.

3000 total square feet

Type: Professional Office

Occupancy: Business (Group B)

Date of Completion: September 2014

High Performance Micro Office Village

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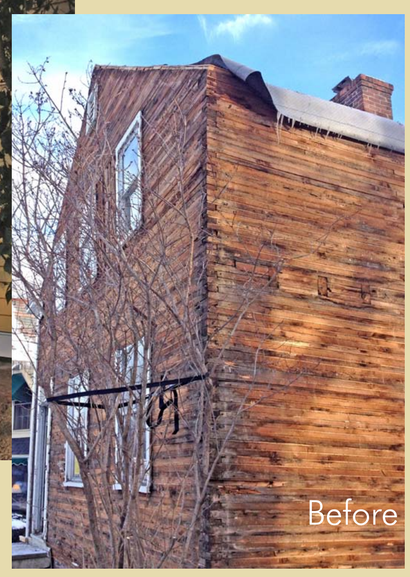
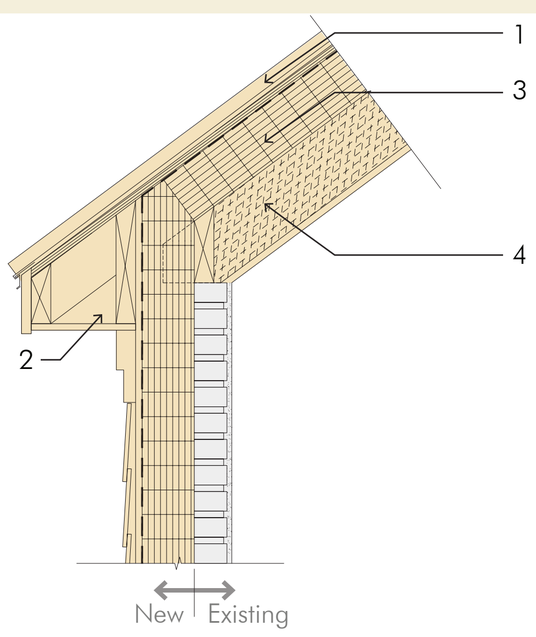
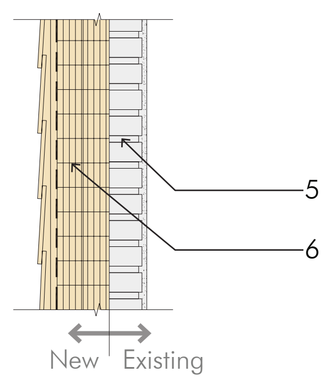
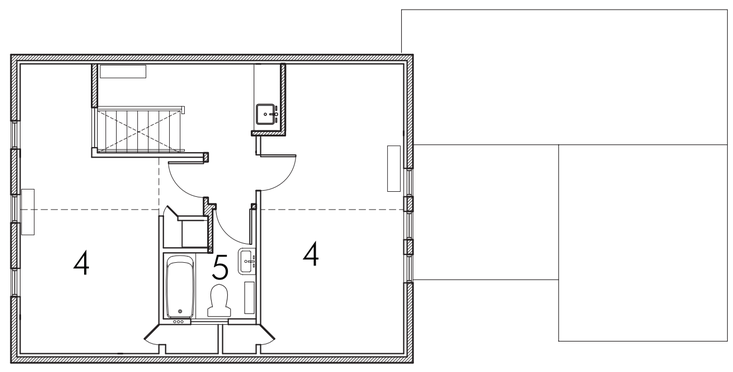


