Dense Pack for Insulation & Air Sealing of California Homes

Part 1: Nov. 14, 2011  11 a.m.-12:30 p.m. Pacific Time
Nov. 17, 2011  11 a.m.-12:30 p.m. Pacific Time

Presented by:
Jim Fitzgerald, Center for Energy and the Environment, MN
Facilitated by: Linda Wigington, Affordable Comfort, Inc.

www.1000HomeChallenge.org    www.affordablecomfort.org
Slides out of Synch Today?

Or Slow Internet Connection???

ecoffman@affordablecomfort.org

Questions for Thursday’s Webinar?

Subject Line: Dense Pack Webinar Question

lwigington@affordablecomfort.org
Past Handouts & Upcoming ACI Events

www.affordablecomfort.org

Colorado ENERGY STAR Summit 2011  Denver, CO  Dec. 6-7, 2011

Information about the Thousand Home Challenge

www.ThousandHomeChallenge.org

- Introduction to the Thousand Home Challenge Webinar
  - Thursday, Dec. 8, 2011: 10-11:30 a.m. Pacific Time

Contact: Linda Wigington  lwigington@affordablecomfort.org
High Performance Hot Water: On the Path to Deep Energy Reductions (2-part) - Gary Klein


Ductless Heat Pumps: Recent Research & Applications for Low Energy Homes (2-part) - Mark Jerome, Bob Davis, & Marc Rosenbaum

Ducted & Ductless Mini-splits for Cooling Existing Homes - Danny Parker & Dave Robinson
PG&E’s 2011 Classes – Free!
Related to Deep Energy Reductions in Existing Homes
For a fall class schedule, visit -- www.pge.com/energyclasses

Deep Energy Reductions – The Thousand Home Challenge - Linda Wigington
Energy-Wise Renovation of Foreclosed Homes - Dave Robinson
Go Ductless California, Try Mini-Splits! - Dick Rome
Planning a Zero Energy New or Existing Home in CA - Danny Parker
Air Sealing & Insulating Existing Homes - Gavin Healy
Balanced Ventilation for High Performance Homes - Dan Perunko & Gavin Healy
Auditing Electricity Use in Existing Homes - Chris Hunt
Retrofitting California Crawlspace - Rick Cowperthwaite
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70%+ Deep Energy Reductions

The Thousand Home Challenge

Access & Integrate

- Efficiency
- Behavioral Choices
- Renewables
- Community Solutions
Key Metric

Transparent & Direct
Include Occupants

Net Annual Household Site Energy
Credits/offsets: Solar & onsite renewables
Wood counts!

Each household has its unique threshold of performance to meet or exceed.
Thousand Home Challenge
Threshold Determination

OPTION A
• 75% reduction in actual annual site energy use

OPTION B
• Climate (ZIP Code or best match weather station)
• House size (FFA), converted to surface area (5 sides)
• Detached or attached
• Electric heat allowance = ½ fossil fuel or wood heat allowance
• Number of occupants (including partial occupancy)
THC Option B Household Threshold
Comparing fossil/wood heat vs. electric heat
(kWh/yr. all end-uses)

NOTE: 5,000 kWh = 17.2 MMBtu, or ~170 therms of natural gas

OPTION B Inputs: detached; 3 in household; 2,000 ft² finished floor area (FFA)
THC Option B Household Threshold
(kWh/yr. by end-use)

NOTE: 5,000 kWh = 17.2 MMBtu, or ~170 therms of natural gas

OPTION B Inputs: Detached; 3 in household; 2,000 ft² finished floor area (FFA); electric heat
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eco@affordablecomfort.org

Questions for Thursday’s Webinar?

Subject Line: Dense Pack Webinar Question

Iwigington@affordablecomfort.org
Learning Objectives

By attending this two-part webinar, participants will be able to:

1. Identify house types and common features where air leakage reductions from dense pack insulation are likely to be particularly effective.

2. Recognize the importance of and be able to describe the on-site/on-the-job process to ensure uniform insulation density.

3. Identify two ways to ensure that they have achieved complete coverage, filling all cavities.

4. Describe considerations for selecting points of access for closed wall cavities.

5. Be able to list features and conditions where dense pack should not be performed.

6. Better differentiate between a job well done & partially complete work.
Webinar Outline Today

Linda Wigington
• Intro & Thousand Home Challenge

Jim Fitzgerald
• What is dense pack?
• What does it take to have a job well done?

Discussion/Questions
• Post comments & questions under “Questions” or submit questions for Thursday (lwigington@affordablecomfort.org)
This Webinar Does Not Address

- Combustion safety (including unvented appliances, venting system performance, potential for pressure-induced backdrafting)
- Source control of pollutants & adequate house ventilation
- Adequacy of electric wiring, e.g., knob & tube wiring
- Flashing/rain & surface water management
- Disturbance of materials containing asbestos or lead
- Potential fire hazards (recessed light fixtures)
- Any other stop work conditions that require repair prior to proceeding
Check It Out - Great Resource!

