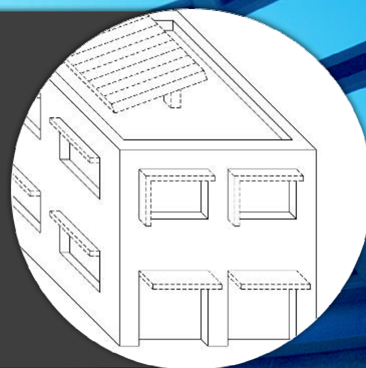
INTEGRATING GREEN BUILDING STRATEGIES INTO YOUR PROJECTS

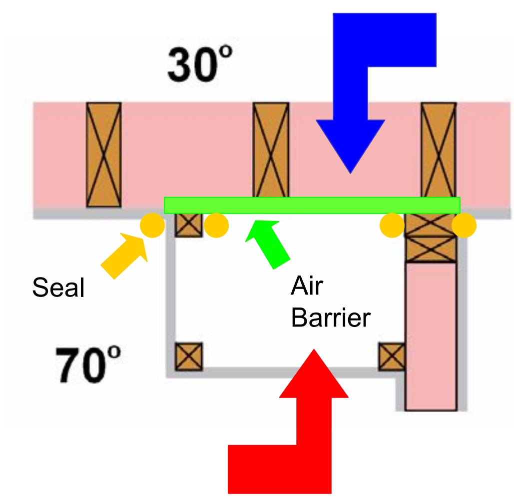
THERMAL BYPASS & AIR BARRIERS

Armando Cobo



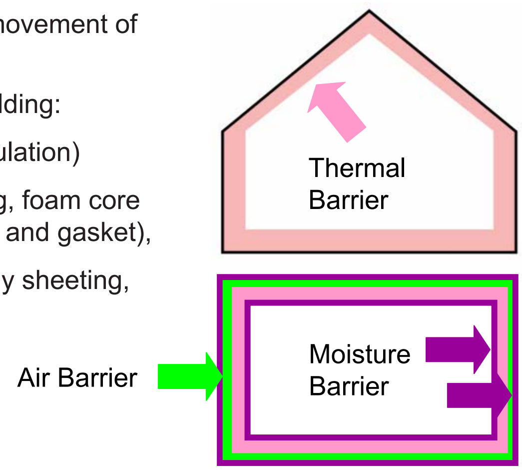
WHAT IS THERMAL BYPASS?

- **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

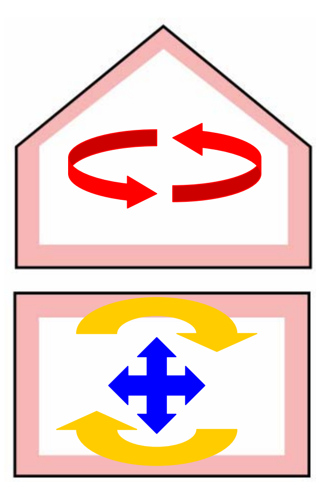
- Building sealed to prevent movement of air, heat, or moisture.
- Three barriers to protect building:
  - 1. **Thermal barrier** (insulation)
  - 2. **Air barrier** (sheathing, foam core board, house wrap, caulk and gasket),
  - 3. **Moisture barrier** (poly sheeting, plastic, etc.).



3C- BARRIERS

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

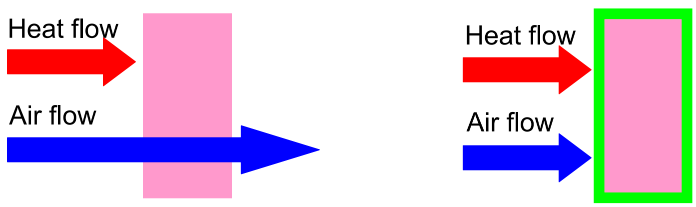
- •**Continuous:** envelope with no breaks in the air and thermal barriers.
- •**Contiguous:** two barriers are physically touching each other at all times, in all places.
- •**Complete:** in that the air and thermal barriers together completely contain the living space within the building.



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.

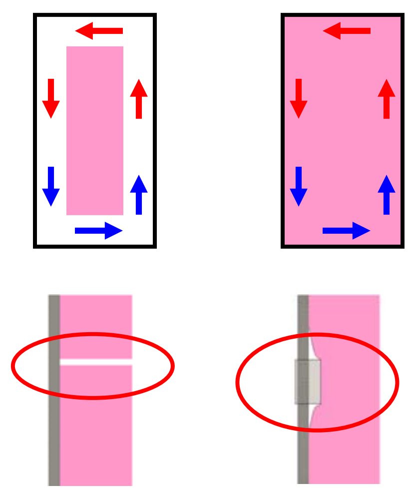
Insulation Only **Insulation & Air Barrier**



AIR LOOPS & GAPS

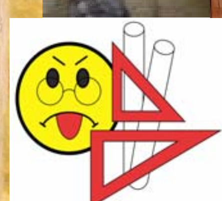
AIR LOOPS
- Convection due to gaps on both sides
- Low density insulation in the attic looses 30% R values to convection air at high Delta T's ≥ 50º or higher.

GAPS
- 1/8" Gap reduces 45% R values



HOW GOOD IS BATT INSULATION?

MORE BATT INSULATION?



BULK & VAPOR MOISTURE

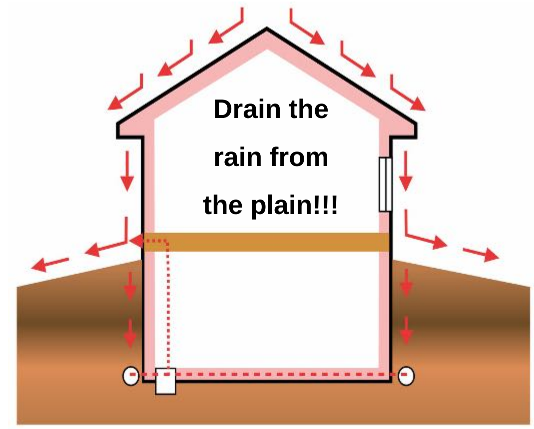
• BULK MOISTURE:

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

•CONDENSATION

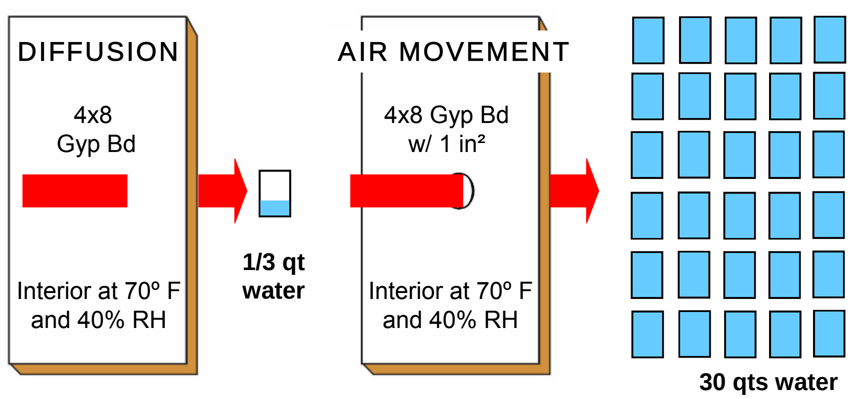
Winter: Humid air cools by contacting cool surfaces

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 though two mechanisms: Diffusion and Air Movement

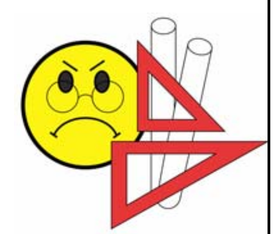


Vapor always moves from more moisture to less moisture and it travels from hot to cold

