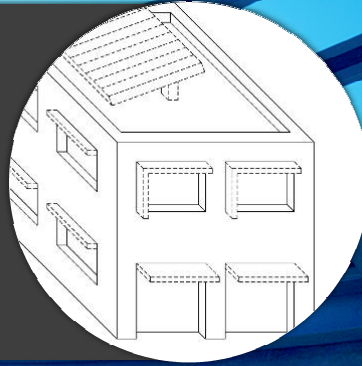


INTEGRATING GREEN BUILDING STRATEGIES INTO YOUR PROJECTS

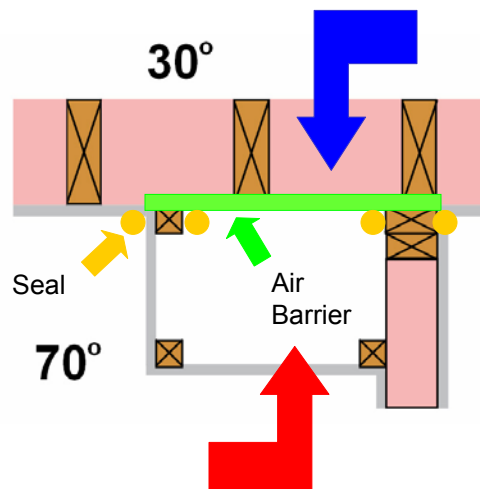
THERMAL BYPASS & AIR BARRIERS
Armando Cobo



WHAT IS THERMAL BYPASS?

- **TBP** is air, heat, and moisture that moves in and out of a building through openings in the building's envelope.

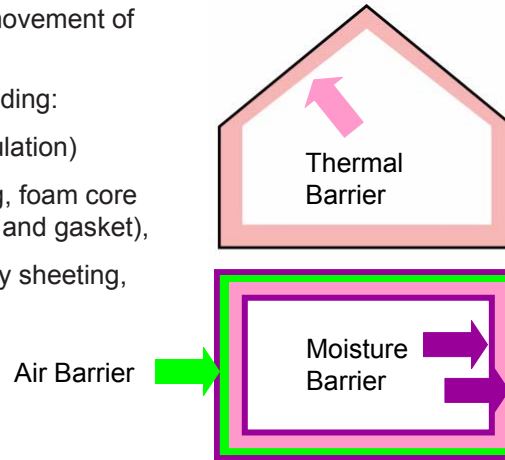
- An **air barrier** is any solid material that is used to block the air flow between conditioned and unconditioned space, including necessary sealing to block excessive air flow at edges and seams.





BUILDING BARRIERS

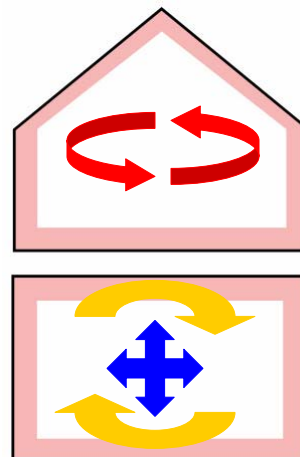
- Building sealed to prevent movement of air, heat, or moisture.
- Three barriers to protect building:
 - 1. **Thermal barrier** (insulation)
 - 2. **Air barrier** (sheathing, foam core board, house wrap, caulk and gasket),
 - 3. **Moisture barrier** (poly sheeting, plastic, etc.).



3C- BARRIERS

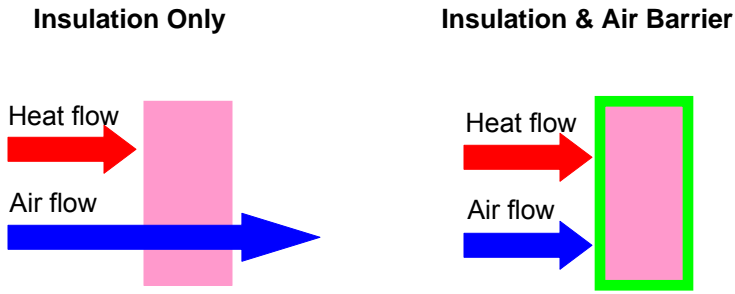
•All buildings must have Continuous, Contiguous, and Complete barrier– **3C Barrier**.

- Continuous:** envelope with no breaks in the air and thermal barriers.
- Contiguous:** two barriers are physically touching each other at all times, in all places.
- Complete:** in that the air and thermal barriers together completely contain the living space within the building.



AIR FLOW

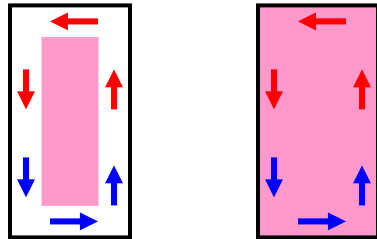
- Most insulation **DOES NOT** stop the flow of air.
- Most insulation **MUST BE SEALED ON ALL SIX SIDES** to be effective.
- **AIR BARRIERS** prevent the flow of air through insulation.



AIR LOOPS & GAPS

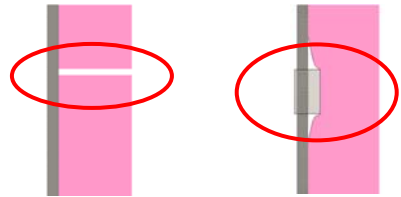
AIR LOOPS

- Convection due to gaps on both sides
- Low density insulation in the attic loses 30% R values to convection air at high Delta T's $\geq 50^\circ$ or higher.



GAPS

- 1/8" Gap reduces 45% R values



HOW GOOD IS BATT INSULATION?



MORE BATT INSULATION?



BULK & VAPOR MOISTURE

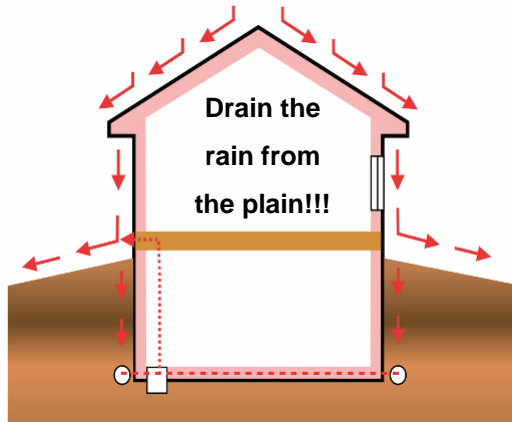
- BULK MOISTURE:

Is the liquid form of moisture, such as rainwater or water leaks from plumbing. Occurs by gravity, Capillary Action, Air Pressure and Wind

- CONDENSATION

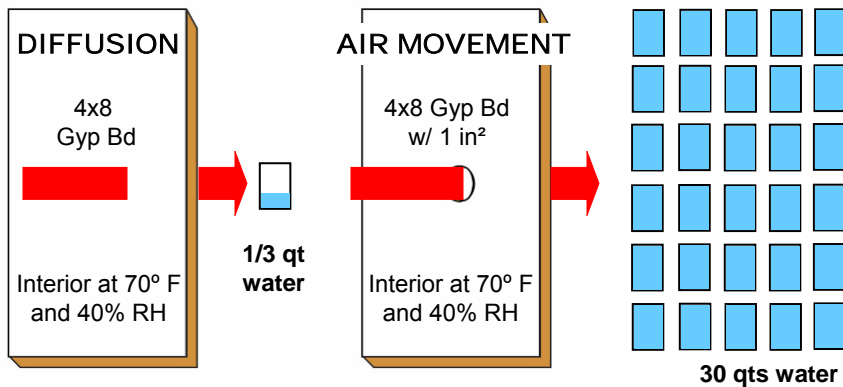
Winter: Humid air cools by contacting cool surfaces

Summer: Humid air contacts envelope, which has been cooled by the air conditioner.



VAPOR MOISTURE

- VAPOR MOISTURE: The other form of moisture to be concerned is vapor. It moves through two mechanisms: Diffusion and Air Movement

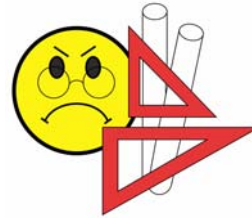


Vapor always moves from more moisture to less moisture and it travels from hot to cold

WHERE IS TBP COMMON?

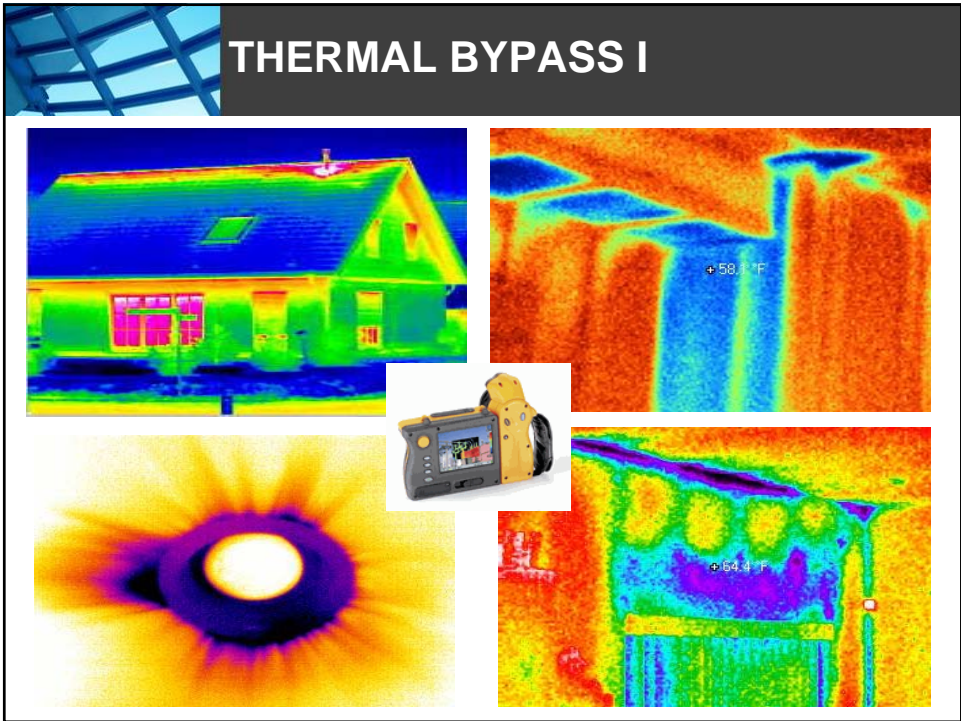
COMMON PROBLEMS:

