



### Lesson #1: High Performance Walls (3 Days)

#### Objectives

##### Students will be able to...

- Identify components of an exterior wall assembly and describe the role each component plays in limiting heat transfer.
- Identify common insulation and air sealing materials and installation methods for high performance walls.
- Understand and demonstrate techniques for creating a high-performance wall assembly.

#### Common Core Standards

LS11-12.6  
RSIT 11-12.2  
Technology 4.1, 4.2, 4.3,  
Problem Solving and Critical Thinking 5.1, 5.2, 5.3, 5.4  
Health and Safety 6.3, 6.6,  
Ethics and legal responsibilities 8.1,  
Leadership and Teamwork 9.1, 9.2, 9.3  
Technical Knowledge and Skills 10.1, 10.2, 10.3, 10.4  
Demonstration and Application 11.1

#### Materials

- Handout or resources for lecture
  - 2019 Energy Code Requirements PowerPoint presentation (slides 6-45)  
<https://www.dropbox.com/sh/oo48no9ip2bsn9v/AACD6ckm3eDKXqPudGNNQdfHa?dl=0&preview=2019+Energy+Code+Requirements.pptx>
  - APA – The Engineered Wood Association: Advanced Framing Guide
    - Source: <https://www.apawood.org/publication-search?q=m400&tid=1>
    - NOTE- This is a National resource, any reference to Climate Zone is not for California
  - Product Specific Guidelines for HPA and HPW in California
  - Source: [https://www.wisewarehouse.org/wp-content/uploads/2018/05/Task-5.6-Product-Specific-Guidelines-for-HPA-and-HPW-in-California\\_FINAL.pdf](https://www.wisewarehouse.org/wp-content/uploads/2018/05/Task-5.6-Product-Specific-Guidelines-for-HPA-and-HPW-in-California_FINAL.pdf)
  - Application Guide: Residential Envelope and Solar Ready 2016 (refer to the 2019 Envelope and Solar Application guide when available)

- Source:  
[https://energycodeace.com/download/14949/file\\_path/fieldList/AppGuide.Res.Envelope.SolarReady.2016](https://energycodeace.com/download/14949/file_path/fieldList/AppGuide.Res.Envelope.SolarReady.2016)
- WISE Warehouse video: Quality Insulation Installation
  - The entire video is useful for this learning objective, and some of the concepts will also transfer to the next learning objective. Consider using entire video as support material for lecture.
  - There is information presented related to attics (next learning objective) and floors, as well as the HERS verification process for QII. If necessary, skip these portions, according to the below time stamps.
    - Intro: 00:00 to 01:23
    - Key Concepts and Definitions: 01:24 to 07:33
    - HERS information: 07:34 to 08:15 (Consider skipping)
    - Inspection procedures: 08:16 to 09:47 (Consider skipping)
    - Walls: 08:17 to 18:41
      - Consider skipping 14:26 to 17:25 if necessary, for time. This section covers very specific situations and is more detailed than required for the concepts presented here.
    - Attics: 18:42 to 24:56
      - Consider using as part of lecture for learning objective 2
    - Floors: 24:57 to 27:49 (Consider skipping, although the information presented is very relevant to floor insulation and should be kept if time allows.)
    - Spray Foam Insulation: 24:50 to 34:05
      - Provides detailed information on the proper installation of spray foam, as well as R-values and other characteristics. Consider using as part of an insulation materials lesson.
    - Multifamily 34:06 to 34:54 (Consider skipping)
    - Video then ends by covering what to expect in the 2019 Code, as well as resource and contact info. The 2019 Code will be in effect January 2020, and therefore will likely be the current Code when the course is delivered.
  - Source: <https://www.wisewarehouse.org/training-certification/training-resources/> or <https://youtu.be/A4QzTZeZdLs>
- Alternative: Selected slides from the 2016 HERS QII Training PowerPoint
  - Allows for a more customized approach and can limit the amount of additional information presented to limit confusion at this stage of the course
- Framed wall assembly with enough stud bays for each team to have their own
  - Create for this exercise or use one previously created as part of the framing module
  - If created for this module, allow students the option to select the materials, spacing, and corner design, if possible (allow for advanced framing concepts)
- Insulating and air sealing materials

- If budget is an issue, consider contacting local insulation contractors and see if they will donate usable materials. Samples of more expensive materials (rigid foam, rockwool, denim) are enough to illustrate the characteristics
- Personal protective equipment (PPE)
  - Including but not limited to: Safety glasses, masks, disposable coveralls or long sleeve shirts, work gloves, long pants, no open toed shoes (preferably boots)
  - Instruct students on the proper handling of the materials present