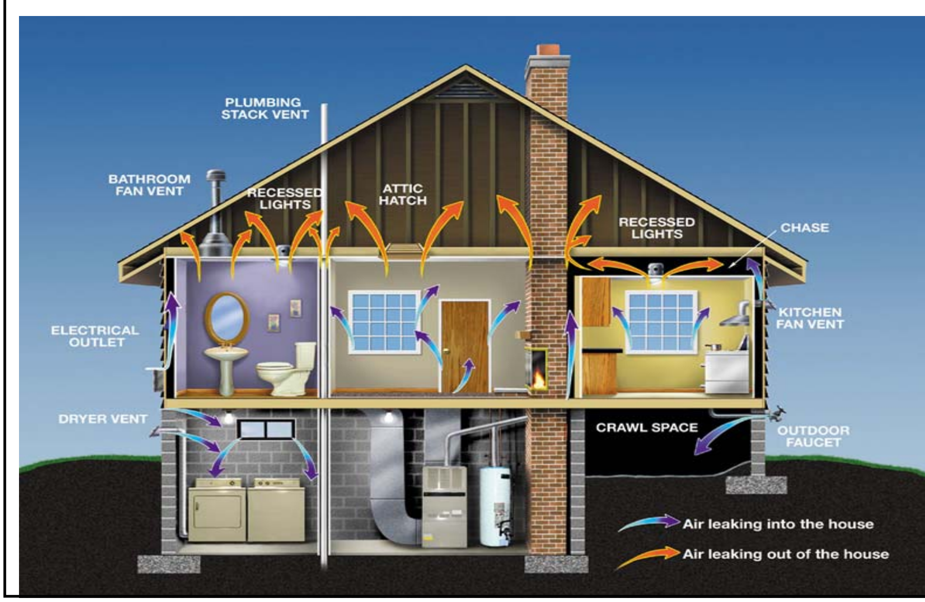
WHERE IS TBP COMMON?

COMMON PROBLEMS:

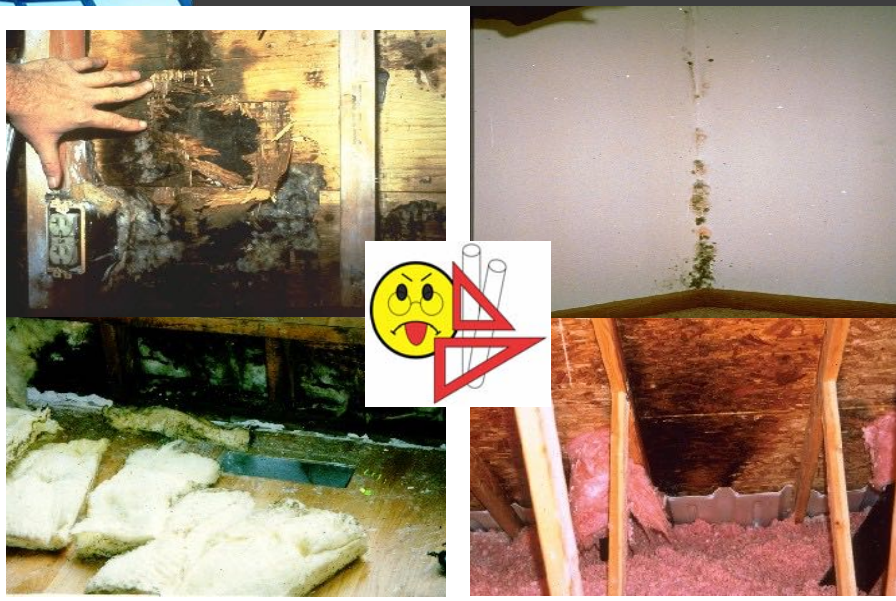
- Overall Alignment
- Windows & Doors
- Behind Bathtubs / Showers
- Recessed Light Fixtures
- Floor Systems / Band Joists
- Plumbing Penetrations
- Electrical Penetrations
- Stairs / Attic Covers / Whole House Fans / Skylights / Roof Doors