- Overall Alignment
- Windows & Doors
- Behind Bathtubs / Showers
- Recessed Light Fixtures
- Floor Systems / Band Joists
- Plumbing Penetrations
- Electrical Penetrations
- Stairs / Attic Covers / Whole House Fans / Skylights / Roof Doors

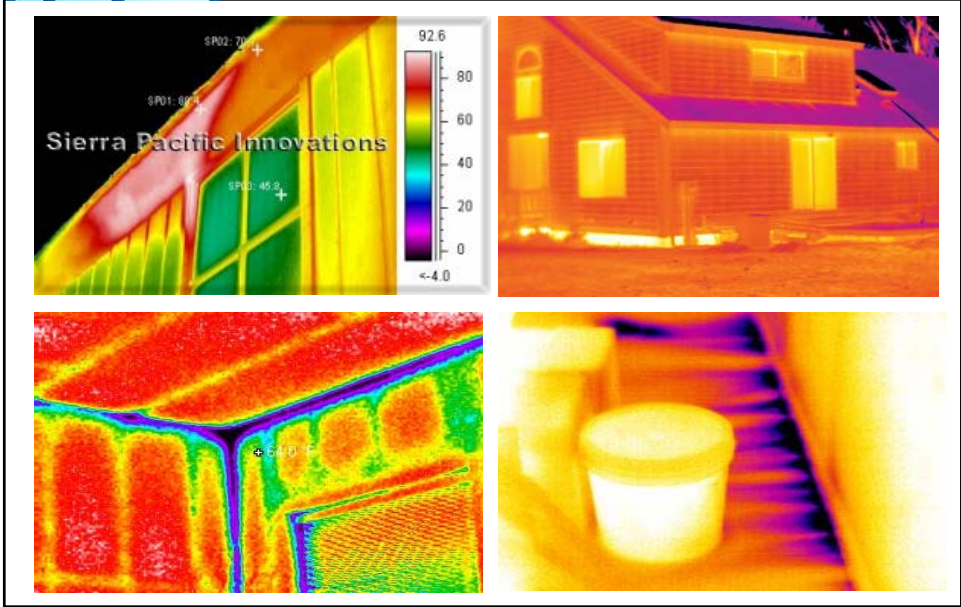


SEALING PENETRATIONS

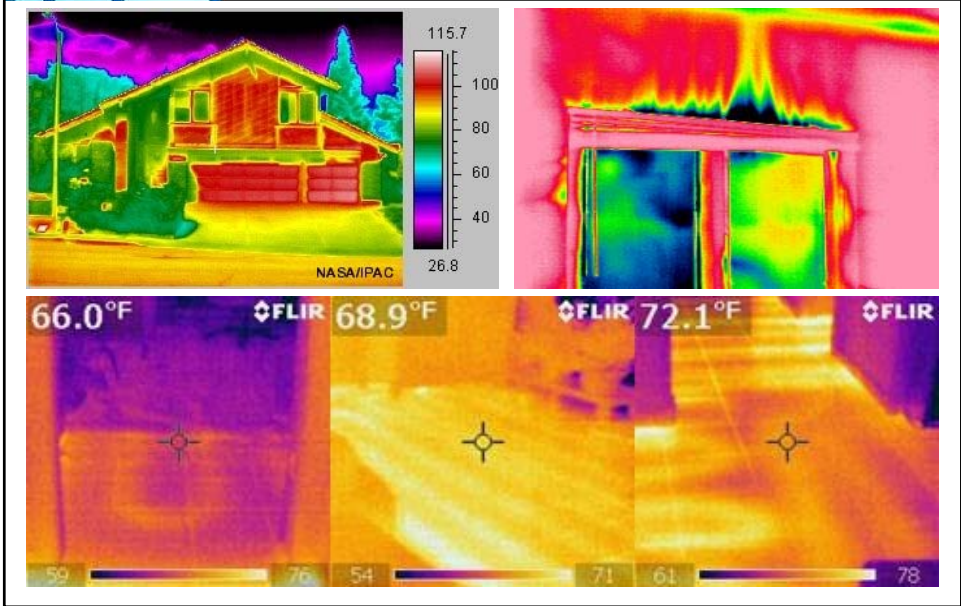


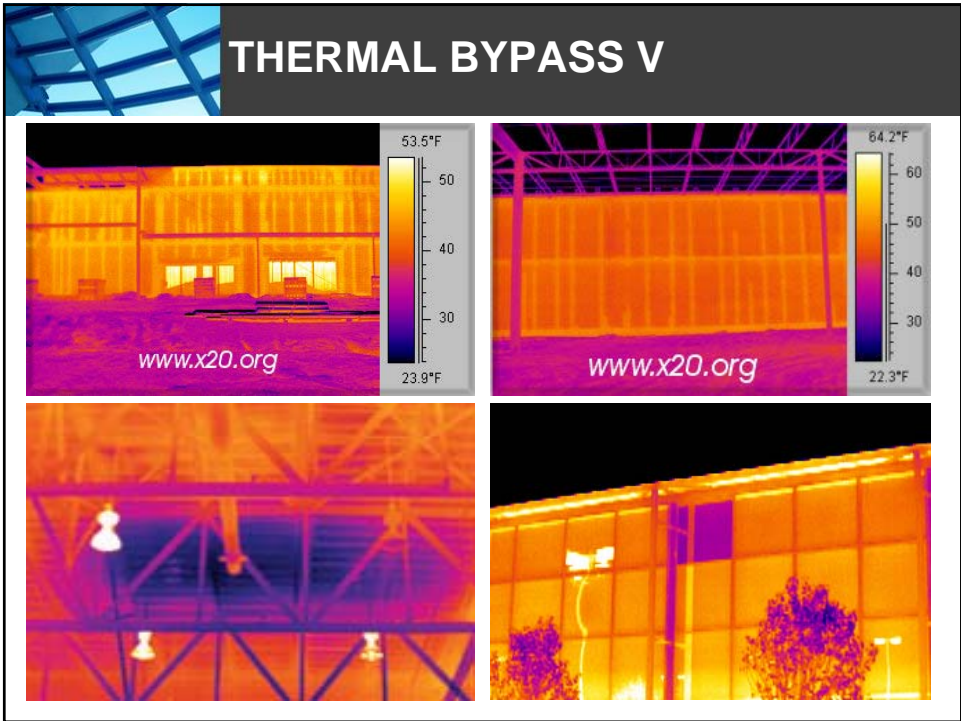
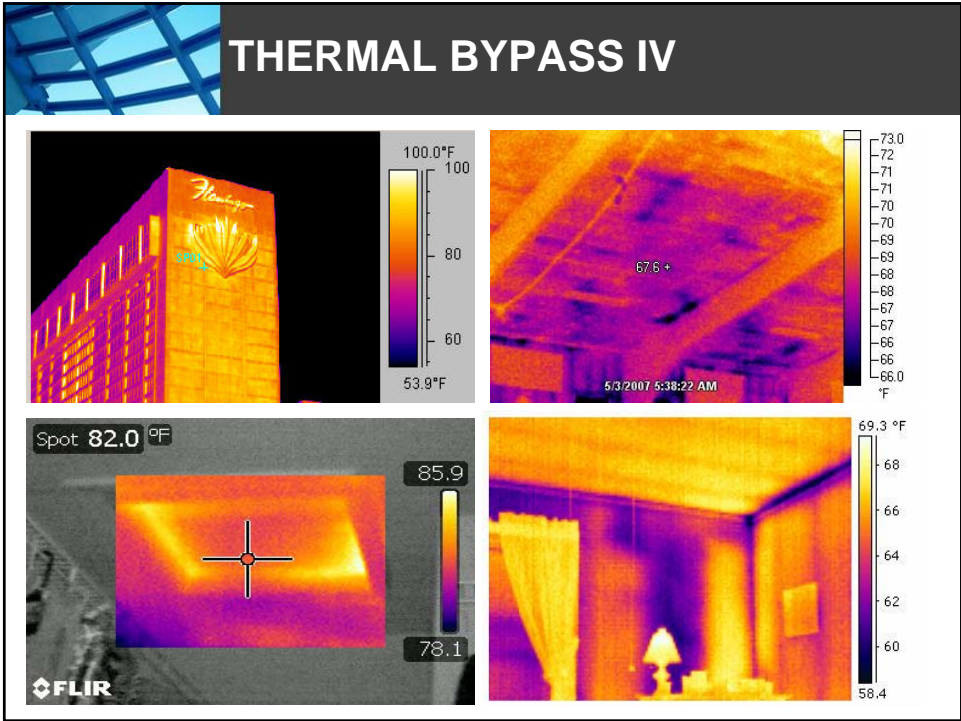


