# Building Shell Retrofit Strategies

# Weatherization Energy Auditor Single Family

Learning Objectives

By attending this session, participants will be able to:

* Discuss how to prioritize building shell retrofits.
* Discuss selected strategies for major building shell retrofits in different types of single-family housing stock.
* Describe specifications for various building shell retrofits.
* Identify material and installation options.
* Explain thermal and air barrier alignment.

Key Terminology

Air barrier (or air boundary)

Balloon-framed

Bypasses

Can light

Cantilevered floor

Chaseway

Collar beam

Condensation

Conductive heat loss

Dense-pack insulation

Dew point

Direct leakage

Dropped soffit

Furred-out walls

Incidental Repair Measure (IRM)

Indirect leakage

Knee-wall attic

Lead-safe Weatherization (LSW)

Loose-fill insulation

Low-e

Meeting rails

Platform-framed

Pocket door

Priority list

Pull-down staircase

Pulley seals

R-value

Solar Heat Gain Coefficient (SHGC)

Thermal boundary

Tuck-under garage

Two-part foam

Vapor retarder

Zone Pressure Diagnostics (ZPD)

Supplemental Materials

Handouts & Resources

“A Look Inside a Wall: Dense Packing.” *WxTV*. Montana Weatherization Training Center. <www.wxtvonline.org>.

“Accessing Stucco Walls for Dense Packing.” *WxTV*. Montana Weatherization Training Center. <www.wxtvonline.org>.

Air Sealing Target Table for State or Region.

Aleshire, Vic. “Handbook for Foam Products.” *Mid-Atlantic Weatherization Training Conference.* 2002. <www.waptac.org>.

Aleshire, Vic. “Crawl Space Solutions.” Home Energy May/June 2004: 27-29. <www.homeenergy.org>.

Appropriate ASHRAE guidelines.

“Attic Prep and Insulation.” WxTV. Montana Weatherization Training Center. <www.wxtvonline.org>.

“Behind the Walls.” Weatherization Tech Exchange. Energy Center of Wisconsin. <http://www.ecw.org/wxdensepackinsulation>.

Christian, Jeffrey, and Jan Kosny. “Wall R-Values That Tell it Like It Is.” *Home Energy* Mar./Apr. 1997. <www.homeenergy.org>.

Dastur, Cyrus and Bruce Davis. “Closed Crawl Spaces Do Double Duty.” *Home Energy* Special Issue. 2005. <www.homeenergy.org>.

“Dense Packing Exterior Walls with Cellulose from the Interior.” WxTV. Montana Weatherization Training Center. <www.wxtvonline.org>.

Efficient Windows Collaborative Website: <www.efficientwindows.org>.

Fisette, Paul. “Q&A: How Should I Finish an Existing Basement Wall?” *Journal of Light Construction* June 2010. <www.jlconline.com>.

Fitzgerald, Jim, Gary Nelson, and Lester Shen. “Sidewall Insulation and Air Leakage Control.” Home Energy Jan./Feb. 1990: 13-20. <www.homeenergy.org>.

Haywood, Talmon. “More Than Just Patching Holes.” Home Energy Mar./Apr. 2002.   
<www.homeenergy.org>.

“How to Choose Weather-Resistive Barriers.” *Toolbase.org*. NAHB Research Center. <www.toolbase.org>.

“Interior Drilling and Blowing.” *Weatherization Tech Exchange.* Energy Center of Wisconsin. <www.ecw.org>.

Keefe, David. “Air Sealing in Occupied Homes.” Home Energy Nov./Dec. 1995. <www.homeenergy.org>.

Klems, Joseph H. “Measured Winter Performance of Storm Windows.” *Paper LBNL-51453*. Lawrence Berkeley National Laboratory, 23 August 2002. <www.escholarship.org>.

LaRue, Jim. “A Conditioned Crawlspace Checklist.” Home Energy May/June 2004: 24-26. <www.homeenergy.org>.

Moriarta, Courtney. “Fixing Air Leaks in Connecticut Town Houses.” *Home Energy* Jul./Aug. 2008. <www.homeenergy.org>.

Shapiro, Ian, and Timothy Lambert. “Sealing Attic Hatches.” *Home Energy* Sept/Oct. 2007. <www.homeenergy.org>.

“Smart Vapor Retarders.” *Toolbase.org*. NAHB Research Center. <www.toolbase.org>.

“The Insulating Process.” *Weatherization Tech Exchange*. Energy Center of Wisconsin. <www.ecw.org>.