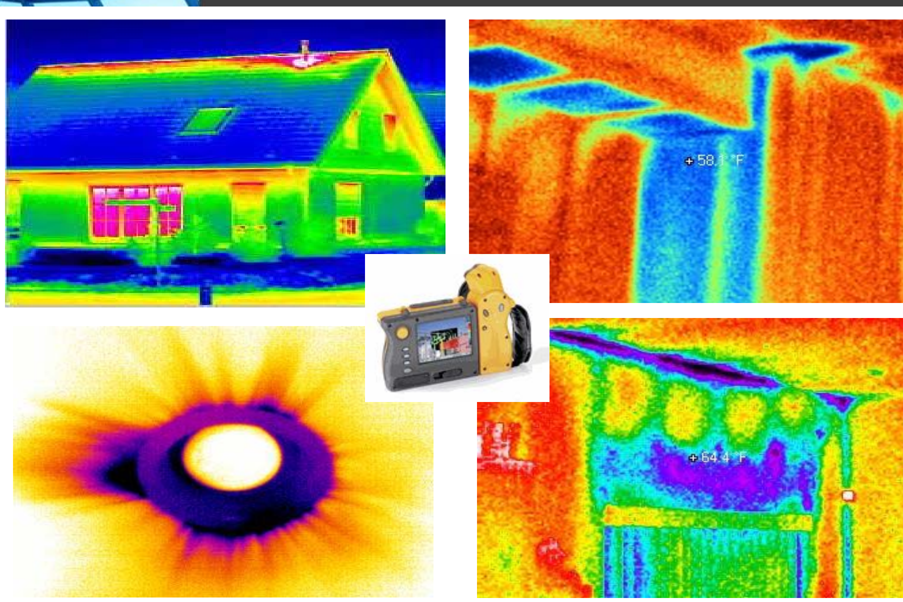
SEALING PENETRATIONS



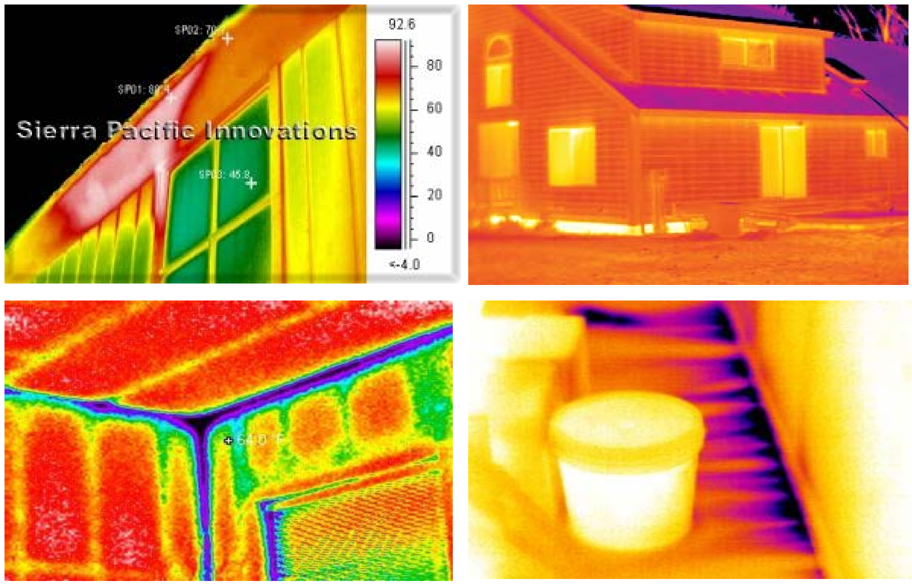
UNINTENDED FAILURES



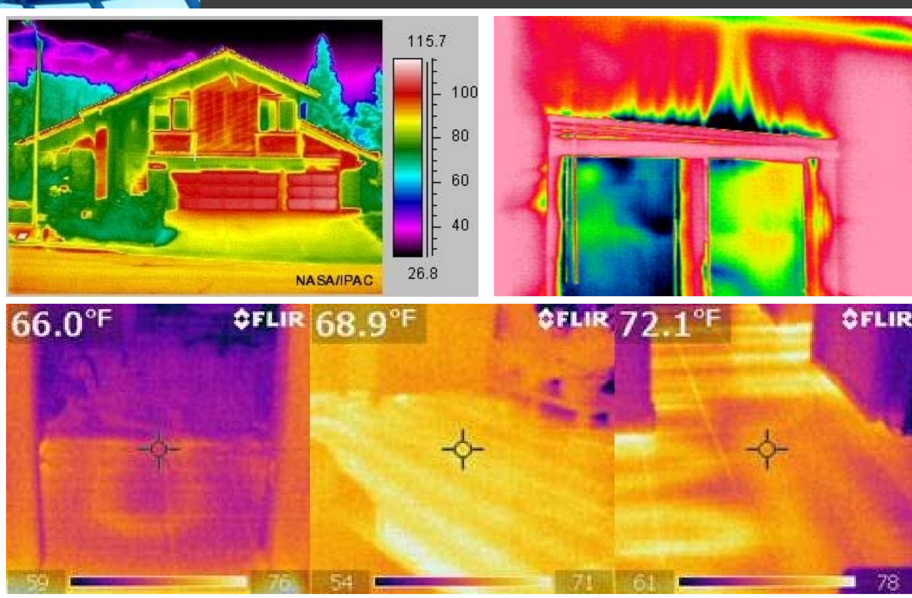
THERMAL BYPASS I



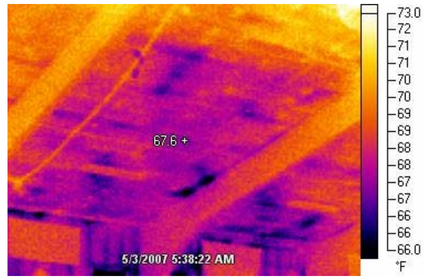
THERMAL BYPASS II

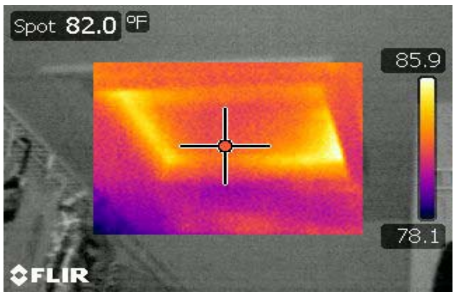


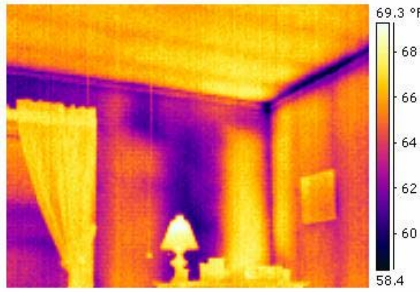
THERMAL BYPASS III



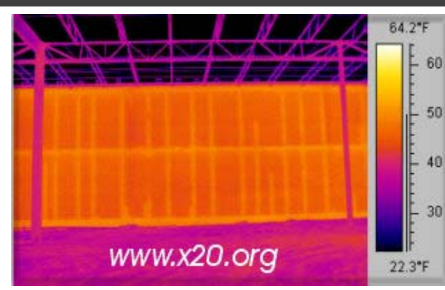
THERMAL BYPASS IV

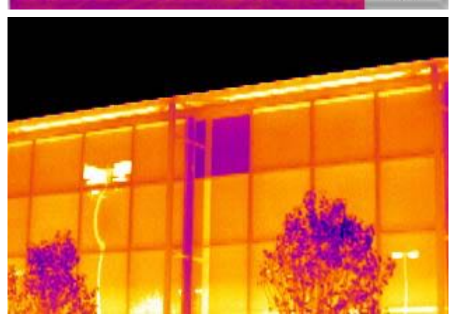




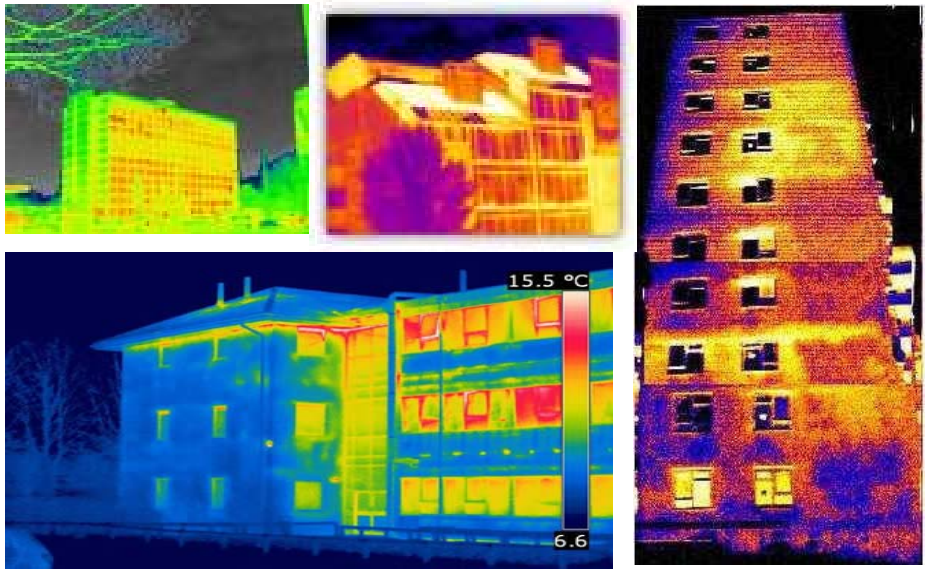


THERMAL BYPASS V

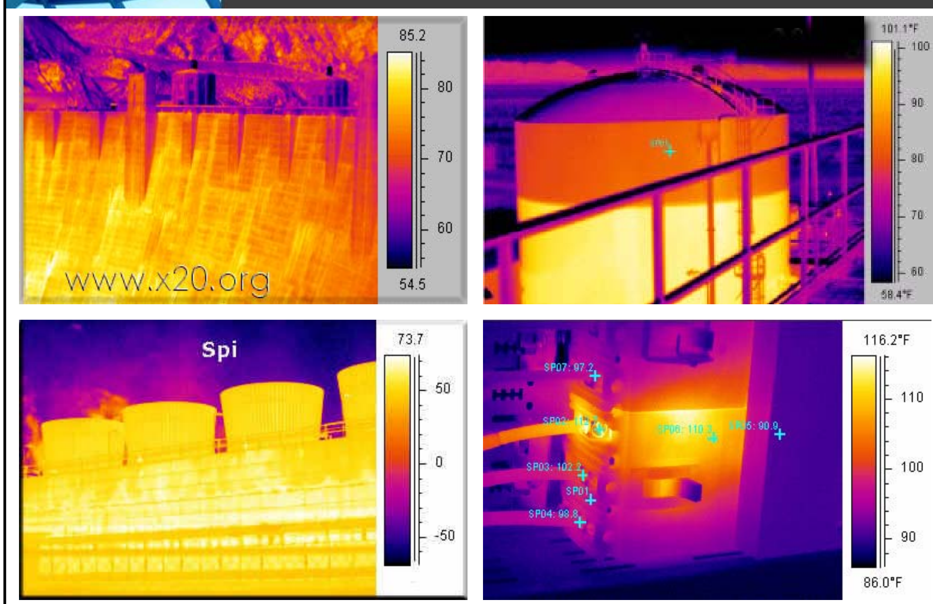




THERMAL BYPASS VI



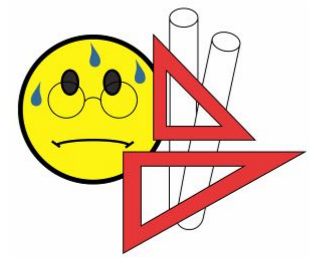
