US building impacts

73% electricity consumption
41% energy use
38% CO₂ emissions
40% raw materials
30% waste output
14% potable water use
US building impacts

- 73% electricity consumption
- 41% energy use
- 38% CO₂ emissions
- 40% raw materials
- 30% waste output
- 14% potable water use
1722 PINE STREET:
FROM MAZE TO MATRIX

Laura Blau AIA
Paul Thompson AIA
LAURA BLAU AIA LEED BD&C® AP
  CPHC (Certified Passive House Consultant)
  CPHB (Certified Passive House Builder)
  CPHD (Certified Passive House Designer-pending)
Principal BLUPATH

BLUPATH is an award winning architecture and design firm focusing on high-performance building design. blupath.us

PAUL THOMPSON AIA LEED BD&C® AP
  CPHC (Certified Passive House Consultant)
Principal IEI ARCHITECTS

IEI ARCHITECTS is part of IEI Group, a nationally recognized interior design and architecture firm. ieigroup.com
PROJECT TEAM

BluPath
GreenSteps
Kent Lessly
Zero Energy Design
Jean Gajary
Buckminster Green
FutureFit / Epiphyte
Bill Henkel
Best Choice
Dave Simpson

Architect and PH Consultant
General Contractor
WUFI, THERM Modeling
HVAC Design
Structural Design
Demolition
Air Seal / Insul / ERV
Roofing
HVAC / Plumbing
Electrician
PRODUCITS

World Class Supply  Building Products
475 Building Supply  Building Products
KlearWall  Front windows and doors
Intus  Rear windows
Zehnder  ERV
Mitsubishi + Daikon Mini-split
GE GeoSpring  Heat pump HWH
Stiebel Eltron  On-demand HWH
LEARNING OBJECTIVES

1. Learn how science-based, conservation-first strategies and the ‘whole-building’ approach can be implemented to achieve energy efficiency, durability and health benefits in historic buildings.

2. Apply passive conservation phasing strategies for building envelope and mechanical systems design for historic buildings.

3. Apply case study examples of best practices and lessons learned, including hygrothermal issues particular to masonry walls in historic residences.

4. Understand potential municipal approval, design and construction challenges when renovating historic properties.
1722 PINE STREET PHILADELPHIA PA
4 story, 4 unit rowhouse, built 1845
Brick front and rear
Rittenhouse – Fitler Historic District
1722 PINE STREET RENOVATION
PROJECT GOALS

1. Change building from mixed use to all residential
2. Modernize the property
3. Improve the property value and increase rents
4. Renovate with tenants in place
5. Create a new home for our family
1722 PINE STREET RENOVATION
PROJECT GOALS

6. Renovate to near zero-energy
   ▪ Eliminate natural gas
   ▪ Include on-site renewable energy
   ▪ Monitor real time energy use
   ▪ EnerPHit certification at Unit 1
   ▪ Step-By-Step EnerPHit at Units 2, 3 and 4
   ▪ Use building science analysis and solutions

7. Raise expectations and establish a precedent for historic renovations in Philadelphia

8. Contribute to Architecture 2030, Achieving 80x50 and Philadelphia Greenworks goals
1st Floor

Lower Level
Roof

4th Floor
North (Pine St.)

South (Waverly St.)
1722 PINE STREET RENOVATION
HISTORICAL COMMISSION APPROVAL

1. Submit proposed work to Historical Commission
2. HC Architectural Committee Presentation
   Rear Insulation, PH Windows NOT APPROVED
3. Historical Commission Hearing May 13, 2016
   Rear Insulation DENIED (but allowed to represent with more science-based information)
   PH windows and rear bay APPROVED with Staff Review
4. Resubmit proposed work
5. Historical Commission Hearing July 8, 2016
   Rear Insulation DENIED
The Standards (Department of Interior regulations, 36 CFR 67), written in 1976, pertain to historic buildings of all materials, construction types, sizes, and occupancy and encompass the exterior and the interior … The Standards are to be applied to specific rehabilitation projects in a reasonable manner, taking into consideration economic and technical feasibility.

