Webinar Overview

- **Q&A will take place at the end of each segment.**
- **Webinar will be recorded and sent.**

Use the Question Section on the webinar control panel to ask a question at anytime during the presentation.

Submit Responses via PollEverywhere

- Respond at PollEV.com/swa335
- Or text swa335 at 22333 to join, then send your answer
The Sponsors of Energize Connecticut, and in partnership with Connecticut Passive House, are pleased to offer *Passive House Initiative* to support workforce development and help transform the energy efficiency and building construction industries in Connecticut.

For more information, please visit EnergizeCT.com/passive-house or email PassiveHouseTrainingCT@icf.com
Take energy efficiency to a new level

Residential New Construction Passive House Multi-family buildings with five units or more
# Passive House Incentive Structure for Multi-Family (5 Units or More)

<table>
<thead>
<tr>
<th>Incentive Timing</th>
<th>Activity</th>
<th>Incentive Amount</th>
<th>Max Incentive (Per Unit)</th>
<th>Max Incentive (Per Project)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Construction</td>
<td>Feasibility Study¹</td>
<td>Up to 100% of Feasibility Study Costs</td>
<td>N/A</td>
<td>$5,000.00</td>
</tr>
<tr>
<td></td>
<td>Energy Modeling²</td>
<td>75% of Energy Modeling Costs (Before 90% Design Drawings)</td>
<td>$500.00</td>
<td>$30,000.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50% of Energy Modeling Costs (90% Design/50% Construction)</td>
<td>$250.00</td>
<td>$15,000.00</td>
</tr>
<tr>
<td>Post Construction</td>
<td>Certification³</td>
<td>Up to 100% of Certification Costs</td>
<td>$1,500.00</td>
<td>$60,000.00</td>
</tr>
</tbody>
</table>

1. Feasibility Study will require documentation in the form of a Feasibility Study report and invoice from the Passive House Consultant.
2. Incentives will only be awarded prior to 50% Construction Drawings for Passive House projects. No incentives will be granted after 50% Construction Drawing set.
3. Certification may be either through PHIUS, PHI, or EnerPHit certification offerings.

Next steps you can take...
Contact your Energy Efficiency Representative or

Go to EnergizeCT.com or call 1-877-WISE USE for more details.
Workshop 1, Part 2
Continuous Insulation
Since 1972, Steven Winter Associates, Inc. has been providing research, consulting, and advisory services to improve the built environment for private and public sector clients.

Our services include:

- Energy Conservation and Management
- Decarbonization
- Sustainability Consulting
- Green Building Certification
- Accessibility Consulting

Our teams are based across four office locations:
New York, NY | Washington, DC | Norwalk, CT | Boston, MA

For more information, visit [www.swinter.com](http://www.swinter.com)
Learning Objectives

Summarize the importance of continuous insulation

Identify challenging details and propose solutions to overcome

Describe common approaches for continuous insulation of residential projects

Recognize new and innovative insulation components
Overview of Presentation

1. High Performance Basics
2. Review various types of insulation installed on projects
3. Identify ways to mitigate thermal bridges

5 min break ~2:50 PM
Wrap Up ~4:00 PM
What is your profession?

A. Architect
B. Engineer
C. Contractor/CM
D. Consultant
E. Other
What is the one thing that you were hoping to learn about today? (hint: link words with an underscore)
Why are We Here

• Push for Building Electrification (Passive House as a pathway)
• Incentives available
• Benefits
  • Drastically lower energy use and operational cost savings
  • Healthy air quality from ventilation systems
  • Consistent and comfortable room temperatures without air drafts
  • Increased natural lighting and quieter acoustic conditions
  • A more resilient and comfortable building
These Trainings - Each has two parts

- **Workshop 1:** Continuous Insulation
- **Workshop 2:** Air Sealing and Insulation for Homes
- **Workshop 3:** High Performance Ventilation Systems for Homes
High Performance Basics
Goals of High Performance Buildings

- Building durability
- Energy $ reduction
- Optimal thermal comfort
- Superior indoor air quality
- Carbon emissions reductions
Passive House as a Pathway to High Performance