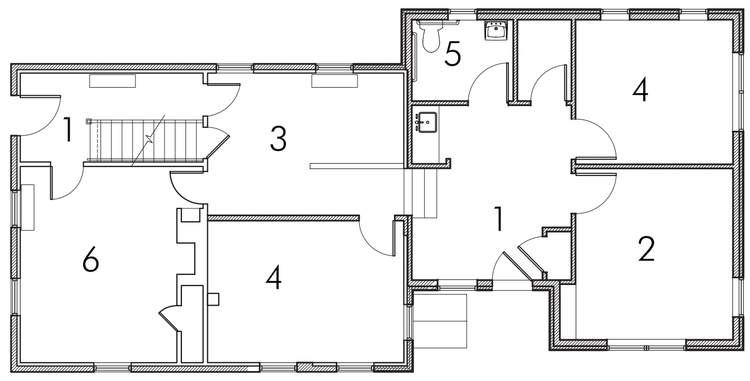
envelope & insulation







Second Floor Plan



First Floor Plan

roof / attic

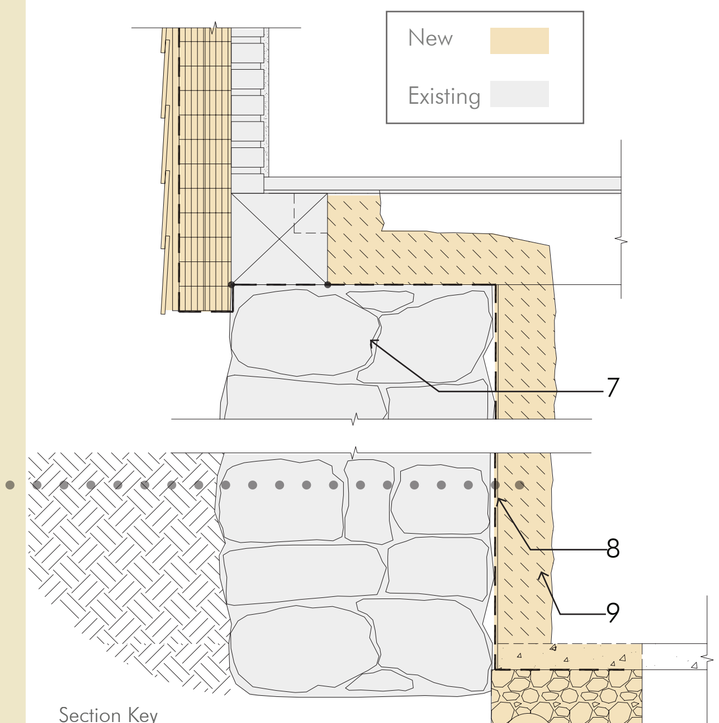
Roof / Attic: Before
Minimal batt insulation in attic.

Roof / Attic: After
4" of rigid insulation was added to the roof, as well as 7" of spray fiberglass, bringing the roof assembly up to R-54

mechanical systems

Mechanical: Before
Radiators tied to oil boiler

Mechanical: After
Daikin ducted air source heat pump, with existing Budarus boiler gas fired backup.



Section Key
1 New metal roofing & weather barrier over roof sheathing
2 New overhang. Compsite trim, fascia, soffit & decorative cornice, to match existing dimensions.
3 Two layers of 2" thick polyisocyanurate insulation, with staggered joints, all exterior joints taped
4 New 2x8 roof rafters, with spray fiberglass
5 Existing 2 1/2" stacked wood wall, reinforced with new plywood sheathing
6 Cedar lap siding over cedar breather over Zip Wall sheathing over 4" thick polyisocyanurate insulation over existing solid stacked wood wall over existing plaster
7 Existing stacked rubble stone foundation wall
8 Dimpled drainage mat to perimeter drainage pipe, connected to sump pump.
9 4" closed-cell spray polyurethane covered w/ intumescent paint

N

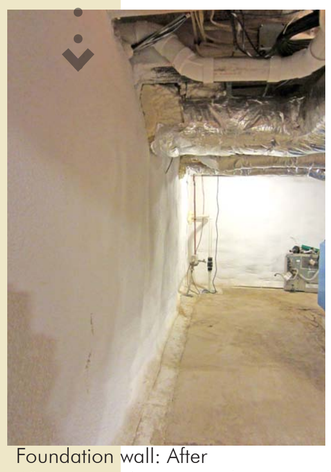
Plan Key
1 Entry
2 Conference
3 Work Room
4 Office
5 Bath
6 Shared Conference

Floor Plan Key
Existing wall
New construction

foundation wall

Foundation wall: Before
Cracked rubble stone foundation. Moisture & insect damaged sill & stacked wood wall. No insulation, no air sealing

Foundation wall: After
New drainage mat over the foundation wall connected to a perimeter drain trench and tied to a sump pump.



Foundation wall: After
4" spray foam insulation with intumescent paint added over the drainage mat.

Ventilation: After
The house uses 1 pair of LUNOS units on each floor, a through-wall dual fan, with a regenerative heat exchanger.

Spray fiberglass insulation at the new addition.