2. The historic character of a property shall be retained and preserved. The removal of historic materials or alteration of features and spaces that characterize a property shall be avoided.

6. Deteriorated historic features shall be repaired rather than replaced. Where the severity of deterioration requires replacement of a distinctive feature, the new feature shall match the old in design, color, texture, and other visual qualities and, where possible, materials. Replacement of missing features shall be substantiated by documentary, physical, or pictorial evidence.

9. New additions, exterior alterations, or related new construction shall not destroy historic materials that characterize the property. The new work shall be differentiated from the old and shall be compatible with the massing, size, scale, and architectural features to protect the historic integrity of the property and its environment.
THE ENVIRONMENT RIGHTS AMENDMENT
TO THE PENNSYLVANIA CONSTITUTION (1971)

Article 1, Section 27 of the Pennsylvania Constitution reads:

"The people have a right to clean air, pure water, and to the preservation of the natural, scenic, historic, and esthetic values of the environment. Pennsylvania's public natural resources are the common property of all of the people, including generations yet to come. As trustee of these resources, the Commonwealth shall conserve and maintain them for the benefit of all the people."
Historical Commission Window Submission
1722 PINE STREET RENOVATION PROJECTS

1. Interior Demolition – Unit 1
2. Window and Bay Replacement – front and rear (HC received)
3. HVAC Improvements – Unit 2, 3, 4
4. Roof Replacement, including PH skylight (HC pending)
5. Interior Renovations – Unit 2, 4
6. Interior Renovations – Unit 1
7. Insulate Exterior, New Fire Escape - rear (HC ???)

HC = Requires Historical Commission approval
Get Rid of the Gas!!
1st Floor Demolition
Deteriorating Stone Walls
Deteriorating Brick Walls
Deteriorating Brick Walls
Rear West Façade: Conduit and Fire Escape
Wall Types
Rainscreen (Drained) Insulated Synthetic Stucco system (EIFS)
Basement Party Wall

**Basement Exterior Wall**

- **SEAL IMBUL PLUS TO FUR AWAY CONTEGA/HF**
- **DENSE PACKED CELLULOSE INSUL.**
- **PROSOCO JOINT + SEAL CONTINUOUS**
- **SLUTEX MENTO PLUS**
- **AB PLYWOOD, EXTR. GR.**
- **SLUTEX MENTO 1000 AIRSEAL TO SLUTEX MENTO PLUS**
- **2X3 PT. STUDS & 16" C.C.**
- **FILL W/MINERAL WOOL INSUL.**
- **SALT ABSORBING PLASTER SEAL VAPOR BARRIER TO SALT ABSORBING PLASTER.**
- **AIRSEAL SLUTEX MENTO 1000 TO SLAB W/CONTEGA HP**
- **2" EPS INSUL**
- **5" EPS INSUL**
- **CONC. SLAB**
- **VAPOR BARRIER**

**LIVING RM 10B**

**DINING RM 10T**

- **CUT BACK EXISTING JOIST AND SUPPORT FROM BRICK INFILL**
- **THRU WALL FLASHING STONE SILL**
- **PAVERS (FERROUS)**
- **GALVANIZED 4X6X14" LLV**
- **THRU BOGERT TO WALL**

**MEDIA RM 10A**

- **SALT ABSORBING PLASTER MINERAL WOOL**
- **IN-FILL & (E) ONG. W/SALVAGED BRICK**

**SECTION 6 WALL ONG, W3 & DR* D12 SILL**

**W1**

**SECTION C N. BASEMENT WALL**

```
1/8" = 1'-0"  
```
Unit 1 Ceiling

Rear Wall – No Ext. Insul.
North Wall – Interior Insulation

2x3 Blocking on (E) Joists
2x6 Plywood Sheathing Sealed to Joists, Roof Deck & Plaster with Frosoco Joint & Seam

5 1/2 MINERAL WOOL INSULATION

(E) Roof Deck

Air Seal Intello Plus to Joists & Roof Deck with 3" strips of Extoseal Encors

(E) Insul, Replace in Kind

As Needed

Remove (E) Suspended Gub Clg, to Extent Red to Install Insul. New Work in Clg, Plenum

1/2" Gub on 2x3 Furring (Horz) @ 12" O.C., Intello Plus - Continuous

2x8's @ 6" O.C.