- Thermal insulation continuity
- Thermal bridge free construction
- Solar control
- Airtightness
- Balanced mechanical ventilation
Continuous Insulation
• Basic Components
  • Gauge (manometer)

• Shroud

• Frame

• Fan
Balanced Ventilation and Heat/Energy Recovery

- Provide fresh, filtered air 24 hours a day
- Heat exchanger +75% Efficient
- Highly insulated and air-sealed ductwork
Questions?
Common Approaches to Insulation
**Perfect Wall**

- Wood framing is the most common building material for low to mid-rise buildings

- Successful wood framed approaches in achieving high performance:
  - Larsen truss
  - Double stud walls
  - Prefabricated systems (SIPs)
  - 2x Framing
    - 2x Framing with Zip System

[https://www.jlconline.com/how-to/the-perfect-wall-concept](https://www.jlconline.com/how-to/the-perfect-wall-concept)
Larsen Truss

- Used in single family home construction
- Trusses build out the wall cavity to allow for super insulation
- Can be used in an existing building retrofit or new construction
Double Stud Wall

- Used in single family home construction
- Utilizes two separately framed walls to allow for super insulation
  - Thickness varies but 9 ½” -11” is common
- Can be used in an existing building retrofit or new construction
- Drawback: lumber costs
Prefabricated Walls and SIPs

- Used in single and multifamily construction
- Implements EPS foam insulation sandwiched with OSB
- Continuous insulation mitigates thermal bridging through framing
- Speedy assembly and inherent air tightness
Advanced Framing – 2x6

• Used in single and multifamily construction
• Implements interior cavity insulation and exterior continuous insulation
• Cost effective approach and can achieve higher R-values
Advanced Framing

- Reduces the amount of lumber used and optimizes material use
  - Thus reducing thermal bridging of framing members

Ex: 2x6 framing 24” O.C., Single top and bottom plate, no headers in non-bearing walls, single stud at rough openings
Building Layout

- Complex architecture
- Wall to foundation connection
- Headers
- Window installations
- Roof to wall connection
- Rim Joist
- Heal of truss
Building Layout
Sub-slab Insulation
Below Grade Walls
Below to Above Grade Transition
Below to Above Grade Transition
Below to Above Grade Transition
• Zip R: Structural panel with built-in exterior insulation
• Integrated moisture, air, and thermal protection
• R-values range from R-3 to R-12

1) Built in exterior insulation
2) Integrated water resistive barrier
3) Continuous air barrier
4) Structural durability
Zip R – Be Careful
Exterior XPS with Furring Strips
Exterior XPS with Furring Strips
Exterior XPS with Furring Strips
Exterior Mineral Wool – Attachments & Spacing

- **Plastic Cap Nails**
  Recommended for temporary holding insulation and fastening insulation to wood and wood-based substrates.

- **Metal Fasteners**
  Recommended for use with metal frame construction. Anti-unevening fasteners (or other precautions) should be used with metal frame construction.

- **Regular**
  Wood Screws
  Concrete Screws
  Concrete Nails
  Must be right type for the substrate and suitable for outside use if not being used inside.

- **Dual-Thread Fasteners**
  e.g. Hex-Tap
  Recommended for use with wood strapping to reduce risk of compression deflection.

- **Clip & Z-Girt**
  e.g. CANADA CLIPS
  Recommended for thick exterior insulation (over 3’). Follow manufacturer recommendation for use.

- **Insulation Fasteners**
  e.g. RAMSET INSULFAST
  Recommended for fastening insulation to concrete, masonry block and through gypsum sheathing (steel stud).

- **Brick-Tie & Wedge**
  Wedges or clips used with masonry ties can be used to attach CAVITYROCK® insulation.