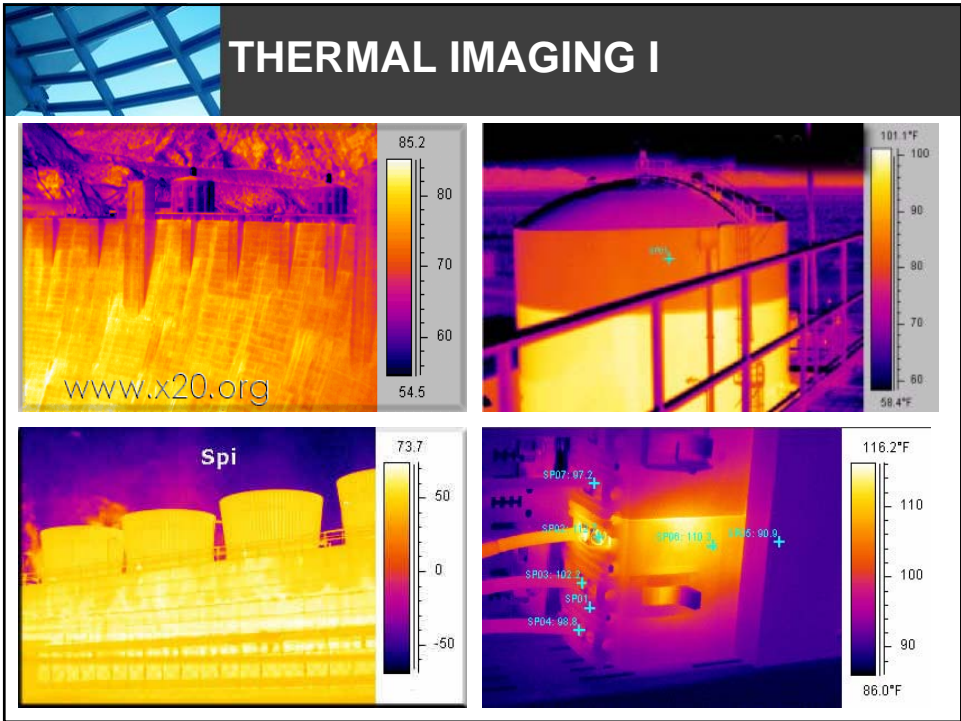
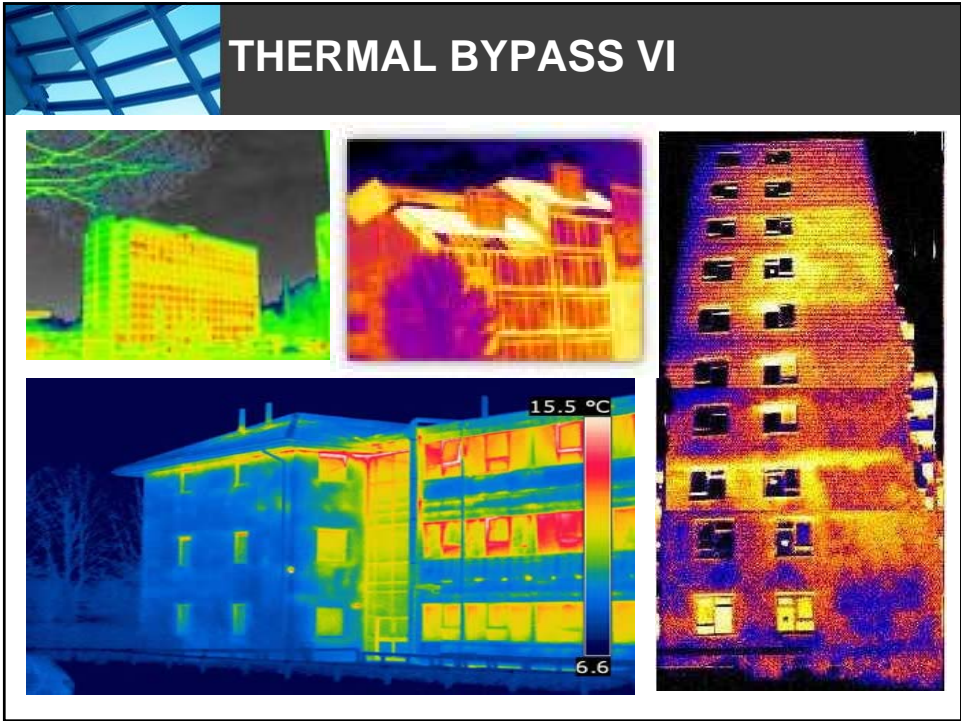
THERMAL BYPASS II



THERMAL BYPASS III



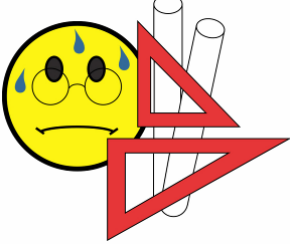





WHY IS TBP COMMON?

UNDESIGNED HOLES:

- Attic / Ceiling Interface
- Shafts / Chases / Ducts
- Soffits
- Floor Systems
- Dropped Ceilings
- Cantilevers
- Common Walls
- Knee Walls
- **DETAILS NOT ON PLANS**








Create New Position: Hole Manager

TIGHT CONSTRUCTION

Air Sealing Before Drywall

- Bottom, Top & Seal Plates
- Window & Door Rough Openings
- Plumbing Rough Openings
- Electrical Penetrations
- HVAC Penetrations
- Roof Decking to Top of Wall
- Cantilevers

TIGHT CONSTRUCTION

Air Sealing After Drywall

- Caulk Electrical Outlets to Drywall
- Caulk Light & Fan Fixtures to Drywall
- Caulk HVAC Boots to Drywall
- Weather-strip Attic/Roof Hatch
- Weather-strip Skylights



GOOD INTERIOR INSULATION



GOOD EXTERIOR INSULATION








OPTIMAL VALUE ENGINEERING

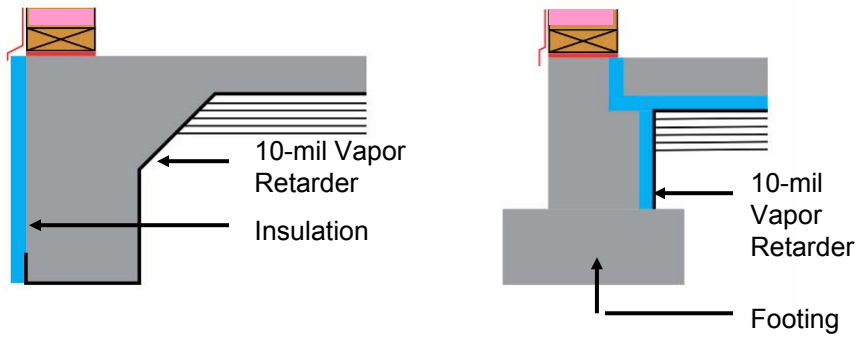




- OVE: Optimal value engineering – minimizes studs and plates.
- Factory built assemblies to ensure thermo bridging, insulation alignment, and integrated air barriers.