Cellulose Insul.

(E) Plaster - Remove Paint from Plaster

1/2" Min. Wool Insul or Density Packed Cellulose

Note: The As Built Condition Above Masonry is Unknown. Air Sealing & Insul, Concept Shows Intent

W14 4th Flr Clg/Roof @ N. Wall (Pine St)

1/8" = 1'-0"
ISSUE: Control Rising Damp

OPTIONS:
1. Admixture in concrete
2. Admixture in dry pack
3. Surface applied water proofing
Rear Windows Details: Triple Pane, Casement / Hopper Windows with Insulated Frames and Triple Gaskets
DesignPH Results
NO EXTERIOR INSULATION AT REAR

EnerPHit verification

Building:
Street Address: 1722 Pine St
City, State, Zip: Philadelphia, PA, 19103
Country: USA
Building type: Historic Brick Rowhome
Climate: PA, Philadelphia
Altitude of building site (feet above sea level): 35

NO!

But Close

NO CERTIFICATION
## EnerPHit verification

**Exterior Insulation at Rear**

<table>
<thead>
<tr>
<th>Building:</th>
<th>Pine Street Renovation - Apartment 1</th>
<th>4&quot; EIFS - Intus SHGC: .37</th>
</tr>
</thead>
<tbody>
<tr>
<td>Street Address:</td>
<td>1722 Pine St</td>
<td></td>
</tr>
<tr>
<td>City, State, Zip:</td>
<td>Philadelphia, PA, 19103</td>
<td></td>
</tr>
<tr>
<td>Country:</td>
<td>USA</td>
<td></td>
</tr>
<tr>
<td>Building type:</td>
<td>Historic Brick Rowhome</td>
<td></td>
</tr>
<tr>
<td>Climate:</td>
<td>PA, Philadelphia</td>
<td></td>
</tr>
<tr>
<td>Home owner / Client:</td>
<td>Laura Blau &amp; Paul Thompson</td>
<td></td>
</tr>
<tr>
<td>Street Address:</td>
<td>1005 S 7th St</td>
<td></td>
</tr>
<tr>
<td>City, State, Zip:</td>
<td>Philadelphia, PA, 19147</td>
<td></td>
</tr>
<tr>
<td>Architectural firm:</td>
<td>BluPath Design</td>
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<tr>
<td>Street Address:</td>
<td>1005 S 7th St</td>
<td></td>
</tr>
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<td>City, State, Zip:</td>
<td>Philadelphia, PA, 19147</td>
<td></td>
</tr>
<tr>
<td>Mechanical system:</td>
<td>Zero Energy Design</td>
<td></td>
</tr>
<tr>
<td>Street Address:</td>
<td>156 Milk St, Suite 3</td>
<td></td>
</tr>
<tr>
<td>City, State, Zip:</td>
<td>Boston, MA 02109</td>
<td></td>
</tr>
</tbody>
</table>

### Year of construction: 1890

| No. of dwelling units | 1 | |
| No. of occupants | 5.0 | |
| Spec. capacity | 34 BTU/F per ft² TFA | |