THERMAL IMAGING I



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**

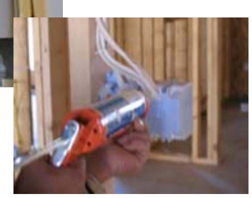


Create New Position: Hole Manager

TIGHT CONSTRUCCION

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 CONSTRUCCION

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

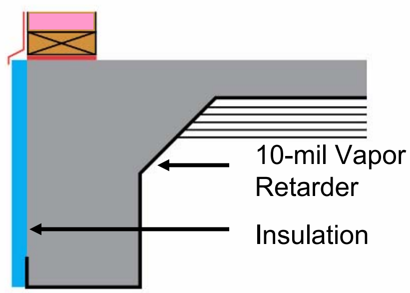
GOOD EXTERIOR INSULATION

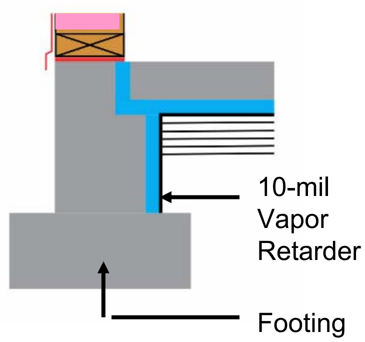
OPTIMAL VALUE ENGINEERING

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

FOUNDATION INSULATION

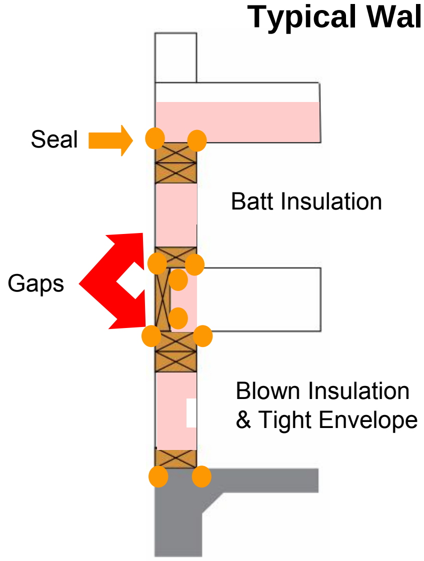
Slab Edge Insulation:
(Climate Zones 4 and higher)