- **Impaling Pin**
  Mechanically attached or bonded to structure. Recommended for use with all types of ROCKWOOL stone wool insulation boards. Adhesive “stick” pins should be avoided.
Polyiso Insulation
Interior Batts
Interior Batts – Sample Install
Interior Batt Grading

- Grade I: Almost no gaps
- Grade II: Up to 2%
- Grade III: 2% - 5%

RESNET protocol for the effect of missing insulation on installation grade

Diagrams from the HERS Standards
Interior Batts – Grading, Example 1
How would you rate this install (example 1)?

A. Grade I: Almost no gaps

B. Grade II: Up to 2% gaps

C. Grade II: 2-5% gaps
Interior Batts – Grading, Example 2
How would you rate this install (example 2)?

A. Grade I: Almost no gaps
B. Grade II: Up to 2% gaps
C. Grade II: 2-5% gaps
Interior Batts – Grading, Example 3
How would you rate this install (example 3)?

A. Grade I: Almost no gaps

B. Grade II: Up to 2% gaps

C. Grade II: 2-5% gaps
Interior Batts – Grading, Example 4
How would you rate this install (example 4)?

A. Grade I: Almost no gaps
B. Grade II: Up to 2% gaps
C. Grade II: 2-5% gaps
Interior Spray Foam
Spray Foam at Rim/Band Joist
Spray Foam at Rim/Band Joist
Roof Insulation – Flat Roof
Roof Insulation – Sloped Roof (Exterior)
Spray Foam – Attic Slope
Spray Foam – Attic Slope
Spray Foam – Attic Flat, Interior
NOTICE TO ALL TRADE PARTNERS

1. All Penetrations through the air barrier system and thermal barrier system (including but not limited to exterior sheathing, roof sheathing, flashing, vapor barrier, etc.) must be approved by Harkin’s designated air sealing coordinator prior to penetration being made.

2. Trade Partners are responsible for sealing any and all penetrations created by the installation of their building system/components and must use sealing methods pre-approved by Harkin’s air sealing coordinator.

3. Trade Partners are held accountable for the cost of repairing any unapproved and/or improperly sealed penetrations through the building’s air barrier system, including re-inspection fees.
Questions?
5 Minute Break
Innovative Insulation Components
Continuous Insulation

**ASHRAE 90.1 - 2019**

*continuous insulation (c.i.):* insulation that is **uncompressed and continuous** across all structural members without thermal bridges **other than fasteners and service openings.** It is installed on the interior or exterior or is integral to any opaque surface of the building envelope.
What types of thermal bridge mitigation strategies have you seen implemented on your projects? (hint: link words with an underscore)
Framing - Thermal Bridges

Credit: Sam Hagerman,
Thermal Bridge Free Construction
Heat Loss Caused by Thermal Bridging

- Example: “R-50” wall with 25% wood framing = R-32

Credit: Hammer & Hand hammerandhand.com
Framing - Thermal Bridge Mitigation

• Advanced framing
• Truly continuous exterior insulation
• Zip R sheathing
• Structural thermal break products at
  • Equipment supports
  • Structural steel
  • Balconies / porches
• Planning and mitigation, during the
design phase

Credit: Fine Homebuilding
Advanced Framing
Advanced Framing

Credit: APA Advanced Framing Construction Guide
Advanced Framing

Credit: APA Advanced Framing Construction Guide

Ladder junctions at interior-exterior wall intersections (Figure 5) produce wall cavities that can be easily insulated to help builders earn the ENERGY STAR® label for new homes.
California Corner

Traditional Corner

No insulation here

California Corner

More insulation here
T Stud – R19

- Uses two lumber members, an internal truss system, and a frothed-in-place closed-cell foam
  - Thermal: reduces thermal bridging
  - Structural
  - Wind: 24” o.c. in wind loads 1-5
  - Sound transmission reduction
  - Fire: foam designed to char than melt
**T Stud – Barenaked Stud**

- Similar benefits to R19 stud, however open web design allows for any type of insulation to be used
  - Blown-in fiberglass, cellulose, mineral wool, or spray foam
Pre-insulated Headers

- 3-1/2” width for 2x4 construction
- 5-1/2” width for 2x6 construction
- Available in depths of 7-1/4”, 9-1/4” & 11-1/4”
- Value engineered for commercial jobs. Custom depths available (call for details).
- Full Thermal Break (Foam Core Construction)
  3-1/2” ExpressHeader = R7.75
  5-1/2” ExpressHeader = R16
- Right size every time. No cupping, twisting, or bowing. Less call backs for drywall problems.
- Stock length is 16’, custom lengths available.
- Bonded with exterior structural adhesive.
- One Piece Express Installation.