### Specific building demands with reference to the treated floor area

<table>
<thead>
<tr>
<th>Space heating</th>
<th>Requirements</th>
<th>Feasible?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating demand</td>
<td>7.03 kBTU/(ft² yr)</td>
<td>69% of 7.92 kBTU/(ft² yr)</td>
</tr>
<tr>
<td>Heating load</td>
<td>5.63 BTU/(hr ft²)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Space cooling</th>
<th>Requirements</th>
<th>Feasible?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall space cooling demand</td>
<td>4.00 kBTU/(ft² yr)</td>
<td></td>
</tr>
<tr>
<td>Cooling load</td>
<td>3.22 BTU/(hr ft²)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Primary energy</th>
<th>Requirements</th>
<th>Feasible?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating, cooling, dehumidification, DHW, auxiliary electricity, lighting, electrical appliances</td>
<td>39.4 kBTU/(ft² yr)</td>
<td>96% of 40.9 kBTU/(ft² yr)</td>
</tr>
<tr>
<td>DHW, space heating and auxiliary electricity</td>
<td>21.2 kBTU/(ft² yr)</td>
<td></td>
</tr>
<tr>
<td>Specific primary energy reduction through solar electricity</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Airtightness</th>
<th>Requirements</th>
<th>Feasible?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressurization test result n50</td>
<td>1.0 1/h</td>
<td>1 1/h</td>
</tr>
</tbody>
</table>

EnerPHit building retrofit (according to heating demand)? CERTIFICATION!
RILEM moisture absorption test
Rilem Tube Moisture Absorption Test – Pine Street
Result - Low Absorption Rate
Add 5.5” Cellulose with Smart Vapor Control (R19)
Acceptable Mold Risk
Rilem Tube Moisture Absorption Test – Waverly Street Result - High Absorption Rate
Existing Conditions
Unacceptable Mold Risk

* over 50 F and 80% RH
1.5” Cellulose in Existing Wall Cavity Unacceptable Mold Risk
New 4” cellulose, smart air vapor barrier

Unacceptable Mold Risk
EIFS with Drainage Plane, 4” EPS
Acceptable Mold Risk
EIFS with 4” EPS + 4” Cellulose
Acceptable Mold Risk
Preservation

Global Climate Mitigation
The new reality requires accommodation, adaption, compromise, and a serious re-evaluation of basic canons.
OR adjust the fulcrum and accept thoughtful exceptions to meet the fundamentals of both missions.
CONCLUSIONS

Criteria for historic renovations should consider:

1. Ranking the value of historic facades as “significant” or “non-contributing”. All bricks are not historic, and all “historic” bricks are not equal.

2. Covering or altering the façade must result in a significant improvement in energy efficiency and health outcomes.

3. The proposal must be backed by proven building science based analysis.

The results will be efficient, durable, healthy buildings that maintain the historic fabric as well as support well-being on a healthy planet.
A skyline of work. One at a time.
ANOTHER PERSPECTIVE ON ENERGY USE
-90%
62Msf or 65,000 NYC apts. renovated to PASSIVE HOUSE

= A single 1.2MW Coal power plant

-90%
62Msf or 65,000 NYC apts. renovated to PASSIVE HOUSE

= 

A single 1.2MW $2B Coal power plant

-90%
60% OF THE WORLD’S BUILDINGS WILL BE REBUILT IN THE NEXT TWO DECADES.

“That is a huge opportunity if we do it right.”

– Ed Mazria, Architecture 2030
25-75 years between renovations

WASTED $$

MISSED opportunities
RESOURCES

**PHIUS** Passive House Institute US  
passivehouse.us

**PHAUS** Passive House Alliance US  
phaus.org

**PHI** Passive House Institute (Germany)  
passiv.de/en/

**iPHA** International Passive House Association  
passivehouse-international.org

**NAPHN** North American Passive House Network  
northamericanpassivehousenetwork.com
RESOURCES

ZERO ENERGY READY HOMES energy.gov/eere/buildings/zero-energy-ready-home

LEED Building rating system new.usgbc.org/leed


THE CLIMATE TRUST Climate solutions for government, utilities and large businesses climatetrust.org
RESOURCES

WORLD CLASS SUPPLY High performance building supply, worldclasssupply.com

FOURSEVENFIVE High performance building supply, foursevenfive.com