KILN APARTMENTS

Lessons Learned
1. Project Overview
2. PH Strategies
3. Lessons Learned
Hickory Hall
Under Construction

Elm Hall
Completed August 2010

Passive house + LEED
74% energy savings
Wood frame modules

LEED
25% energy savings
• 6 units of 54-unit affordable housing apts
• Individual HRVs
• Electric baseboard heat
• 4” Polyiso exterior insulation
2. Kiln Apartments
3. PH Strategies
The “weakest” link in any exterior envelope is the window. Meeting the Passive House standard often requires very high performing windows with insulated or thermally broken frames and triple panes of glass.

Note: a key element to consider is amount of exterior glazing: more % glazing requires high performing windows.
A significant difference between a standard such as LEED and Passive House is energy reduction strategies are black and white vs gradations with LEED.

With Passive House, the building either meets the energy consumption criteria or it does not. As a result, the analysis is much more definitive.

Analysis during design phase to find a path to being below the required source EUI of 38.0 to meet Passive House criteria.
Multi-family housing treated floor area (TFA)

Exclude stairs, elevator;

60%:
Hallways, lobby, mechanical rooms, bike storage, trash room.

Floor plan describing different floor areas and types of uses for Pre-Certification.
Many of the architectural design elements required careful analysis to conform with the Passive House energy model.

This is an example of just one of those conditions that required additional evaluation. Others included:

- Foundation
- Moment Frame steel
- Roof

Architectural detailing of metal sunshade and subsequent analysis of thermal bridging and impact to energy model.
OBSERVATIONS ABOUT CONSTRUCTION

For a mixed-use commercial building, the level of care and quality is significantly different than a “typical” commercial building. To date, almost all of the Passive House buildings in the NW have been homes and many of those have been built by either the designer or very small construction crews.

It is different to build with a crew of a dozen vs a crew of many dozens.

Example showing the level of care required for Passive House construction – in this example, underground insulation with gaps greater than ¼” were required to be spray foamed.
Images during preliminary full building blower door test. Achieving the strict envelope requirements, the size of holes being looked for are very small.
4. Lessons Learned
LESSONS LEARNED

1. Skin to volume ratio has major impact
2. Orientation and massing impact
3. High performing windows - most bang for the buck
4. Simplify slab or exclude ground floor space from thermal envelope
5. Reduce glazing on east/west
6. Unit size
LESSON #1
SKIN TO VOLUME RATIO
4.9 VS 7.9

This ratio describes the amount of exterior envelope vs amount of interior volume. Historically, we have always thought about this ratio from a cost of construction point of view. However, the ratio has a much larger impact in a passive house because the heat loss through the skin is the dominant driver of energy use.

Typical floor plan at the Janey.

Typical floor plan at Kiln Apartments.
LESSON #2

ORIENTATION
AND MASSING

Both the Janey and Kiln have optimal solar orientation – broad sides of the building face north/south.

Out of curiosity, we ran the energy model rotating Janey 90 degrees to assess impact.

That rotation resulted in a building consuming 30% more energy. That would be significant to overcome (…cost more money).
LESSON #3
MOST COST EFFECTIVE DESIGN STRATEGIES

The analysis performed (Janey vs Janey Passive) was fundamentally about identifying:

1. Janey Passive Strategies
2. Most cost effective strategies based on $/% energy reduction
3. Most cost effective Janey Scheme

1. HIGH PERFORMING WINDOWS
   $132,500, 103% REDUCTION, $1,290 PER 1% ENERGY

2. INSULATING GROUND FLOOR SPACES
   $9,137, 42.5% REDUCTION, $215 PER 1% ENERGY

3. PROVIDING HEAT RECOVERY VENTILATION
   $127,500, 29% REDUCTION, $4,397 PER 1% ENERGY

4. ADDING EXTERIOR WALL INSULATION
   $39,902, 15% REDUCTION, $2,670 PER 1% ENERGY

5. ADDING ROOF INSULATION
   $13,930, 8% REDUCTION, $1,788 PER 1% ENERGY

Note: Some strategies are givens; for example, the building couldn’t perform without a heat recovery or energy recovery ventilator.
LESSON #4
EXCLUDE GROUND FLOOR SPACE FROM THERMAL ENVELOPE

The amount of below grade insulation at Kiln was very difficult to install and expensive. All of that could be avoided in a 5 over 1 strategy.

There are many advantages of this approach:

1. Flexibility
2. Construction Cost
3. Simplified Foundations

View of concrete structural foundation showing insulation under footings.

Rendering of complexity of concrete structural foundation at Kiln
LESSON #5

REDUCE EAST / WEST GLAZING

The Janey has significantly more glazing overall than Kiln (32% vs 23%). However, the amount of glazing on the east/west is half of Kiln.