### Lesson Sequence

- Lecture
  - A wall assembly must attempt to control transfer of
    - Moisture
    - Air
    - Heat
  - A framed wall assembly is constructed of:
    - Exterior Finish
      - Stucco or plywood siding
    - Sheathing, shear wall, cladding, furring strips and other structural components as necessary
    - Framing
      - 16" OC has a framing factor of 25%
      - 24" OC has a framing factor of 22%
      - 2x4 and 2x6 most common option
    - Moisture and Air barriers (including air sealing)
      - Tyvek and other house wrap (Kraft paper vapor retarder)
      - Spray foam, minimally expansive foam sealing (aka gun foam), caulk, tape
      - Exterior and interior materials can also act as a barrier
    - Insulation materials (including but not limited to)
      - Fiberglass- batt, roll, blown
      - Cellulose- blown (wet or dry), dense packed
      - Spray foam- open cell, closed cell
      - Rigid insulation board- Polystyrene (EPS, XPS), Polyisocyanurate (Polyiso), Polyisourethane
    - Interior Finish
      - Drywall
  - Methods to limit heat transfer in a wall assembly- what is a High-Performance Wall?
    - Advanced framing techniques

- 2x6 or greater studs, 24" OC, insulated corners and headers, ladder blocking, wood panel sheathing, double walls, staggered studs
  - Alternative assemblies- SIPS, ICFs, Mass Walls etc.
    - Brief overview, purpose of this course is HPW but there are alternatives using performance method of Energy Code compliance
  - Quality Insulation Installation (QII)
    - Six-sides of insulation in contact with the air barrier
    - No compression, gaps, voids
      - Batts are sized to fit stud by, centers and depth
    - Impact of poorly installed insulation product
      - An R-19 batt will function as an R-13 batt if not installed properly (30% loss).
    - Source: Wise Warehouse Quality Insulation Installation video (as listed above)
  - Continuous exterior or interior insulation to mitigate thermal bridging
    - Installation techniques and potential challenges
      - Fasteners, insulated window bucks, exterior finish installation considerations
      - Air infiltration is reduced with proper installation and sealing
  - Insulation R-value in relation to thickness of product (density)
- Group discussion/activity
    - Introduce hands on activity
    - Emphasize proper PPE and material handling techniques specific to materials present
    - Divide the class into 4-5 person teams. Have each team attempt to properly air seal and insulate a stud bay (in a framed wall constructed in an earlier portion of the course, or one designed just for this exercise). Include typical obstacles such as plumbing and electrical penetrations. Assess each team based on air tightness, quality of insulation installation, and ability to explain the function of each installed product (Why is air sealing important? Etc.)

### **Assessment**

-Students will properly air seal and insulate a stud bay using HPW standards. Assess each team based on air tightness, quality of insulation installation, and ability to explain the function of each installed product.

-High Performance Walls Quiz

**Accommodations/Modifications**

Check for Understanding  
One on One Support  
Peer Support  
Strategic Partnering  
Extra Time If Needed

## High Performance Walls Quiz

1. In a properly insulated wall cavity, the insulation should have how many of its surfaces in contact with the adjacent assembly?
  - a. 2
  - b. 4
  - c. 6
  - d. 8
  
2. When installing insulation, it is best to avoid which of the following?
  - a. Voids, gaps or compressed insulation
  - b. Completely fill the wall cavity on all surfaces
  - c. Use the manufactures installation procedures
  - d. Install insulation in contact with the air barrier
  
3. A wood framed wall with studs at 24" on center has a framing factor of approx. what percentage?
  - a. 20%
  - b. 22%
  - c. 24%
  - d. 26%
  
4. Which of the following describes the energy efficiency benefits of utilizing advanced wall framing techniques?
  - a. Increase the total assembly U-factor of the wall
  - b. Reduce the amount of lumber harvested from sustainable forests.
  - c. Increase the rate of heat transfer through framing members
  - d. Reduce the rate of heat transfer through framing members
  
5. What type of insulation is typically used to provide a continuous layer of insulation on the exterior of a framed wall?
  - a. Loose-fill fiberglass insulation
  - b. Fiberglass batt insulation
  - c. Rigid foam insulation
  - d. Spray foam insulation

**High Performance Walls Quiz – *Answer Key***

1. C
2. A
3. B
4. D
5. C