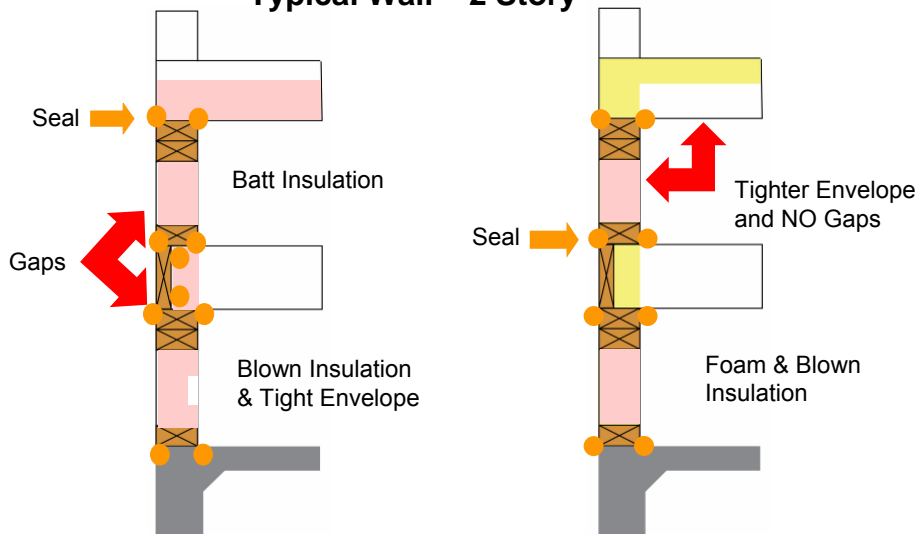
FOUNDATION INSULATION

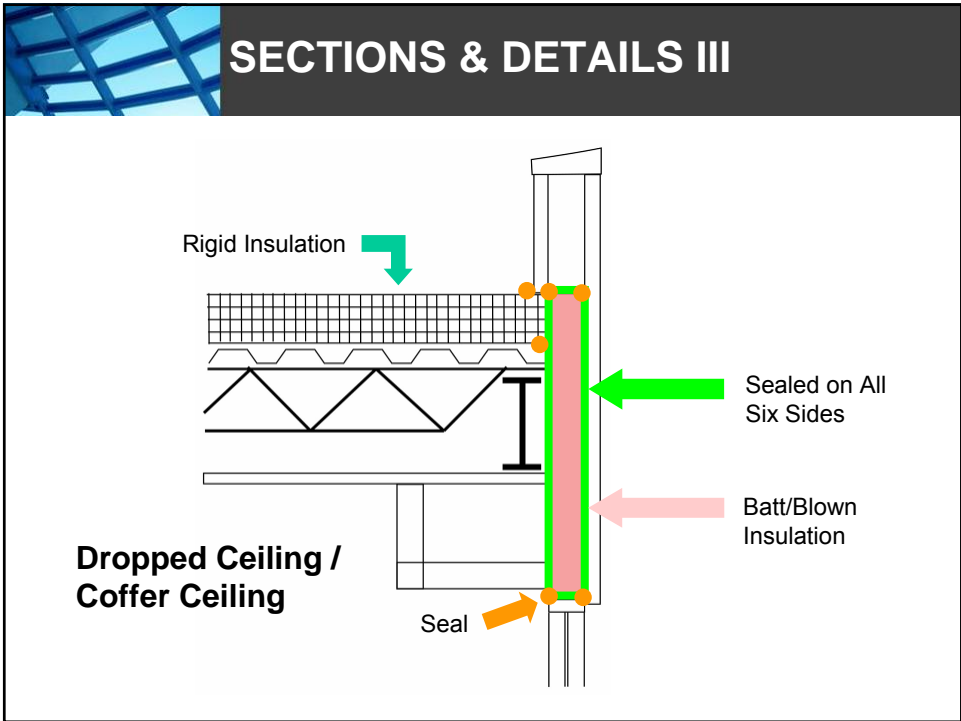
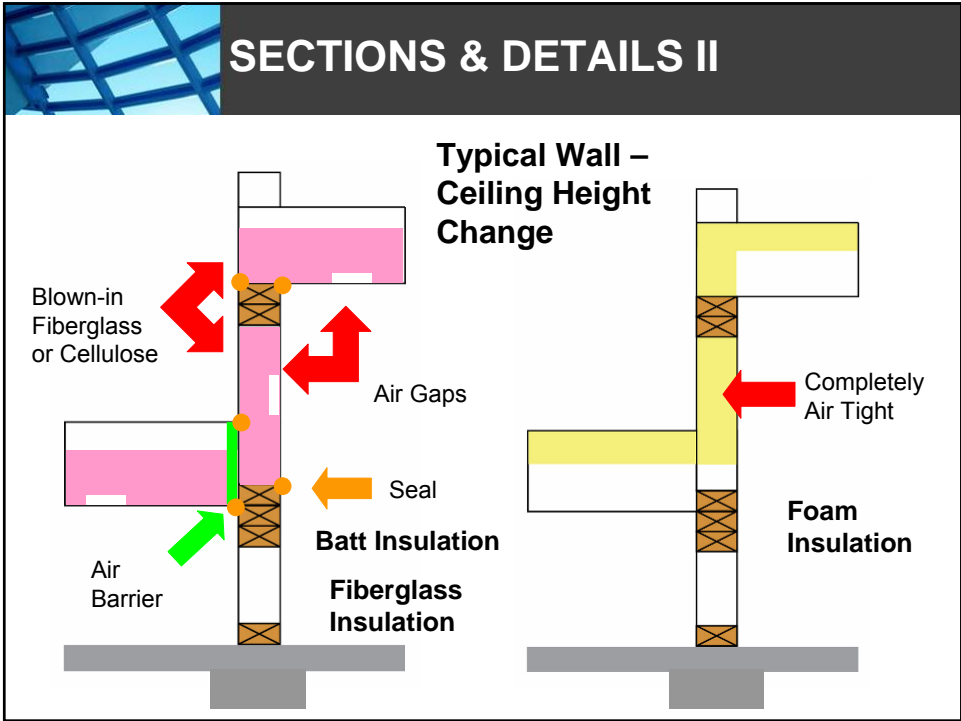
Slab Edge Insulation: (Climate Zones 4 and higher)

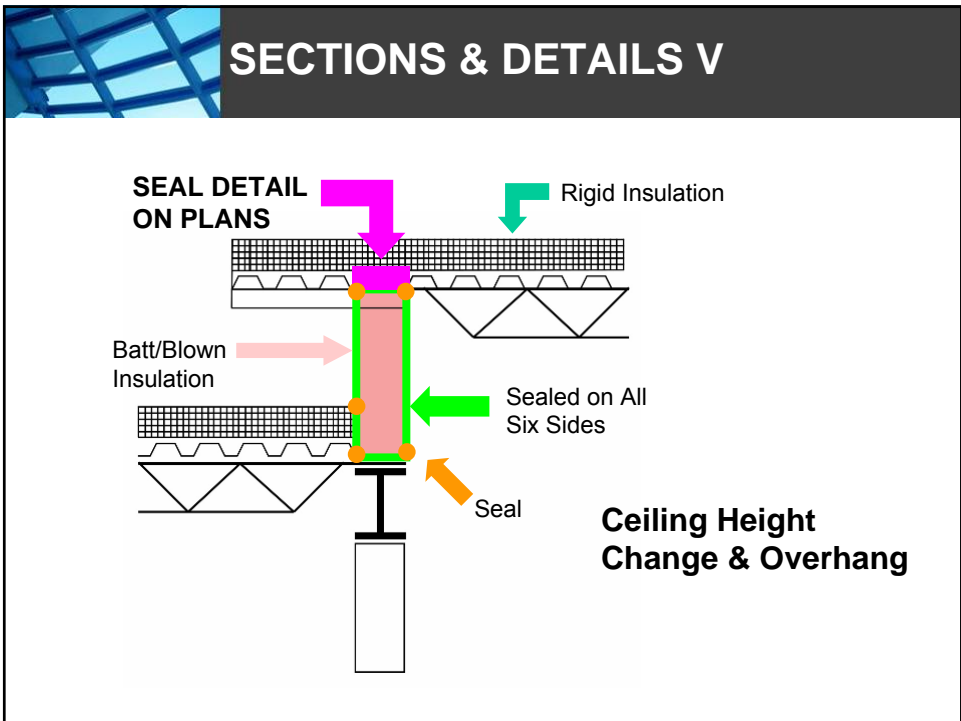
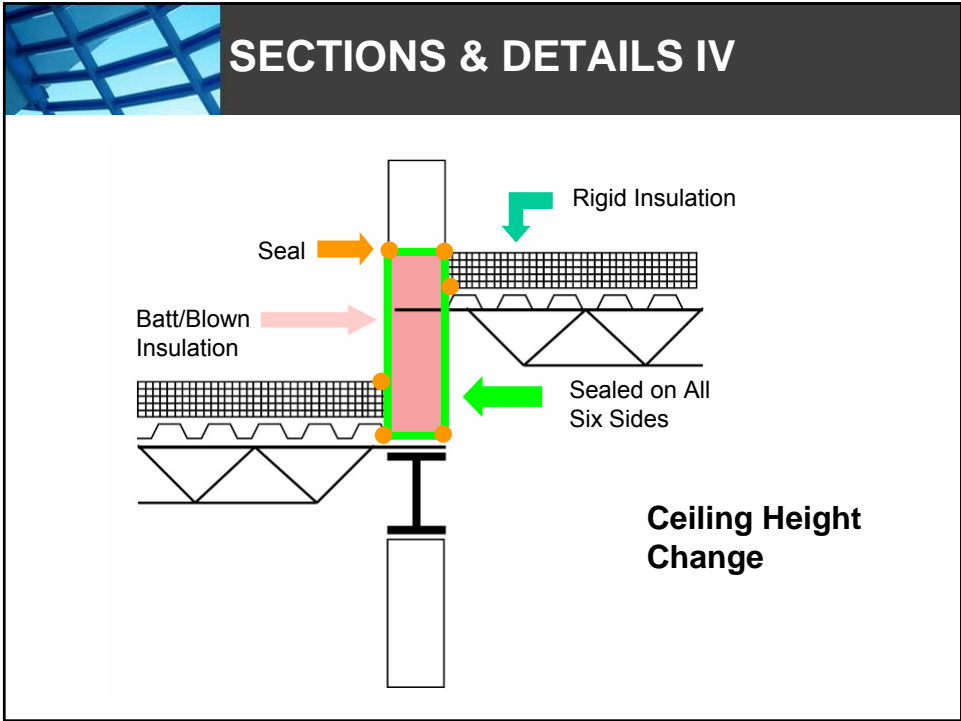


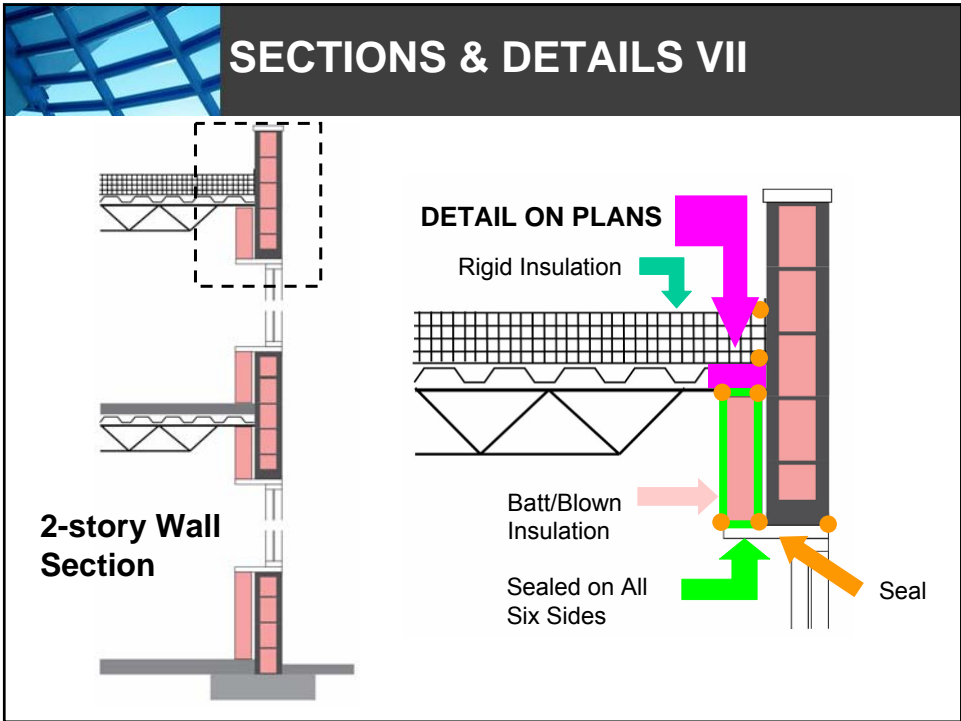
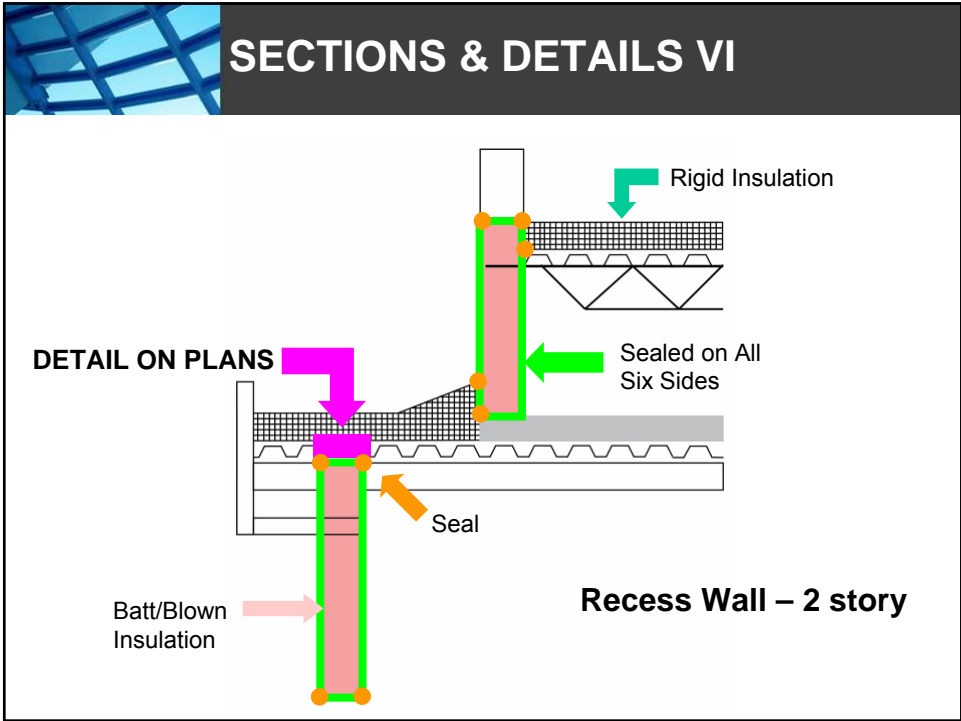
SECTIONS & DETAILS I