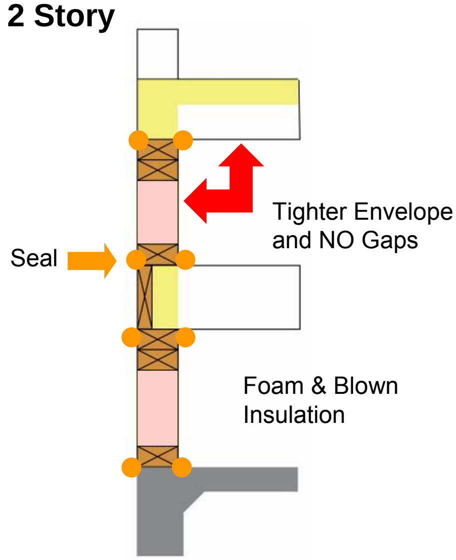




SECTIONS & DETAILS I

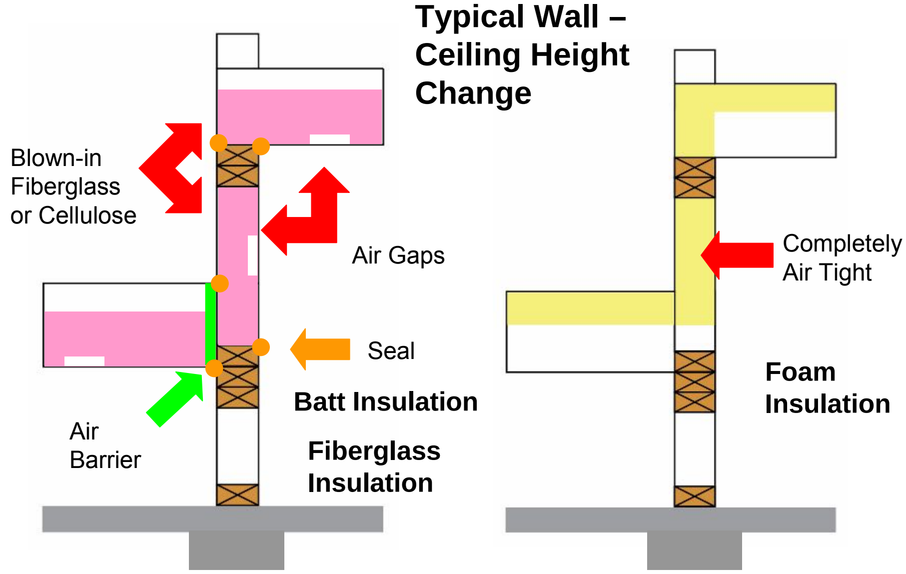
Typical Wall – 2 Story



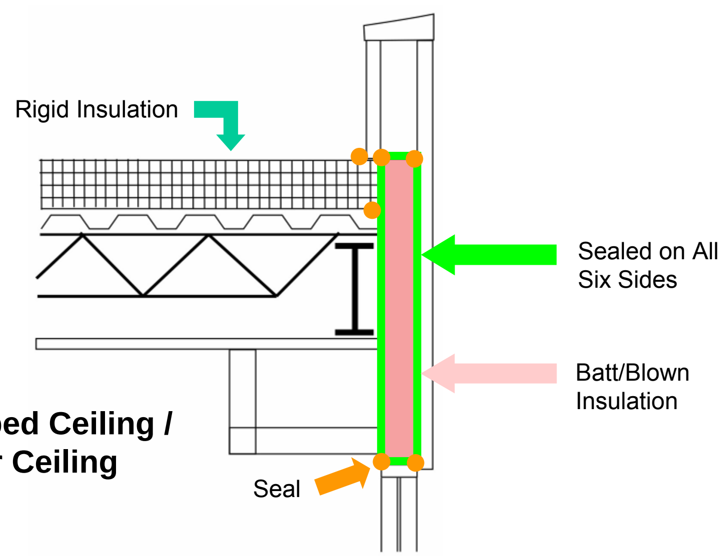


SECTIONS & DETAILS II

Typical Wall – Ceiling Height Change

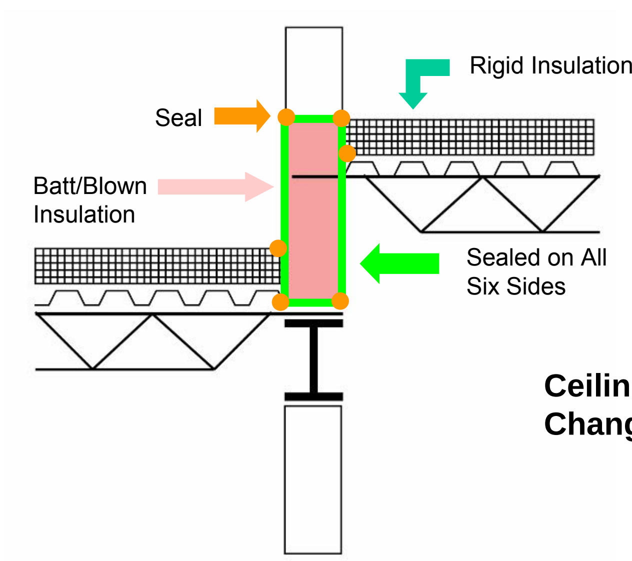


SECTIONS & DETAILS III



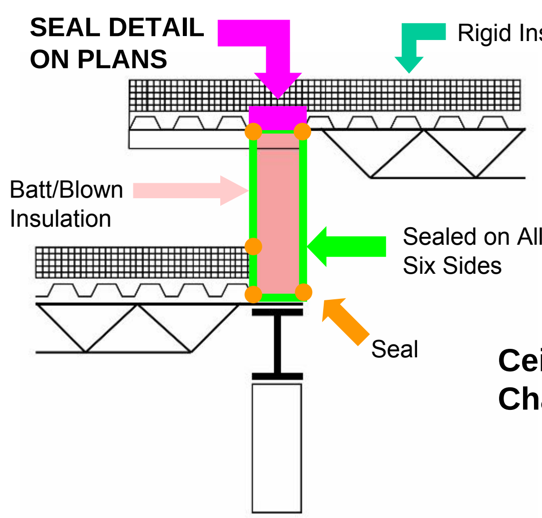
Dropped Ceiling / Coffer Ceiling

SECTIONS & DETAILS IV



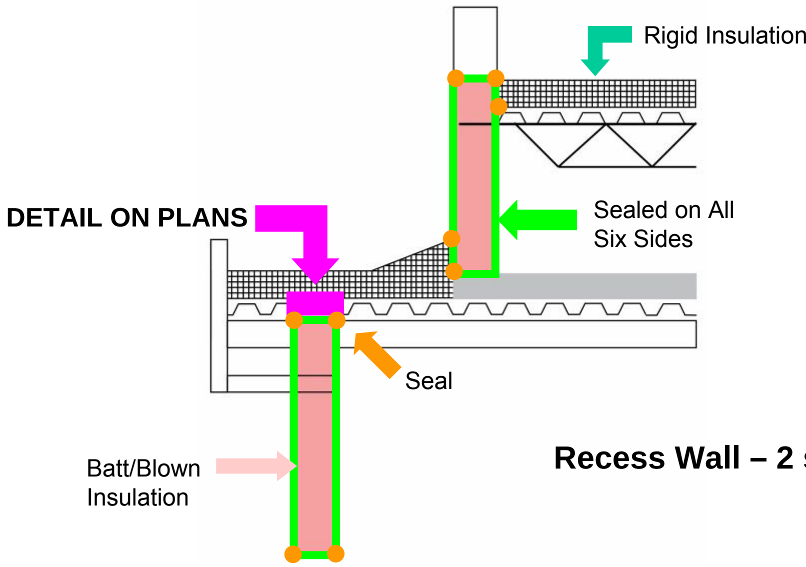
Ceiling Height Change

SECTIONS & DETAILS V



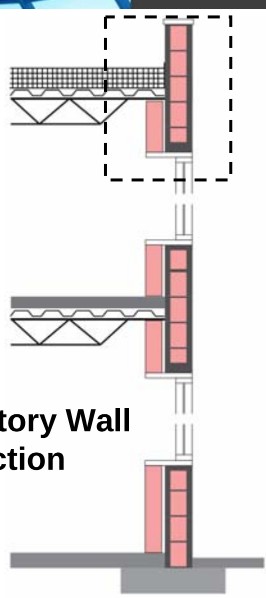
Ceiling Height Change & Overhang

SECTIONS & DETAILS VI

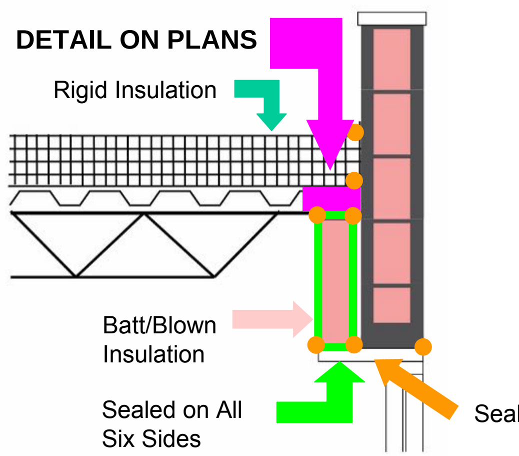


Recess Wall – 2 story

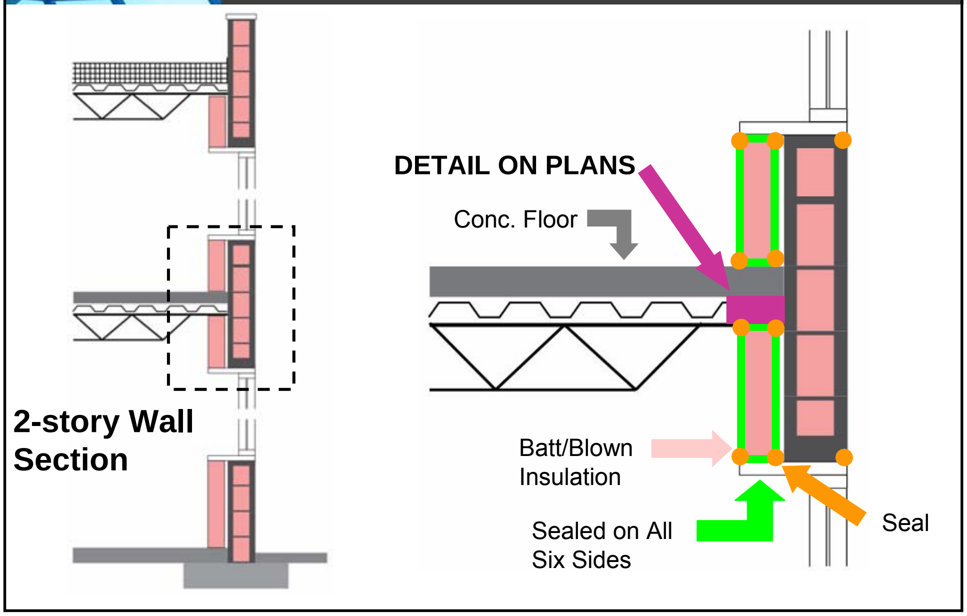
SECTIONS & DETAILS VII