Turk, Brad. “Crawlspaces, Considering the Options.” Home Energy May/June 2004: 30-33. <www.homeenergy.org>.

U.S. Department of Energy. Hot Climate Initiative. Air Sealing.

U.S. Department of Energy. Hot Climate Initiative. *Dense-pack Sidewall Insulation.*

U.S. Department of Energy. Weatherization Assistance Program. “Attic Air Sealing Video.” 2009. <www.waptac.org>.

U.S. Department of Energy. Weatherization Assistance Program. “Crawl Space Air Sealing Video.” 2009. <www.waptac.org>.

U.S. Department of Energy. Weatherization Assistance Program. “Sidewall Insulation Video.” 2009. <www.waptac.org>.

U.S. Department of Energy. Weatherization Assistance Program, Midwest Regional Field Office. “Midwest Weatherization Best Practices Field Guide.” May 2007: 70-117.

U.S. Environmental Protection Agency. ENERGY STAR. “Do-It-Yourself Guide to Sealing and Insulating.” 6 Aug. 2009. <www.energystar.gov>.

Van der Meer, Bill. “Air Leakage Control: The Devil’s in the Details.” *Home Energy* 21 Mar. 2006. <www.homeenergy.org>.

Van der Meer, Bill. “Air Leakage in Recessed Lighting.” Builder Brief (BB0502) 2002. Pennsylvania Housing Research Center, Pennsylvania State University. <www.engr.psu.edu>.

Online Platform Lessons

Use these online interactive training modules as prerequisites before students attend the course, or as in-class computer lab sessions. Users must first create an account at [www.nterlearning.org](http://www.nterlearning.org) to access.

c- 5.1 Understanding Effective R-Value  
<https://www.nterlearning.org/web/guest/course-details?cid=247>

i- 5.1 Insulation Options & Safety   
<https://www.nterlearning.org/web/guest/course-details?cid=249>

i- 5.3 Insulating Attics <https://www.nterlearning.org/web/guest/course-details?cid=249>

i- 5.4 Insulating Walls <https://www.nterlearning.org/web/guest/course-details?cid=249>

i- 5.5 Insulating Crawlspaces/Basements   
<https://www.nterlearning.org/web/guest/course-details?cid=249>

i- 6.2 Air Sealing Basements and Crawlspaces  
<https://www.nterlearning.org/web/guest/course-details?cid=249>

i- 6.3 Air Sealing for Separation: Garage, Porches, and Between Occupancies <https://www.nterlearning.org/web/guest/course-details?cid=249>

i- 6.4 Weatherizing Windows and Doors  
<https://www.nterlearning.org/web/guest/course-details?cid=249>

Relevant Standard Work Specifications

1.402 – Drainage, Crawl Spaces

1.403 – Vapor Barriers

3.1000 – Air Sealing, Attics

3.1200 – Air Sealing, Windows and Doors

3.1400 – Basements and Crawl Spaces

3.1501 – Garage Openings

4.1001.1 – Attics, Non-Insulation Contact Recessed Light

4.1001.2 – Attics, Knob and Tube Wiring

4.1003 – Attic Ceilings

4.1004.5 – Knee Walls and Gable End Walls

4.1005 – Attic Floors

4.1006 – Attic Openings

4.1101.1 – Wall Preparation, Exterior Wall Dense Packing

4.1102.1 – Accessible Walls, Open Wall Insulation

4.1103.1 – Enclosed Walls, Dense Pack Exterior Walls

4.1103.2 – Enclosed Walls, Additional Exterior Wall Cavities

4.1301 – Accessible Floors

4.1402.1 – Closed Crawl Spaces – Wall Insulation

Classroom Props & Activities

This section is primarily based on lectures. Facilitate discussions and chalk talk showing principles of building retrofit strategies per the presentation and speaker notes.

**Attic Air Sealing Video:** Discusses various air sealing materials, common sites for air leakage in attics, and one approach to insulating half-stories when knob and tube wiring is discovered.

**Sidewall Insulation Video**: Discusses benefits of the technique and various issues that installers may face with dense-pack sidewall insulation.

Class Overview

Throughout the presentation, ask students leading questions about their perception of different building shell retrofit strategies, citing personal anecdotes from the field and encouraging participants to do the same.

* Use the presentation, discussion, and handouts to introduce students to the key elements of:
  + Specifying cost-effective air sealing and insulation retrofits.
  + Applying building shell retrofits to a variety of single-family housing types.
  + Highlighting retrofit strategies for specialized building components such as tuck-under garages, porches, basements, pocket doors, and windows.
* Show video segments at relevant portions of the presentation.