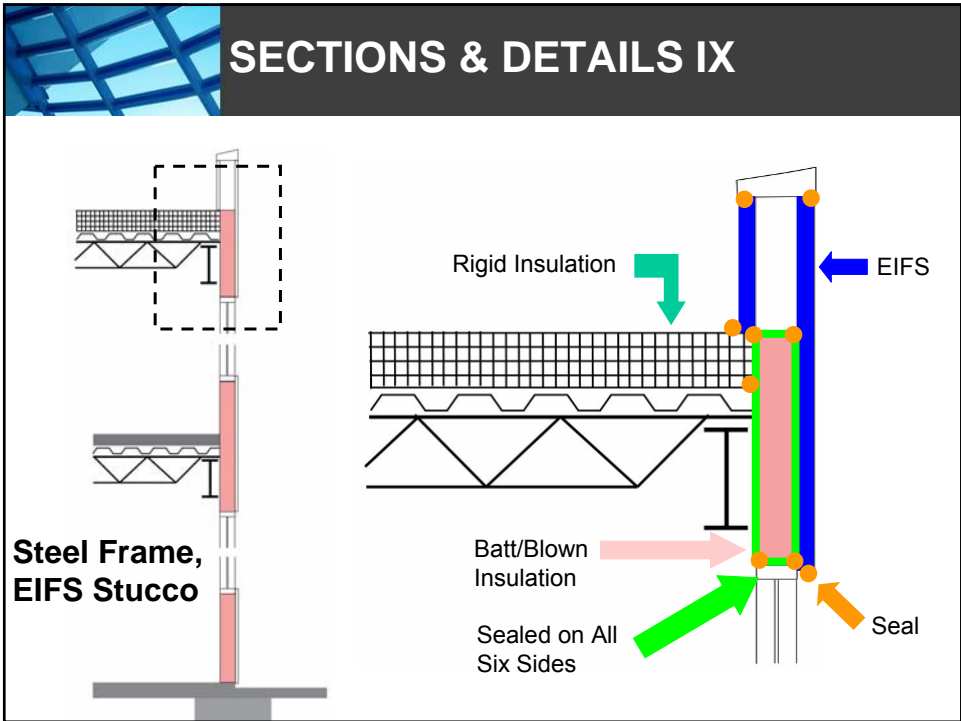
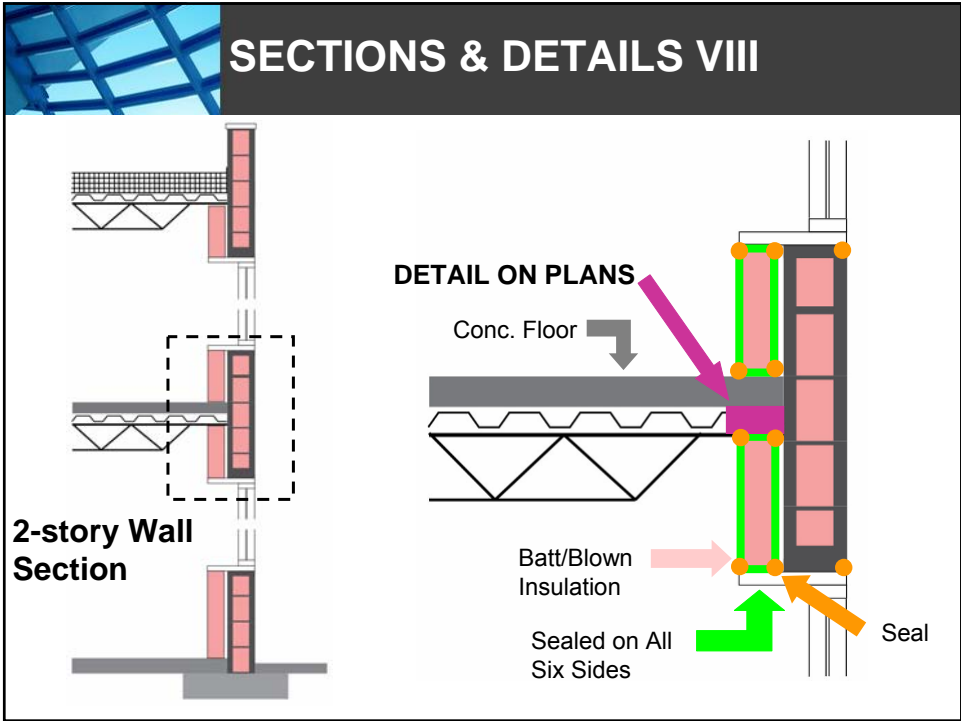
Typical Wall – 2 Story

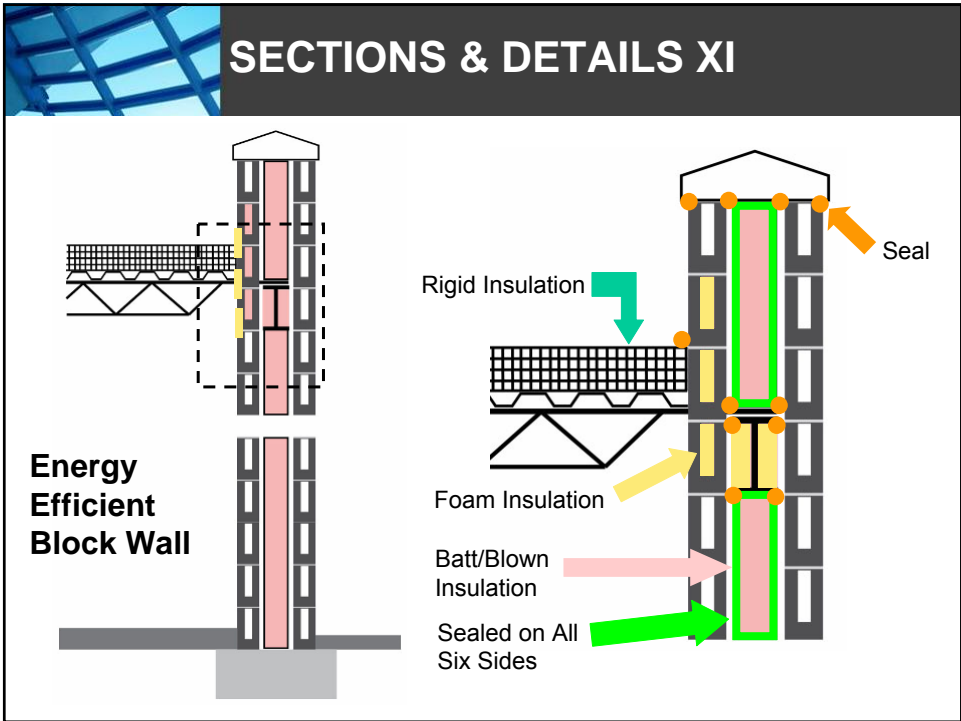
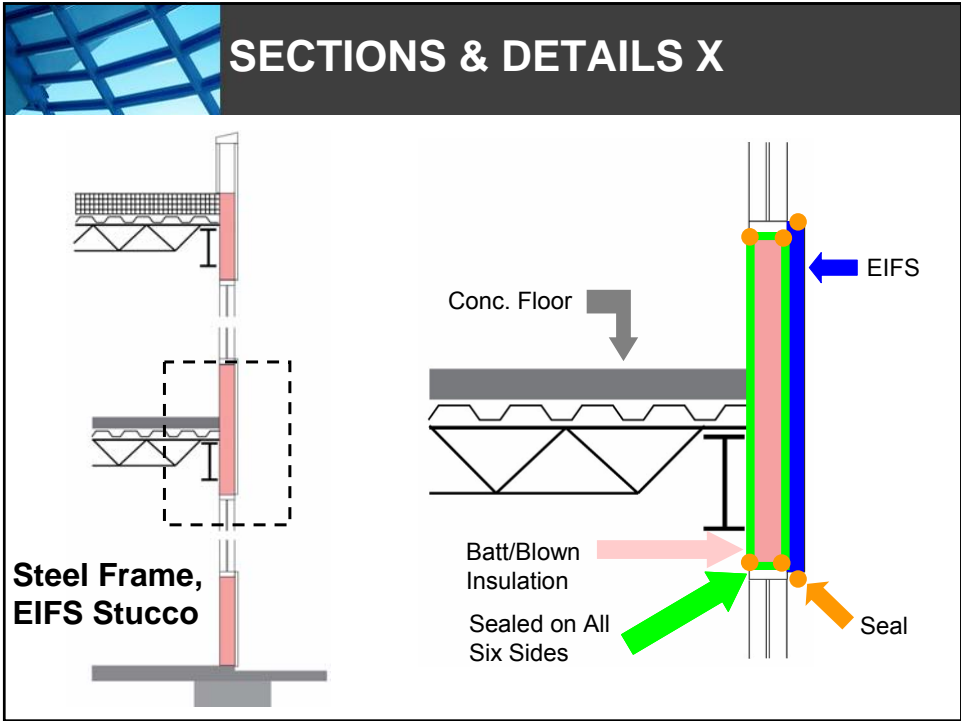