“DENSE-PACK SIDEWALL INSULATION VIDEO”
developed by WECC & the Energy Center of Wisconsin, funded by a US DOE weatherization grant:

http://www.ecw.org/wxdensepackinsulation
Jim Fitzgerald

Jim Fitzgerald is widely known throughout North America for training weatherization contractors & crews. He started his career as an insulation contractor in Minneapolis, where he developed techniques for dense pack cavity fill insulation of existing homes. With the help of Gary Nelson (The Energy Conservatory) & the use of infrared & blower door diagnostics, Jim developed a comprehensive approach to dense packing that consistently yields insulation continuity & significant air leakage reductions. Jim recently helped develop BPI's criteria for Air Leakage Control Installer certifications, & is now a member of BPI's working group to draft standards for thermal insulation used as an air retarder. He also provides field audits for ABAA (Air Barrier Association of America) in new commercial work. In the past, he has conducted hundreds of stucco moisture investigations.
Dense Pack in California

Part 1 - Wall Cavities
Why Dense Pack?
I Can’t Forget the 1st House

2,000 ft² wood lap walls
DIY cellulose on a weekend
January gas use dropped
From 310 therms to 160 therms (MN - cold)

Dropped more than expected, made me wonder ....

Quieter, more uniform in temperature
Harold the Homeowner Asked
“What Will Wall Insulation Save?

2,000 ft$^2$ of walls
1,200 ft$^2$ of attic
R 19 to R 38

Answer (predicted):
460 therms of gas or
350 gallons of oil/year
It Saved 800 Gallons That Year!

- 500-gallon fuel oil tank
- Five fills in 2 years before (1,250 gal/yr.)
- One tank lasted all year (<450 gal)
- Harold told his friends he saved double & to call us!

- I could not forget 500 gallons per year extra
- Reality did not fit the model
It Is Not Just the Walls -

It is all of the connections!!

And whatever else the IR shows
How Measured?

Cubic feet per minute (CFM)
cfm50 = airflow at 50pa pressure difference as measured by a blower door
50pa = about 1 lb/square foot
I Started Taking CFM50 Pre/Post

Home Energy, vol. 7, No. 1, 1990 Jan/Feb
2,000 cfm50 average reduction - 32 MN houses

4 houses had no accessible airsealing, only cavities to pack:
50% average reduction in cfm50 on just airflow through cavities

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<th>volume ft.³</th>
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*above ground

ACI - Thousand Home Challenge 11-14-11
What Does It Take to Get Both
Insulation & CFM50 Reduction?
Packed Fibers Resist Airflow through Wall Cavities

- **Cellulose:** 3.5 lbs/ft$^3$ or higher (R 3.5-3.7/inch)

- **Mineral wool:** 3.5 lbs/ft$^3$ or mfg. requirement (R 3.8-3.9/inch)

- **High performance fiberglass wool:** 2.2 lbs/ft$^3$ or mfg. required level (R 4.2-4.3/inch). Material designed for air resistance, tested with results provided to BPI. *This is not the same product as high loft attic insulation.*
Dense Pack Materials
(in the directory of certified insulation materials)

• **All cellulose** in directory is also approved by BPI

• **4 fiberglass materials** in directory are approved by BPI use in reducing airflow
  – JM Spider: Reg CA-T040 (CO)
  – Knauf Perimeter Plus: Reg CA-T003
  – CertainTeed: InsulSafe & Optima: Reg CA-T024 (PA)

(For info: [http://www.bpi.org/](http://www.bpi.org/) or 518-899-2727)
Air Seal & Dense Pack Combine to Wrap the Whole Building

1. Seal accessible attics, exterior ducts, & crawl spaces; make continuous air barrier across top & bottom wherever possible

2. Dense pack wall volumes we can’t reach to seal
   – Reduce airflow through hollow cavities
   – Block edges of chases
   – Leave no escape routes for air we are trying to keep inside
Dense Pack: Not Loose Insulation

Lab training mockup

4 lbs/ft$^3$ density stays in place
Walls, floors, cantilevers

(4 lbs/ft$^3$ - Cellulose)

“I did this!”
High Performance Fiberglass into Density Test Box
(same tube as cellulose)
Dense Pack Cellulose

✓ Different from loose
✓ Turns into a block - too tight to fall out
✓ Won’t settle in 8’ wall
✓ Clogs up paths for cavity airflow

But, dense pack is not an air barrier...
Resources: Air Barriers

- ABAA (Air Barrier Association of America)
  www.airbarrier.org/
- Building America (US DOE Initiative)
  http://www1.eere.energy.gov/buildings/building_america/
- Building Science Corp. (BSC)  www.buildingscience.com/
- www.GreenBuildingAdvisor.com
- Passive House California (PHCA)
  http://passivehousecal.org/
- The Passivhaus Institut (PHI)
  http://www.passivehouse.com/07_eng/index_e.html
- Passive House Institute US (PHIUS)
  http://www.passivehouse.us
It Is Time for a Poll!
Part 1 (continued)
Sacramento Job