High Performance Micro Office Village

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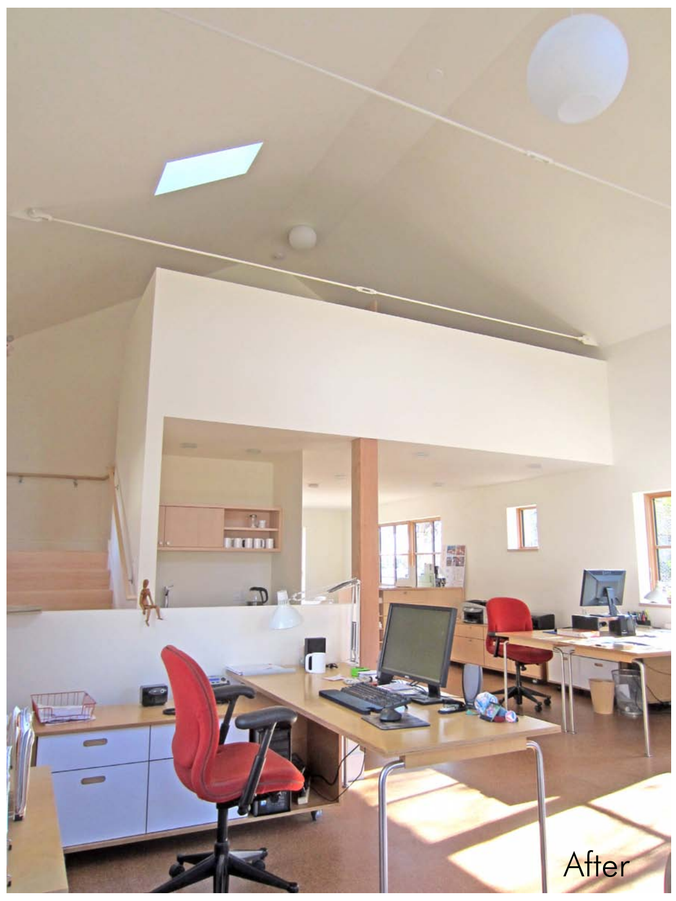
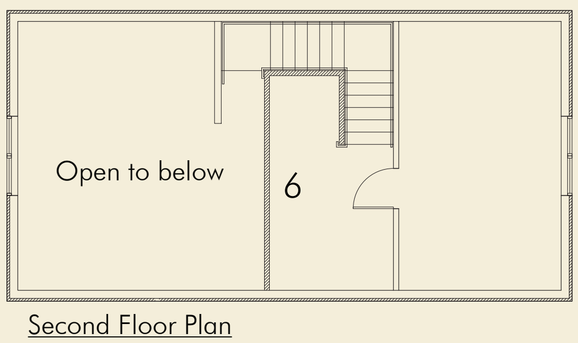
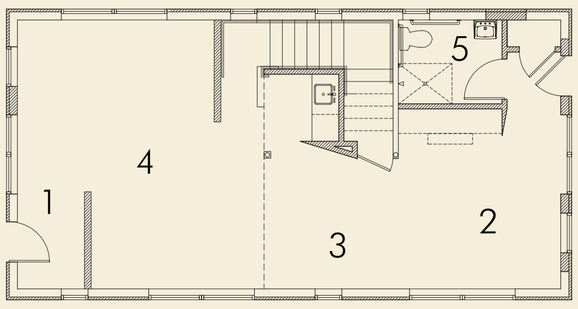


Barn --> Studio
Existing barn converted to studio with durable metal siding.



Second Floor Plan



First Floor Plan

Plan Key
1 Entry
2 Conference
3 Work Area
4 Office
5 Bath
6 Loft Conference

Floor Plan Key
Existing wall
New construction

Section Key
1 Existing architectural shingle roofing and sheathing to remain
2 Existing 2x10 rafters to remain with new dense pack cellulose
3 2" polyisocyanurate insulation attached to underside of 2x10s
4 New GWB attached to strapping
5 New structural tie rod and angle
6 New 2x6 rafter extension, sistered to existing roof rafters. 4" rigid insulation runs in between, taped & sealed.
7 New wood fascia & soffit
8 Typical wall construction (exterior to interior): Metal siding, 5/8" Zip wall sheathing, over 4" thick foil faced polyisocyanurate insulation, over existing sheathing, over existing 2x6 stud wall with new spray fiberglass insulation, over new GWB
9 New cork flooring over existing plywood over 2x sleepers with 1 1/2" rigid insulation over existing concrete slab

Window bucks are added to accommodate the addition of 4" polyiso insulation

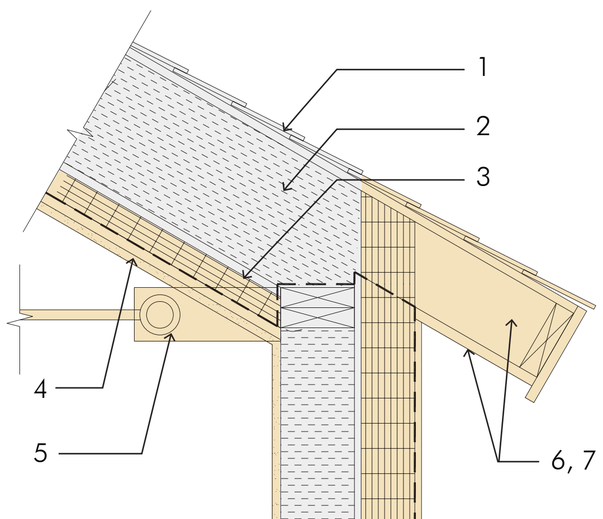
Window installation

window installation

Envelope: After
Zip system sheathing is added over 4" rigid polyisocyanurate .

Air sealing and flashing around windows

air sealing / insulation



Roof / Attic: Before
Fiberglass batt insulation.

Roof / Attic: After
2" of polyiso rigid insulation was added to the underside of the existing rafters, with dense pack cellulose in the existing cavity, bringing the roof assembly up to R-49

roof / attic

Stud cavity: Before
5 1/2" cavity with batt insulation (~R-19)

Stud cavity: After
5 1/2" spray fiberglass added to existing cavity, window bucks added, air sealed (R-47).

cvaity & insulation

Mechanical: After
The entire studio is heated and cooled by a highly efficient Mitsubishi Electric 18,000 BTU/HR wall mounted cold climate heat pump.

Mechanical: After
The studio utilizes a LUNOS ventilation system with 90% heat recovery efficiency.

mechanical systems

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