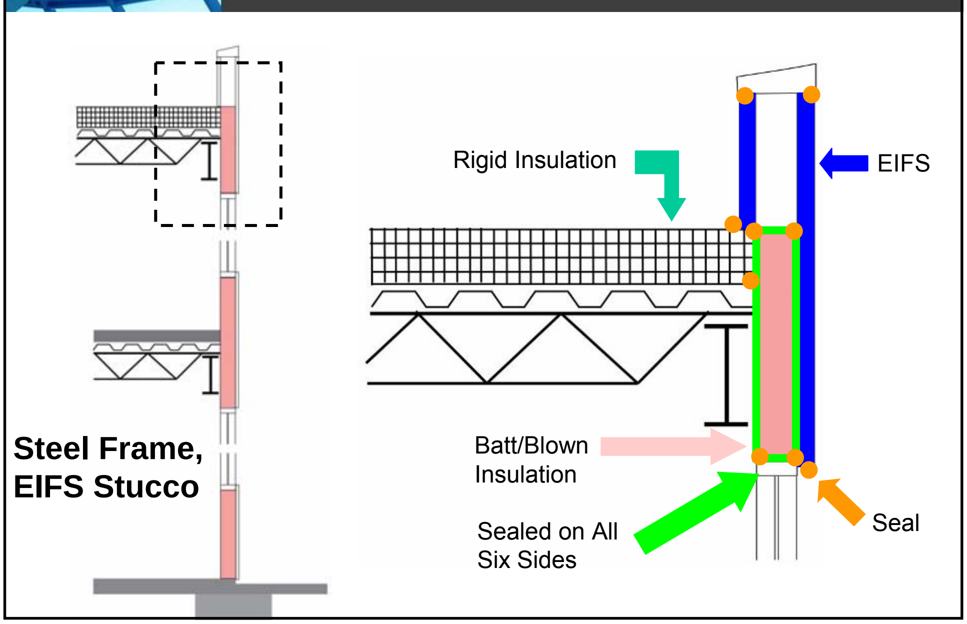
2-story Wall Section



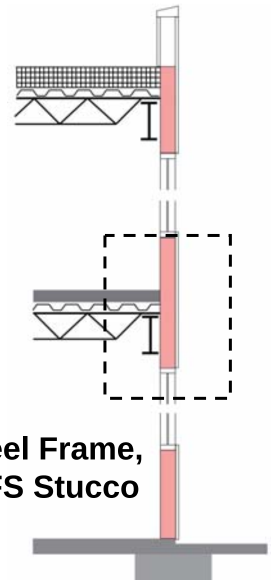
SECTIONS & DETAILS VIII



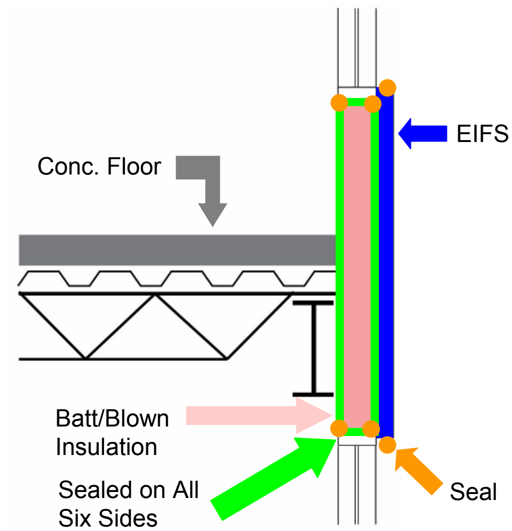
SECTIONS & DETAILS IX



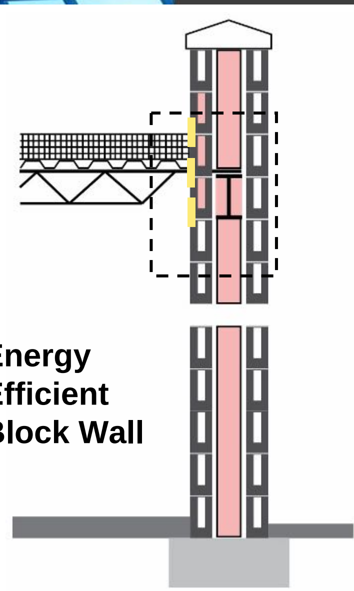
SECTIONS & DETAILS X



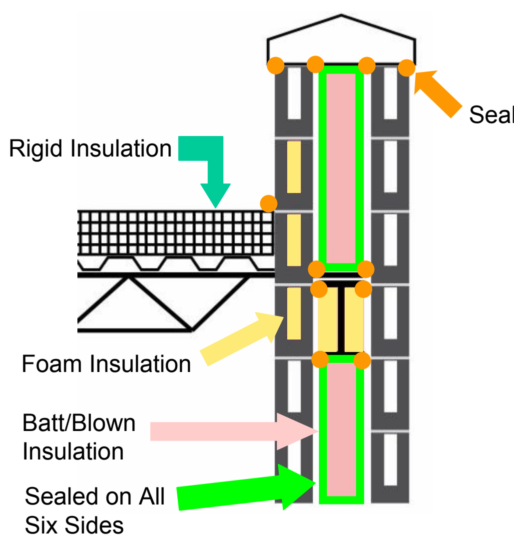
Steel Frame, EIFS Stucco



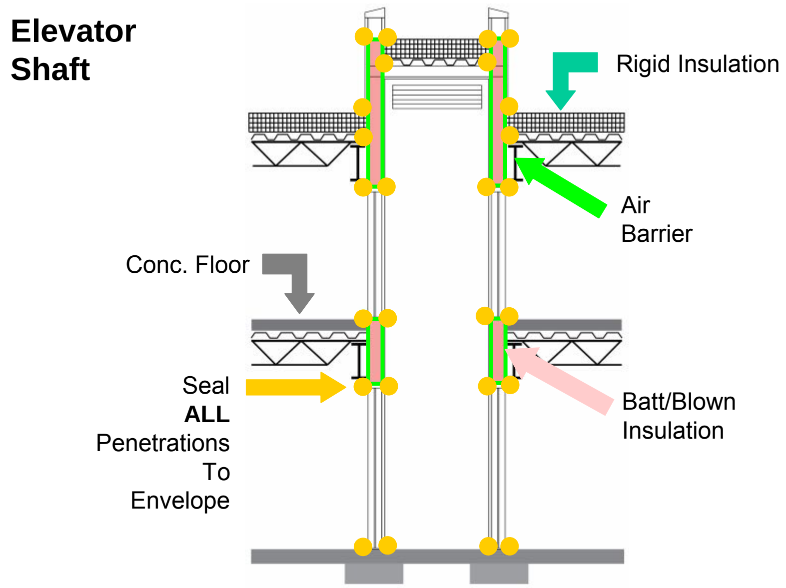
SECTIONS & DETAILS XI



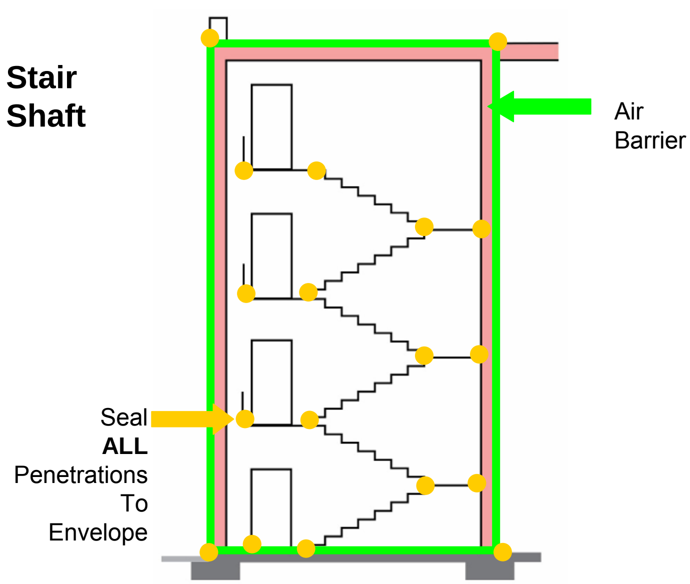
Energy Efficient Block Wall



SECTIONS & DETAILS XII

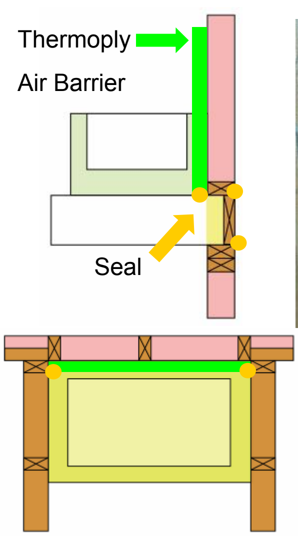


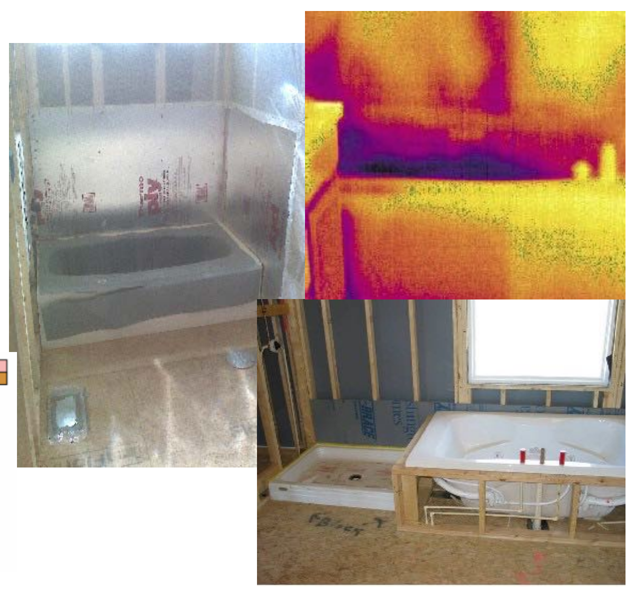
SECTIONS & DETAILS XIII



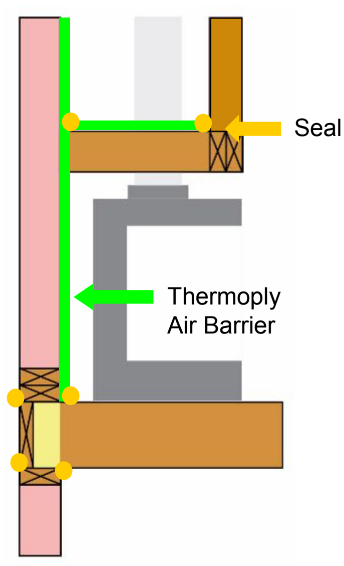
CONDITIONED VS UNCONDITIONED

TUB/SHOWER AIR BARRIER



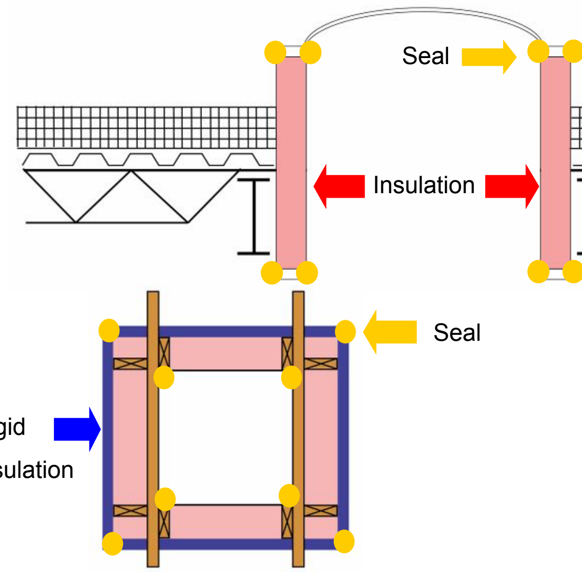