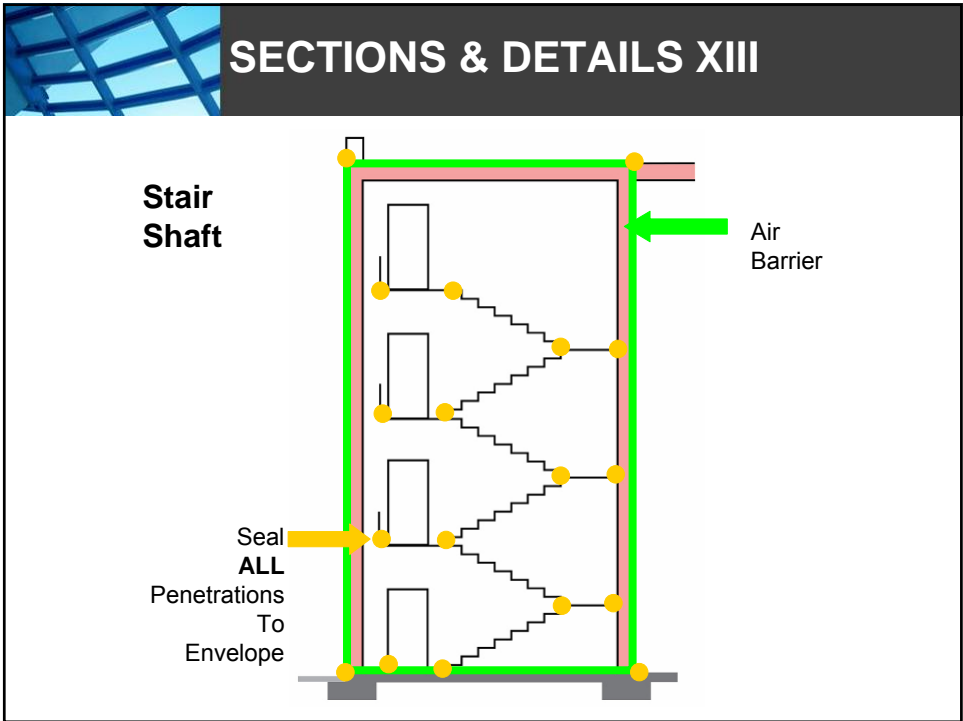
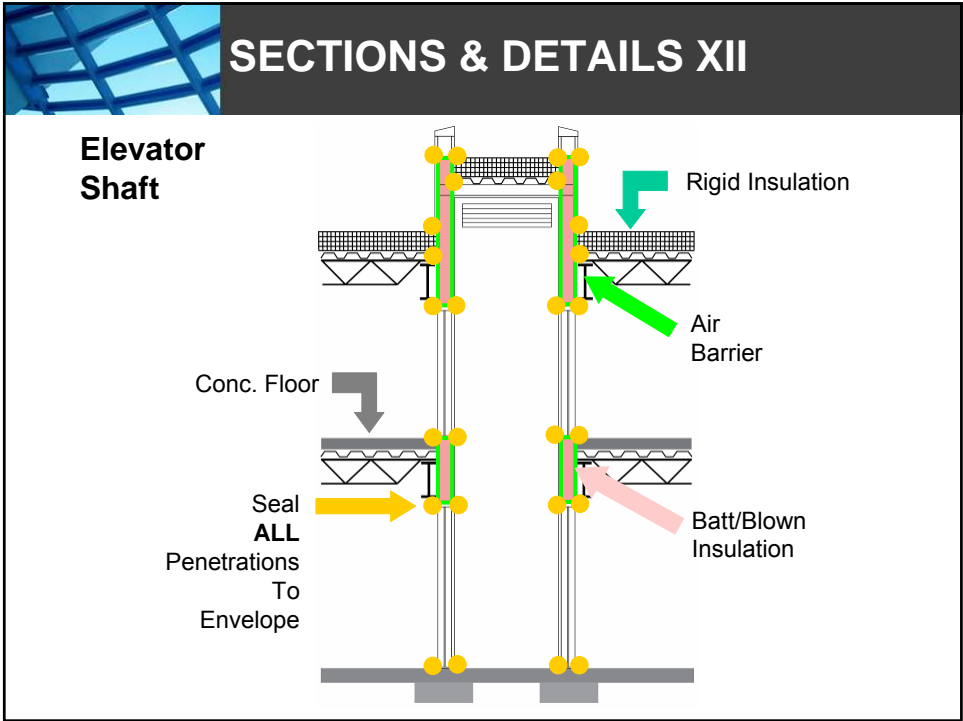








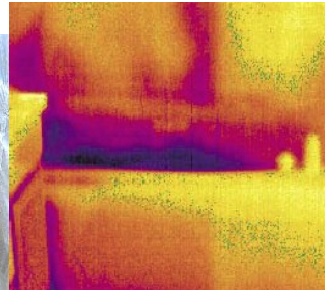
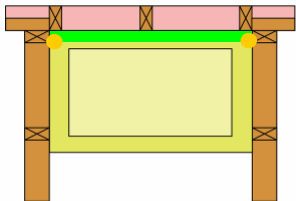
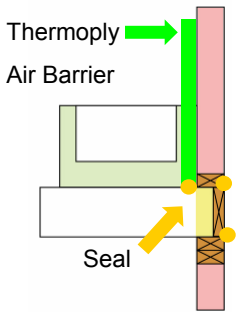




