

Net Zero Energy Retrofit of a Brooklyn Townhouse

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Presentation Outline

- Design and construction overview (David)
- Air sealing (Jason)
- Financing and PV system design/install (McGowan)

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Design & Construction Overview

- Design brief
- Analysis
- Steam System Repair
- Construction

Design Brief

Townhouse, occupied for duration of work.

Owner duplex above, renter at garden level, unfinished basement.



Design Brief

Owner desires

- New windows
- More even heating
- Better AC
- Fight climate change
- Capital improvement to building

Design Brief



Analysis

Enclosure

- Walls – 2- and 3-wythe brick with interior plaster over wood lath over stud frame. Exterior stucco in satisfactory condition.
- Roof – 2" loose mineral wool between ceiling framing. Fairly new roof with some pocketing.



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- Floor – uninsulated frame floor to basement; much of basement ceiling removed for service runs



Analysis

Windows

- Broken springs
- Inability to close/open
- Sashes prone to fall in to interior
- Convective bypass in weight pockets



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Skylight

- Typical intentionally vented construction
- Thick debris collecting on stained glass below



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Analysis

Roof Hatch

- Typical type
- Insulated but heavily thermally bridged



Analysis

Air leakage

- Blower door and smoke puffer for diagnosis
- Biggest leaks found in attic and cellar (outdoors to cellar and cellar to house).
- Service shaft open to cellar shown at right



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- Curtain to seal dryer exhaust from cellar



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Air leakage

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- Service shafts open to cellar
- Curtain to seal dryer exhaust from cellar
- Steam pipe penetrations in floor and ceiling
- Voids in plaster hidden from view
- Gaps under baseboards
- Gaps at entry doors



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- Termination showed no particular flow with all fans on
- Hypothesized that risers terminate in interstitial space





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- Poor kitchen hood to duct connection
- Durability issues with duct tape, many seams not sealed at all



Ducts (Dryer)

- Crumpled flex



Analysis

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- Pinched bullnose
- 6 or more adjustable elbows, most at 90°
- Duct tape seals, on transverse joints only



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- Booster fan disconnected
- Exhaust termination not blocked from cellar



Odors

- Out of use washer, dry trap in drain
- Missing cap on house trap



Analysis