(house type with significant air leakage reduction; porch roof, open sheathing at wall tops)

Photos courtesy of Gary Talbott, Sacramento, CA 2011
Inside: Plaster Drill & Patch
Outside: Stucco Drill
Insertion Tube Method

Inside with tube

Outside with siding removed before foam board installed
Wood Shakes, Lead Safe

Photos courtesy of Chris Clay Oppco.org, Bellingham, WA 2011

Vinyl Siding

Blow down open gable walls from attic

Courtesy Bruce Torrey 2009
For Quality Assurance

Two Questions:

1. What is the density?
   
   *Get bag count to calculate lbs. of material/wall volume filled*

2. Is coverage 100% with no air leaks?
   
   *An IR scan with a blower door at 50pa will answer that*
Infrared Can Confirm Work

John Snell is an independent expert who helped RESNET develop an IR certification for these specific tests.

He trained many California IR technicians in building energy & air leakage inspection.

*IR in background shows wall leakage during winter, natural conditions*
IR #1 Interior: No Voids, No Air Leaks

Quality basic job

During heating season (cold outside)

Sample to show R-13 wall without voids or bypasses.
Note: No continuous exterior insulation; studs significant source of heat loss once wall is insulated
IR Example #2: Voids & Air Leaks

Quality yet to be delivered
Process After IR Finds Work To Do

• Send contractor back
  (IR image is a map of where to fix)

• Drill into parts colored gold, pack empty cavities
Action If Density Is Low

• Reblow to prevent settling if >10% below

• Any fiber insulation cavity can be rebloed to get proper density, fill, or consistency

• Use fill tube with machine switched to “air only” to enter cavity, then redo
Deliver Target Density Uniform & Complete Coverage

- Confirm insulation blower systems can reach 80” wc or 3 psi
- Drill & probe side to side, up & down to access every cavity
- Set machine & pack density test box to target
- Insert tube to both ends & pack 1st cavities, check with smoke, compare bag coverage to density target
- Pack remainder & compare total material coverage to target
- Stop & check inside for openings if a cavity takes longer to fill
Check Static Pressure
Full Air with Outlet Blocked, Feed Shut
(small airlock blowers)

Minimum of 3 psi or 80 IWC

Dwyer Magnehelic Pressure Gauges
Catalog #2205, 0 – 5 150 IWC ($62)
Adjust Machine & Blow Test Box to Target Density

Measure weight added,

adjust machine until target met

7 lbs. added cellulose = 3.5 lbs/ft³
Adjust to 2.2 lbs/ft$^3$
Target with Approved Fiberglass
Process: Probe & Drill to Access All Cavities in a Given Area
Insert Tube Up & Down to Ends; Fill a Cavity
Process During Installation
Smoke Check with Blower Door On

Smoke pulled into cavity before

Smoke drifts past packed material after
Compare Material Coverage to Target
During Work, Check Inside for Surprises If Cavity Takes Longer to Fill
Best to Check *Before We Start & Avoid Cleanup*

- **Block all openings** inside the house that may allow blown insulation to enter
- **Brace weak surfaces**
- **Find all non-IC recessed lights** before blowing & maintain clearance or replace
- **Confirm all safety checks & repairs** before work is done & site is ready
Non-IC Light Fixture
(not found in time)
High Performance Fiberglass

• Goes in with ~½ the pressure of other materials & provides good air resistance at lower density
• It may be better to use where interior finish materials are not as strong as ½” sheetrock
• It will not react with the lime in masonry or corrode metals
• Can be installed in contact with heat sources like chimneys
• Blowing equipment & hose need to provide more conditioning for material (check with manufacturers)
High Quality Cellulose

• Has boric acid as a flame retardant & newsprint & other recyclable paper as its primary components; considered “green”

• Has shown a degree of fungal suppression where slight wetting & drying cycles were found

• Borates also restrict insect activities, but are not a fumigant
Conditions to Avoid
(contact with wet materials, exposed soil, flashing leaks)

Including:

• Brick, stucco, & cultured stone exterior finishes installed with no weather barrier or wall sheathing protecting interior components

• All 3 materials are moisture “reservoirs,” as they take up water during rain & mist and transfer moisture into the wall assembly if the drainage space is not maintained

• Brick cavity wall construction has shown efflorescence when the central space is filled, & chemical reactions with borate flame retardants
Example 1 Stucco Wall w/o Sheathing
(no drainage after foam installed; cannot be repaired)

IR irregular: voids & wet

Area in box > 20% moisture in foam with 2 areas >30%
Example 2 Brick Cavity Wall Needs to Maintain Drainage When Filled

=> EIFS Option
Solid Full: Efflorescence Outside Moisture Weeps through Felt to Inside
Time for Questions & Comments

Use “question option” to submit questions

Part 2 - Thursday
(separate registration required)
Dense Pack for Insulation & Air Sealing of California Homes

Part 2

Nov. 17, 2011 11 a.m.-12:30 p.m. Pacific Time

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Facilitated by: Linda Wigington, Affordable Comfort, Inc.

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