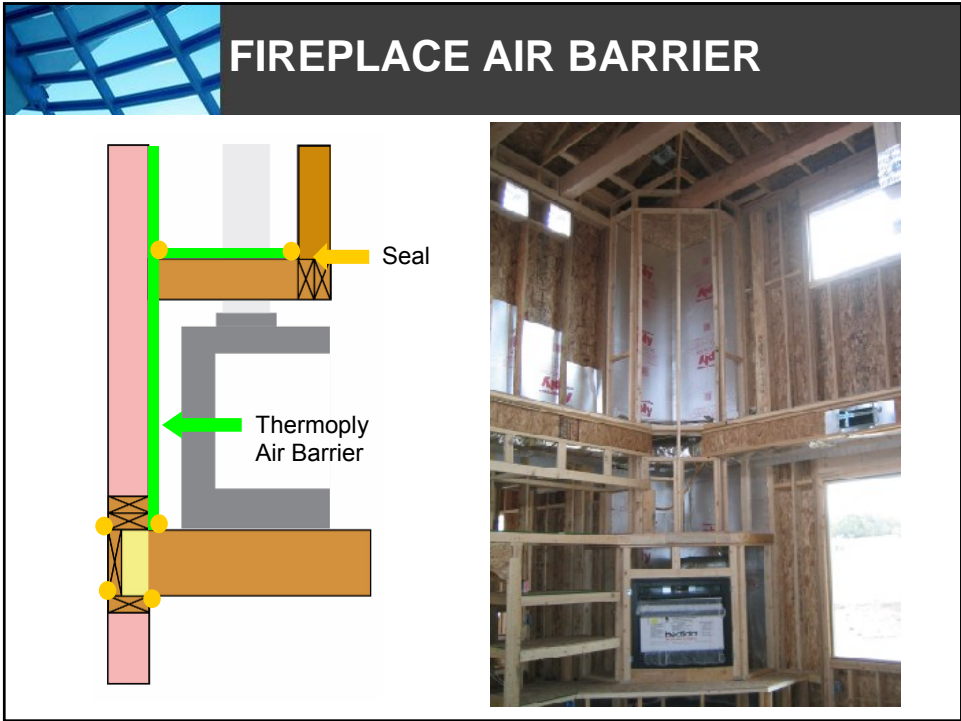
CONDITIONED VS UNCONDITIONED



TUB/SHOWER AIR BARRIER



FIREPLACE AIR BARRIER

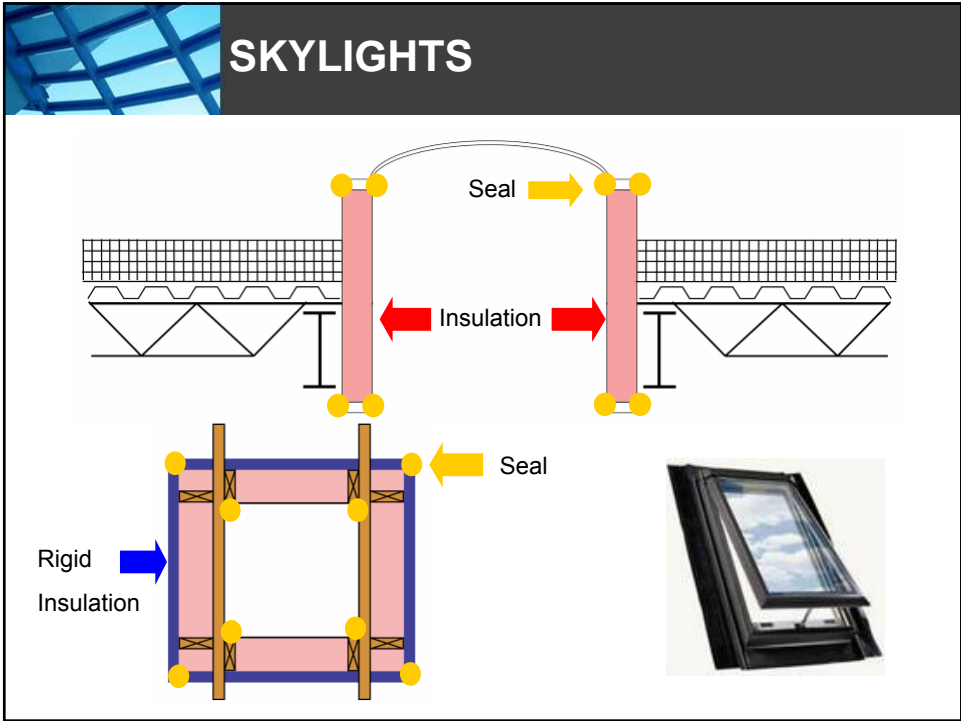


The diagram on the left illustrates the cross-section of a fireplace air barrier. A vertical pink wall on the left is connected to a horizontal brown wall. A green line, labeled "Thermoply Air Barrier", runs vertically along the pink wall and then horizontally across the top of the brown wall. A yellow "Seal" is applied at the junction where the air barrier meets the horizontal wall. A grey L-shaped structure, representing the fireplace opening, is shown below the horizontal wall. The photograph on the right shows the interior of a building under construction, with wooden framing and insulation visible. A television is mounted on a wall in the lower part of the frame.

INSULATED ATTIC SPACE



The four photographs show the progression of insulating an attic space. The top-left photo shows the initial state with wooden joists and rafters exposed. The top-right photo shows a worker in a dark jacket installing insulation. The bottom-left photo shows a close-up of the insulation being installed, with a black cable visible. The bottom-right photo shows a worker in a white protective suit standing on a yellow scissor lift, working on the ceiling of the attic space.



TUBULAR SKYLIGHTS

The collage shows tubular skylights in various settings: a kitchen, a dining room, a warehouse, a retail store, and a library. The skylights are circular and provide natural light to the interior spaces.

LEED Credits:
 Energy & Atmosphere
 Materials & Resources –
 Indoor Environmental Quality
 Innovation & Design Process

DOUBLE WALLS

Outside

CANTILEVER FLOORS

TIP:
Consider spray foam Insulation installed to desired thickness because It can serve as both Insulation and as an air barrier.

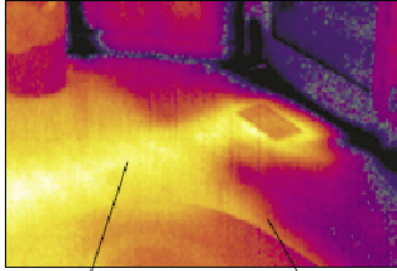
CRITICAL:
AIR BARRIER AT FLOOR

CANTILEVER FLOORS



Exterior soffit appeared to be tightly fit

As the infrared photo (right) shows, this dining room cantilever was cold due to ineffective insulation and air leakage. (Infrared photo taken with blower door operating.)



Warm
Cool

Residual warmth from heat run

Cantilever boundary clearly visible

TITLE

TIP: Specially colored fire-rated foam now available for sealing difficult air gaps at flue openings




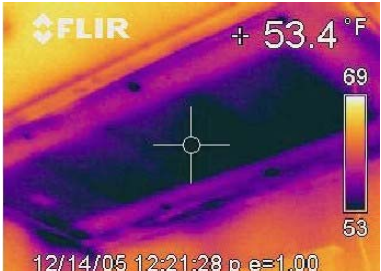
BAD




GOOD

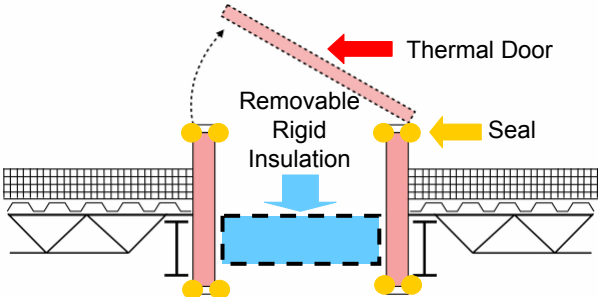
ATTIC/ROOF ACCESS PANEL






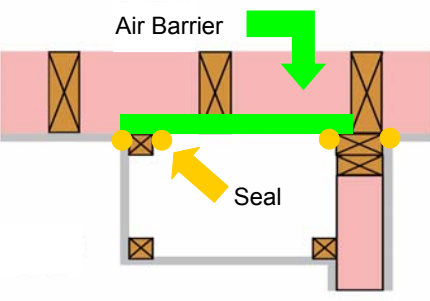
Attic Stairs Cover Box

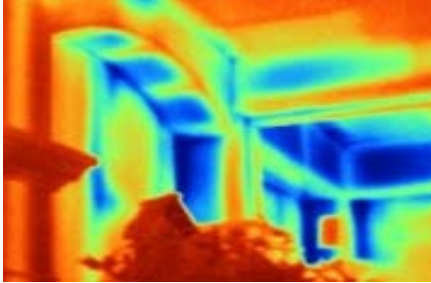


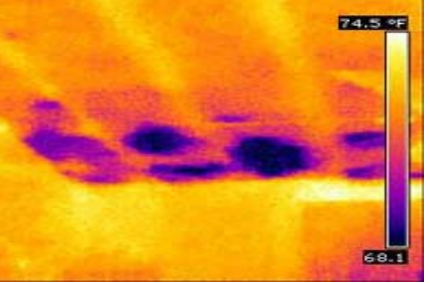


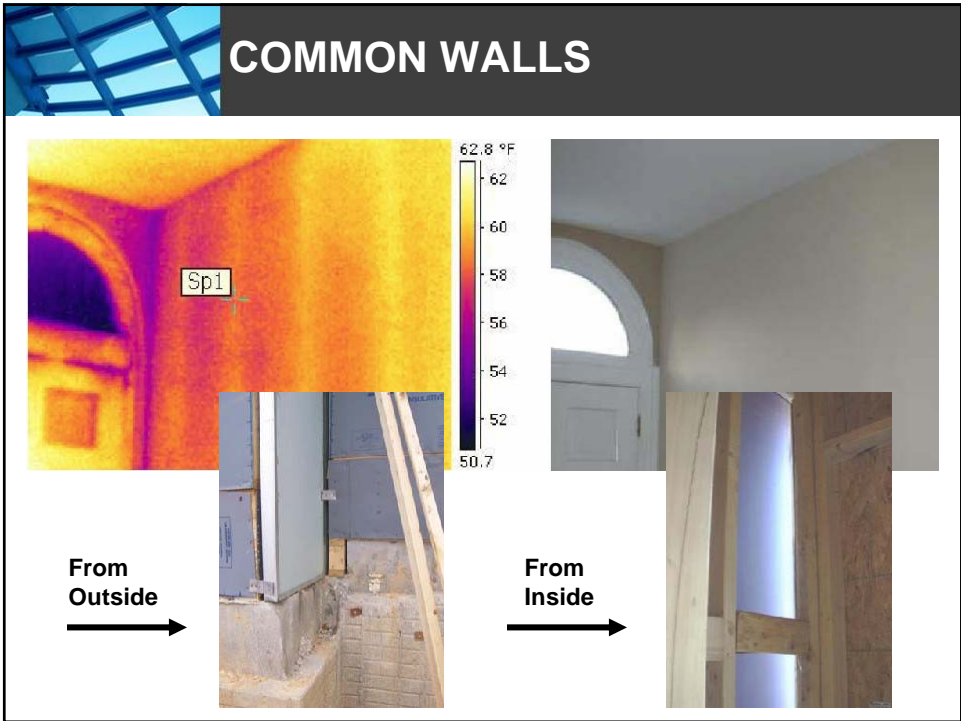
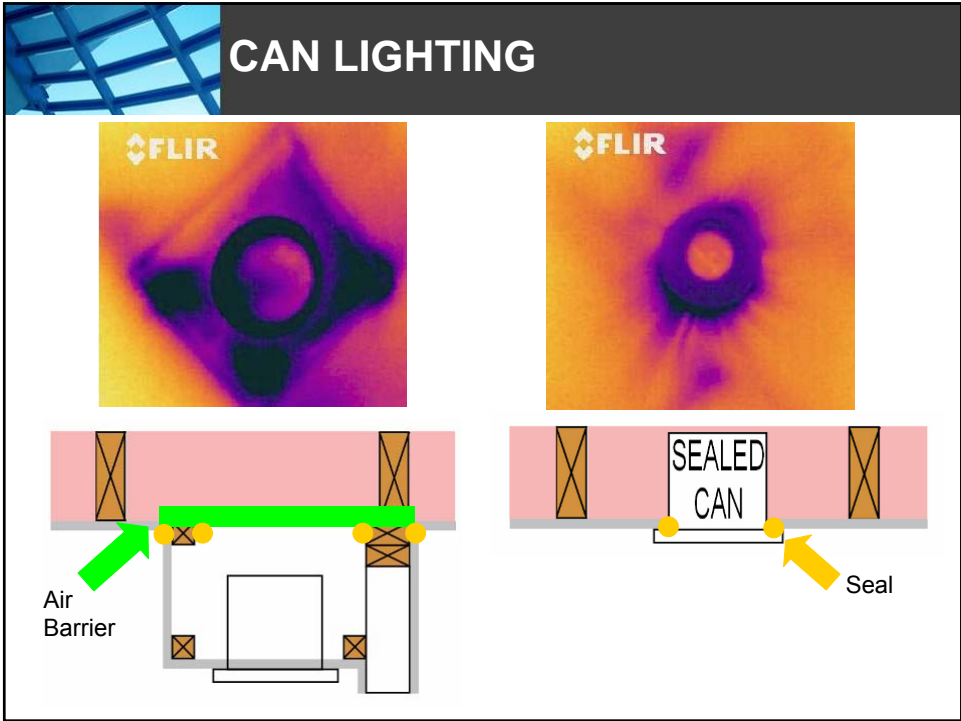
DROPPED CEILING/COFFER