FIREPLACE AIR BARRIER



INSULATED ATTIC SPACE

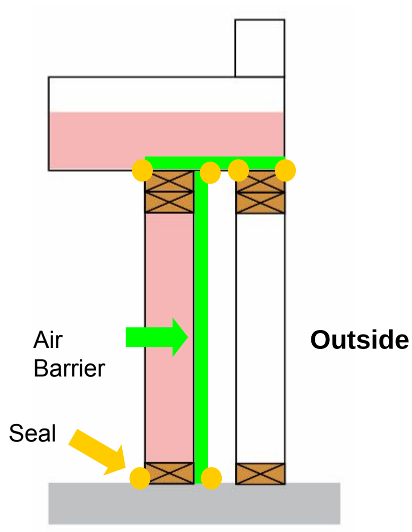
SKYLIGHTS



TUBULAR SKYLIGHTS

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

DOUBLE WALLS



CANTILEVER FLOORS

TIP:

Consider spray foam

Insulation installed to

desired thickness because

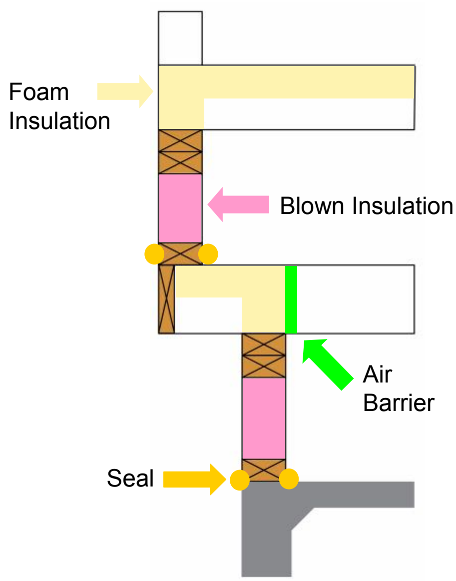
It can serve as both

Insulation and as an

air barrier.

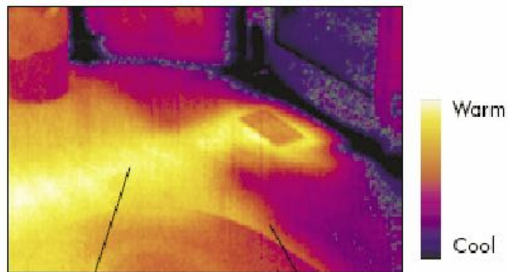
CRITICAL:

AIR BARRIER AT FLOOR



CANTILEVER FLOORS

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.)



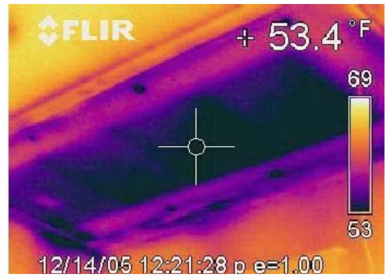
TITLE

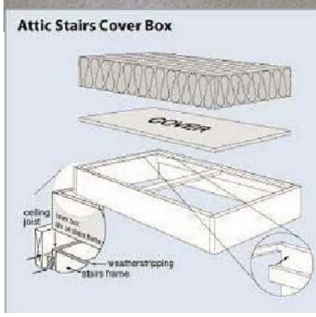
TIP:
Specially colored fire-rated foam now available for sealing difficult air gaps at flue openings