3-1/2” Construction Description
- 1-1/4” LVL (Laminated Veneer Lumber)
- 1” of Expanded Polystyrene (EPS)
- 1-1/4” LVL (Laminated Veneer Lumber)

5-1/2” Construction Description
- 1-1/4” LVL (Laminated Veneer Lumber)
- 3” of Expanded Polystyrene (EPS)
- 1-1/4” LVL (Laminated Veneer Lumber)
Continuous Exterior Insulation

5" Comfortboard. Photo Credit: Dan Edemen for Rockwool.
Furring Strips Over Continuous Rigid Insulation

Steps:

1. Install first layer of rigid insulation with limited number of nails or screws with washers.
2. Install second layer of rigid insulation with limited number of nails or screws with washers.
3. Fasten furring with screws; spacing and fastener size to be decided by weight of sliding material and spacing of furring.
Steps for installing furring over mineral wool:

1. Install first layer of mineral wool with limited number of nails or screws with washers.
2. Install second layer of mineral wool with limited number of nails or screws with washers.
3. Align vertical edges of exterior layer to ensure coverage by furring and prevent puckering.
4. Fasten furring with screws; spacing and fastener size to be decided by weight of siding material and spacing of furring. Consult manufacturer, architectural, or structural specifications.
Clip and Rail Systems

Credit: DOW Knight Wall MFI, Cascadia Windows
Wood Framed – Porches, Balconies

[Diagram showing details of wood-framed porches and balconies, including materials and construction techniques.]
Structural Thermal Breaks

• Armatherm™ 500 is a high strength, closed cell polyurethane material made in several densities to support a wide range of loading conditions.

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Armatherm™ 500</th>
<th>500-150</th>
<th>500-200</th>
<th>500-280</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressive Stress (psi)</td>
<td>560</td>
<td>1100</td>
<td>2150</td>
<td></td>
</tr>
<tr>
<td>Compressive modulus (psi)</td>
<td>18,130</td>
<td>29,000</td>
<td>49,300</td>
<td></td>
</tr>
<tr>
<td>Thermal Conductivity (BTU in/hr ft2 F)</td>
<td>0.32</td>
<td>0.39</td>
<td>0.53</td>
<td></td>
</tr>
<tr>
<td>R value per inch</td>
<td>3.1</td>
<td>2.6</td>
<td>1.9</td>
<td></td>
</tr>
<tr>
<td>Operating Temperature</td>
<td></td>
<td>-300F/+175F</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Flat Roof - Equipment Supports
Flat Roof
Thermal Break – Concrete Connections
EIFS - Insulation Options

• Typical EPS insulation board in the EIFS system substituted with Neopor GPS insulation board

• GPS - graphite polystyrene – comprised of small pockets of air within a polymer matrix. Graphite reflects radiant heat energy increasing R-value

• R-value slightly better in cold conditions

• R-3.85 (EPS) vs 4.7 (GPS) per inch
Parapet Insulation Wrap
Insulation Over Window Frame
What are your final thoughts and takeaways from the presentation today? (hint: link words with an underscore)
Questions & Final Discussion
Join Us for More Trainings!

- **Workshop 1**: Continuous Insulation
- **Workshop 2**: Air Sealing and Insulation for Homes
- **Workshop 3**: High Performance Ventilation Systems for Homes
Contact Us
Steven Winter Associates, Inc.
307 7th Ave., New York, NY 10001

Scott Pusey
Principal Sustainability Consultant | CPHC
spusey@swinter.com
717.587.0921 (c)
www.swinter.com
Thank You

For more information, please visit EnergizeCT.com/passive-house or email PassiveHouseTrainingCT@icf.com