TBP CHECKLIST




ENERGY STAR Qualified Homes
Thermal Bypass Inspection Checklist

The Thermal Bypass Inspection Checklist must be completed for homes to earn the ENERGY STAR label. The Checklist requires visual inspection of framing areas where air barriers are commonly missed and inspection of insulation to ensure proper alignment with air barriers, thus serving as an extra check that the air and thermal barriers are continuous and complete. State, local, and regional codes, as well as regional ENERGY STAR program requirements, supersede the items specified in this Checklist.

Guidance on Completing the Thermal Bypass Inspection Checklist:

- Accredited HERS Providers and certified home energy raters shall use their experience and discretion in verifying that each Inspection Checklist item is installed per the inspection guidelines (e.g., identifying minor defects that the Provider or rater deems acceptable versus identifying major defects that undermine the intent of the Checklist item).
- Alternative methods of meeting the Checklist requirements may be used in completing the Checklist, if the Provider deems them to be equivalent, or more stringent, than the Inspection Checklist guidelines.
- In the event an item on the Checklist cannot be verified by the rater, the home cannot be qualified as ENERGY STAR, unless the builder assumes responsibility for verifying that the item has met the requirements of the Checklist. This option is available at the discretion of the Provider or rater but may not be used to verify more than six (6) items on the Inspection Checklist. This responsibility will be formally acknowledged by the builder signing-off on the Checklist for the item(s) that they verified. The column titled "N/A" should be used when the checklist item is not present in the home or when local code requirements take precedence.
- The Checklist may be completed for a batch of homes using a RESNET-approved sampling protocol when qualifying homes as ENERGY STAR. For example, if the approved sampling protocol requires rating one in seven homes, then the Checklist will be completed for the one home which was rated.
- In the event that a Provider or rater finds an item that is inconsistent with the Checklist inspection guidelines, the home cannot be qualified as ENERGY STAR until the item is corrected in a manner that meets the ENERGY STAR requirements. If correction of the item is not possible, the home cannot earn the ENERGY STAR label.
- The Provider or rater is required to keep a hard copy record of the completed and signed Checklist. The signature of a builder employee is also required if the builder verified compliance with any item on the Checklist.
- For purposes of this Checklist, an air barrier is defined as any solid material that blocks air flow between a conditioned space and an unconditioned space, including necessary sealing to block excessive air flow at edges and seams. Additional information on proper air sealing of thermal bypasses can be found on the Building America Web site (www.energystar.gov/buildings/building_america) and in the EBBA Builder's Guides (www.ebba.org). These references include guidance on identifying and sealing air barriers, as well as details on many of the items included in the Checklist.




ENERGY STAR Qualified Homes
Thermal Bypass Inspection Checklist

Home Address: _____ City: _____ State: _____

Thermal Bypass	Inspection Guidelines	Comments Needed	Builder Verified	Rater Verified	N/A
1. Overall Air Barrier and Thermal Barrier Alignment	<p>Insulation shall be installed in full contact with sealed interior and exterior air barrier except for alternate to interior air barrier in Unconditioned Spaces.</p> <p>All Climate Zones:</p> <p>1.1 Overall Alignment: Unconditioned Home</p> <p>1.2 Garage Slab and Air Barrier or layer adjoining conditioned space</p> <p>1.3 Attic Eave Baffles Where Verms/Vents/Attic Eave</p> <p>Only in Climate Zones 4 and higher:</p> <p>1.4 Edge-edge insulation (L max/min) of 20% of the slab edge may be installed in Climate Zones 4 and 5.</p> <p>Best Practices Encouraged, Not Required:</p> <p>1.5 Air Barrier in All Base Joist (Climate Zones 4 and higher)</p> <p>1.6 Monitor Thermal Bridging (e.g., OVE framing, SIPs, ICFs)</p>				
2. Walls Adjacent Unconditioned Spaces	<p>Requirements:</p> <ul style="list-style-type: none"> Fully installed and aligned with air barrier at both interior and exterior. OR Alternate for Climate Zones 1 thru 3: sealed exterior air barrier aligned with RESNET Grade 1 insulation fully supported + continuous top and bottom plates or sealed blocking. <p>2.1 Wall Behind Shower/Tub</p> <p>2.2 Wall Behind Fireplace</p> <p>2.3 Insulate Attic: Staircase Walls</p> <p>2.4 Attic Knee Walls</p> <p>2.5 Skylight Shaft Walls</p> <p>2.6 Wall Adjoining Walk Raft</p> <p>2.7 Staircase Walls</p> <p>2.8 Double Walls</p>				
3. Floor Between Conditioned and Unconditioned Spaces	<p>Requirements:</p> <ul style="list-style-type: none"> Air barrier is installed at any exposed insulation edges Insulation is installed to necessary placement (connect to sub-floor above and air barrier below - optional with page 3 use) <p>3.1 Insulated Floor Above Garage</p> <p>3.2 Carport/Floor</p>				
4. Shafts	<p>Requirements:</p> <ul style="list-style-type: none"> Clearings in unconditioned space are fully sealed with solid blocking or flashing and any remaining gaps are sealed with caulk or foam (include the seal caulk and flashing when inspected). <p>4.1 Dust Shaft</p> <p>4.2 Flue Shaft/Penetrations</p> <p>4.3 Flue Shaft</p>				
5. Attic Ceiling Structure	<p>Requirements:</p> <ul style="list-style-type: none"> All attic penetrations and dropped ceilings include a full interior air barrier aligned with insulation with any gaps fully sealed with caulk, foam or tape Insulate condition (to verify alignment and air barrier is fully gasketed) <p>5.1 Attic Access Panel (fully gasketed and insulated)</p> <p>5.2 Attic Chimney Cover (fully gasketed and insulated)</p> <p>5.3 Dropped Ceiling/Duct Full air barrier aligned with insulation</p> <p>5.4 Recessed Lighting Fixtures (CAT sealed and sealed to drywall)</p> <p>5.5 Other Access Panel (insulation covered adjacent to the opening)</p>				
6. Common Walls Between Dwelling Units	<p>Requirements:</p> <ul style="list-style-type: none"> Top, bottom, and end (corner, sill) and structural framing (stud walls) to include all exterior sheathing conditions <p>6.1 Common Wall Between Dwelling Units</p>				

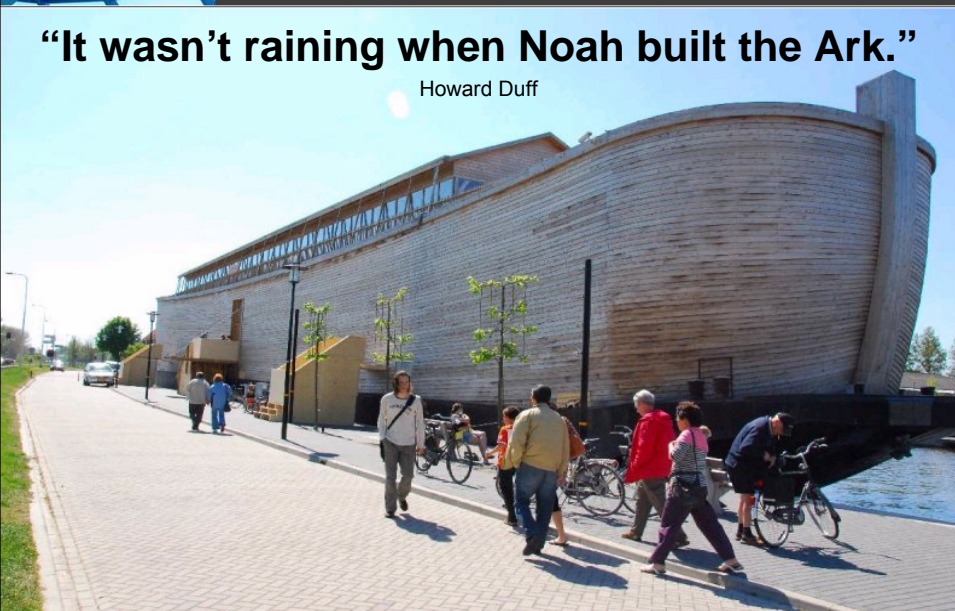
Rater Inspection Date: _____ Builder Inspection Date: _____
 Home Energy Rating Provider: _____ Builder Company Name: _____
 Home Energy Rater Signature: _____ Builder Company Name: _____



NOAH'S ARK

“It wasn’t raining when Noah built the Ark.”

Howard Duff





FOR MORE INFORMATION

Google: Thermal Bypass Guidelines V2.1
Thermal Bypass Checklist

Or...

[Energystar.gov/homes](http://energystar.gov/homes)
Buildingamerica.gov
Usgbc.org/leed/homes
BuildGreenNM.com
CoboDesigner.com



THANK YOU



ARMANDO COBO, Designer

www.CoboDesigner.com

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