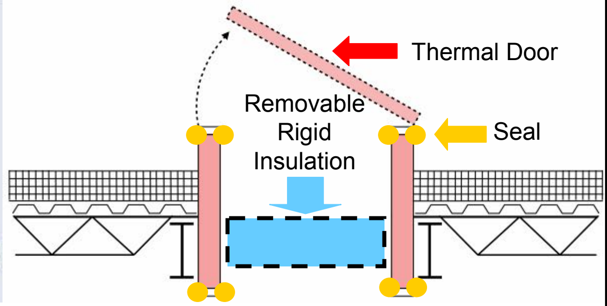
BAD

GOOD

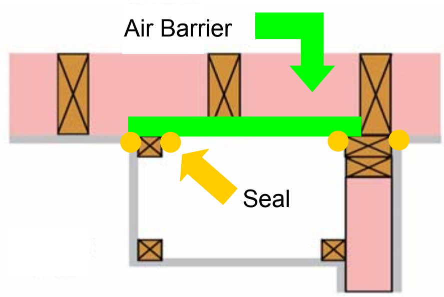
ATTIC/ROOF ACCESS PANEL

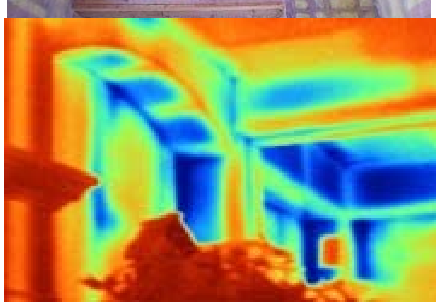


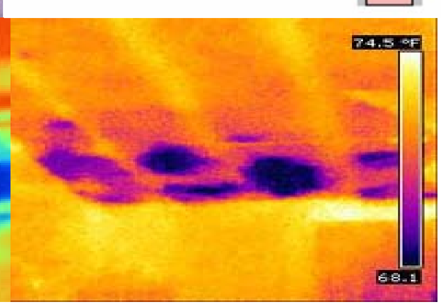




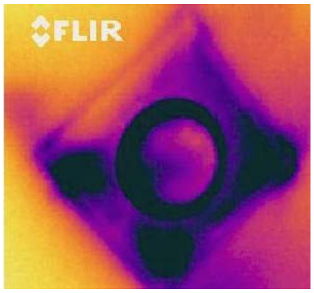
DROPPED CEILING/COFFER

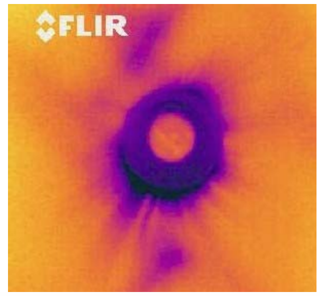


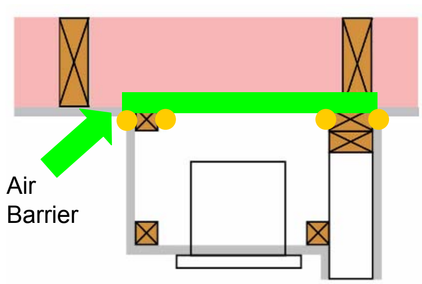


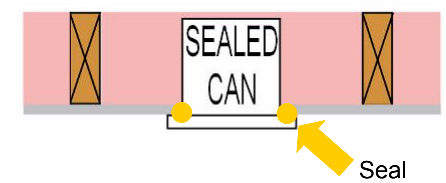


CAN LIGHTING

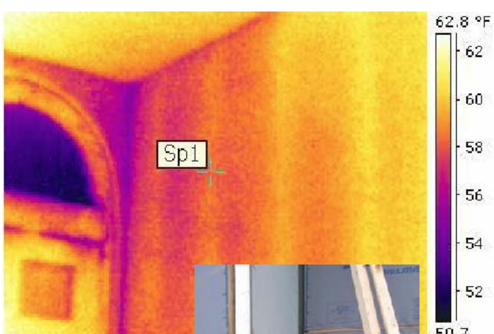








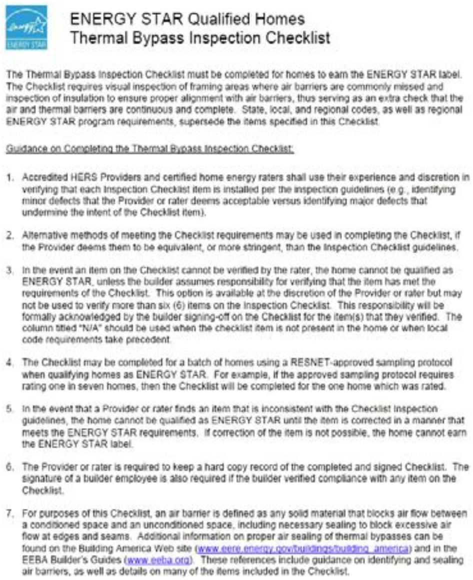
COMMON WALLS



From Outside →

From Inside →

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:

1. 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).
2. 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.
3. 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 precedent.
4. 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.
5. 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.
6. 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.
7. 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.eere.energy.gov/buildings/building_america) and in the EEBA Builder's Guides (www.eeba.org). These references include guidance on identifying and sealing air barriers, as well as details on many of the items included in the Checklist.

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Home Address: ______ City: ______ State: ______

Thermal Bypass	Inspection Guidelines	Corrections Needed	Builder Verified	Rater Verified	N/A
1. Overall Air Barrier and Thermal Barrier Alignment	**Requirements:** Insulation shall be installed in full contact with sealed interior and exterior air barrier except for alternate to interior air barrier under item no. 2 (Walls Adjoining Exterior Walls or Unconditioned Spaces)				
	All Climate Zones:				
	1.1 Overall Alignment Throughout Home	☐	☐	☐	☐
	1.2 Garage Band Joist Air Barrier (at bays adjoining conditioned space)	☐	☐	☐	☐
	1.3 Attic Eave Baffles Where Vents/Leakage Exist	☐	☐	☐	☐
	Only at Climate Zones 4 and Higher:				
	1.4 Slab-edge Insulation (A maximum of 25% of the slab edge may be uninsulated in Climate Zones 4 and 5.)	☐	☐	☐	☐
	Best Practices Encouraged, Not Req'd.:				
	1.5 Air Barrier At All Band Joists (Climate Zones 4 and higher)	☐	☐	☐	☐
	1.6 Minimize Thermal Bridging (e.g., OVE framing, SIPs, ICFs)	☐	☐	☐	☐
2. Walls Adjoining Exterior Walls or Unconditioned Spaces	**Requirements:** • Fully insulated wall 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				
	2.1 Wall Behind Shower/Tub	☐	☐	☐	☐
	2.2 Wall Behind Fireplace	☐	☐	☐	☐
	2.3 Insulated Attic Slopes/Walls	☐	☐	☐	☐
	2.4 Attic Knee Walls	☐	☐	☐	☐
	2.5 Skylight Shaft Walls	☐	☐	☐	☐
	2.6 Wall Adjoining Porch Roof	☐	☐	☐	☐
	2.7 Staircase Walls	☐	☐	☐	☐
	2.8 Double Walls	☐	☐	☐	☐
3. Floors between Conditioned and Exterior Spaces	**Requirements:** • Air barrier is installed at any exposed insulation edges • Insulation is installed to maintain permanent contact w/ sub-floor above and air barrier below - Optional until July 1, 2008				
	3.1 Insulated Floor Above Garage	☐	☐	☐	☐
	3.2 Cantilevered Floor	☐	☐	☐	☐
4. Shafts	**Requirements:** Openings to unconditioned space are fully sealed with solid blocking or flashing and any remaining gaps are sealed with caulk or foam (provide fire-rated collars and caulking where required)				
	4.1 Duct Shaft	☐	☐	☐	☐
	4.2 Piping Shaft/Penetrations	☐	☐	☐	☐
	4.3 Flue Shaft	☐	☐	☐	☐
5. Attic/ Ceiling Interface	**Requirements:** • 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 • Movable insulation fits snugly in opening and air barrier is fully gasketed				
	5.1 Attic Access Panel (fully gasketed and insulated)	☐	☐	☐	☐
	5.2 Attic Drop-down Stair (fully gasketed and insulated)	☐	☐	☐	☐
	5.3 Dropped Ceiling/Soffit (full air barrier aligned with insulation)	☐	☐	☐	☐
	5.4 Recessed Lighting Fixtures (ICAT labeled and sealed to drywall)	☐	☐	☐	☐
	5.5 Whole-house Fan (insulated cover gasketed to the opening)	☐	☐	☐	☐
6. Common Walls Between Dwelling Units	**Requirements:** Gap btwn drywall shaft wall (common wall) and structural framing btwn units is sealed at all exterior boundary conditions				
	6.1 Common Wall Between Dwelling Units	☐	☐	☐	☐

Rater Inspection Date: ______ Builder Inspection Date: ______
Home Energy Rating Provider: ______ Builder Company Name: ______
Home Energy Rater Company Name: ______ Builder Division Name: ______
Home Energy Rater Signature: Builder Employee Signature:

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
Buildingamerica.gov
Usgbc.org/leed/homes
BuildGreenNM.com
CoboDesigner.com

THANK YOU

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www.CoboDesigner.com

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