East/West glazing is difficult to control in the Summer (overheat the apartments) and doesn’t give as much benefit in the Winter (passive heat source).

View of SW corner of the Janey. East elevation party wall - 0% glazing. West Elevation looks like a lot of glazing, but there is very little – 24%.
LESSON #6
AVERAGE UNIT SIZE IS NOT AS CRITICAL AS ORIGINALLY ASSUMED

The average unit size does make a difference as the energy modeling makes plug load assumptions based on number of occupants. However, it is not nearly as important as assumed. Varying the number of units in the Kiln energy model changed the energy consumption between 5-10%. Though significant, compared to other inputs, that is not a key driver.

Typical floor plan at Kiln Apartments.
Note: of the 6 units per a typical floor, 4 are corner units.
THE PASSIVE HOUSE STANDARD
A FEW OTHER OBSERVATIONS

1. Cladding Attachment
2. Unvented Roof, Parapet Air Sealing
3. Moisture management
4. Construction schedule (implication of blower door test)
5. Design process observations
Enhanced Performance Roof Hatches
Our Most Energy-Efficient Model Yet!

The new thermally enhanced design features special gaskets and improved ventilation for superior thermal performance and cost savings. With new UL Class 1 fire ratings, Bilco's JRH models offer enhanced fire resistance. A lightweight, easy-to-install, compact design means you can enjoy your home office or home gym in absolute comfort! The Bilco JRH offers: 
- Energy efficiency, sound transmitted by the roof is reduced by 35% for a quieter home. 
- Airtight installation, no leaks with a simple gasket. 
- UV stable double wall, durable and long lasting. 
- Non-perforated/1/2" CEU-123 impact resistant glass insulation. 
- Double pane glass with a 35% lower emissivity. 
- High-end finish with a metal frame finish. 
- Energy-efficient polyisocyanurate insulation with glass fiber insulation.
- Air pressure resistance 10 psi.
- Fluor Polymers gasketing with enhanced weather resistance.

Payne Apartments
GBD Architects
Lorenz Bruun Construction

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**Specifications:**

1. **Cover:** 11 Ga Alum cover stiffened to withstand a live load of 40 psf with a max deflection of 1/300 of the span.
2. **Liner:** 10 Ga Alum.
3. **Curb and Counterflash w/ ez tab:** 11 Ga Alum.
4. **Finish:** Mill finish.
5. **Spring/Hinge Assembly:** Zinc plated steel tamper-proof hinge contained within spring hinge assembly. Telescopic tube contains coil steel compression springs for lift assistance.
6. **Hinged Open Arm:** Locks cover in fully open position - 110° swing with red vinyl grip handle pull release.
7. **Latch:** 2-Point Rotary Latch Slam latch holds cover closed against 90 psf wind uplift. Internal and external turn handles with padlock hatchs.

**Roof Hatch Size:**

- **Rough opening:** 36" x 96" (Length)
- **Clear opening:** 27.94" x 94.31" (Length)

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<th>Project:</th>
<th>Architect:</th>
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<tbody>
<tr>
<td>Payne Apartments</td>
<td>GBD Architects</td>
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<tr>
<td>Contractor:</td>
<td>Lorenz Bruun Construction</td>
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**Babcock Davis**

3300 Tideway Ave South
Brooklyn Park, MN 55428

**Title:** Roof Hatch, Personnel Series, Steel, S-Dr, Zinc Nole, Alum, Mill, Singl Wall Curb

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**Drawing:** 5/8 10/13 A

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**Revision:** 36x96
MOISTURE MANAGEMENT

Due to the high performing and very tight envelope of a passive house building, understanding moisture management is more involved. At Kiln, the team hired outside experts to run a number of moisture management scenarios to prove adequate drying of the building initially as well as over time.

Some of the analysis necessary to understand moisture management at Kiln Apartments (Moisture Generation Table, On-site moisture testing of wood framing, hygrothermal model of roof system).
A passive house must meet a stringent air tightness standard: <0.60 ACH @ 50 Pa

To ensure that, a preliminary blower door test is typically performed after the envelope is complete (air tight), but before the insulation and drywall installation. As such, passing this test becomes critical path construction schedule milestone.

The full building blower door test requires a complete envelope. This reduces some construction sequencing alternatives that a contractor typically has.
Though Kiln is certainly an R&D effort for all involved, we have noticed a few areas that are different than GBD’s “typical” design process.

From a developer’s point of view, some of these items result in more design time than “typical” high performing standards such as LEED.

1. Finding the right MEP systems requires more early analysis to avoid costly design revisions.
2. Pre-design / schematic design is more involved as it must include energy modeling.
3. Energy modeling is more involved and critical.
4. Construction administration requires more attention from the design team.

GBD observations based on Kiln Apartments. Much of the process at Kiln can be attributed to it being the first time designing a Passive House, however, there are some elements of the design process that should evolve.
Q&A