

Insulation – Improving the Thermal Envelope

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The thermal envelope includes: floors, walls, windows, doors, and roofs. The thermal envelope function is not just to reduce heat transfer. Other equally important functions include: reducing air movement between the outside and the inside, preventing water from entering the building, and reducing the transfer of water vapor. In order to do this the building components need to have control layers. They are listed below in order of importance:

1. rain control layer
2. air control layer
3. vapor control layer
4. thermal control layer

Some would argue that because of higher energy costs, the thermal control layer should have a higher priority. Granted, reducing heat transfer lowers energy consumption and related cost; but if the rain is not kept out, the building will deteriorate and mold could develop. If air moves between the outside and inside (infiltration and exfiltration) it can account for a large portion of a buildings heat loss. If vapor is not controlled and condensation forms inside the wall or roof cavity it will deteriorate the assembly.

The best place to locate the insulation control layer is outside the structure so that the structure is protected and there are fewer thermal breaks. If the insulation is on the inside of the structure the insulation will not protect the structure from heat and cold. Expansion, contraction, corrosion, decay, and ultra-violet radiation are functions of temperature and locations of the various control layers. But if the insulation must be placed in the cavities of the structure there are improvements that can be made over current practices.

Why Insulate?

This seems like a silly question because we all know the answer. Adding insulation lowers energy consumption, allows for capacity reduction for the heating and cooling equipment, makes the inside space more comfortable, and makes it easier to provide a more uniform temperature inside the various rooms of the building. But improving all of the control layers reduces deterioration of the building materials and further lowers energy consumption.

How Insulation Works:

Batts, blankets, loose fill, and low-density foams (fiberglass, cellulose, polyisocyanurate, polyurethane foam, and expanded polystyrene), all work by limiting air movement. The still air inside the insulation is an effective insulator because it eliminates air convection. The insulation material has a low conductance. Conductance is the ability of a material to conduct heat. The lower the value the harder for heat to pass.

Reflective insulation works by reducing the amount of energy that travels in the form of radiation. There needs to be an air space between the building material and the reflective material. Caution should be exercised when installing reflective insulation because the radiant material can act as a vapor barrier. If not placed properly problems can occur with condensation.

The ability of insulation to prevent passage of air also helps lower energy cost by reducing air transfer. If there is a perfect air barrier an air-impermeable insulation is not a factor but often the air barrier has penetrations from grilles, lights, electrical devices, pipes, and wires.

The following insulation materials are considered to be “air-impermeable”:

- Closed-cell medium density polyurethane spray foam (2 lb./cubic foot)
- Open-cell low density polyurethane spray foam (0.5 lb./cubic foot)
- Extruded polystyrene foam board

The following insulation materials are not considered to be “air-impermeable”:

- Netted or blown cellulose
- Fiberglass batt insulation
- Blown-in fiberglass
- Mineral wool insulation
- Cotton batt insulation

R-value, U-value, k-factor:

Insulation is rated in terms of thermal resistance, called R-value, which indicates the resistance to heat flow. The higher the R-value, the greater the insulating effectiveness. The R-value of thermal insulation depends on the type of material, its thickness, and its density. In calculating the R-value of a multi-layered installation, the R-values of the individual layers are added together.

The effectiveness of an insulated ceiling, wall or floor depends on how and where the insulation is installed.

- Insulation which is compressed will not provide its full rated R-value. This can happen if you add denser insulation on top of lighter insulation in an attic. It also happens if you place batts rated for one thickness into a thinner cavity, such as placing R-19 insulation rated for 6¼ inches into a 5½ inch wall cavity.
- Insulation placed between joists, rafters, and studs does not retard heat flow through those joists or studs. This heat flow is called thermal bridging. So, the overall R-value of a wall or ceiling will be somewhat different from the R-value of the insulation itself. This is why it is important that the attic insulation cover the tops of the joists and why the use of insulative sheathing on walls performs better than just cavity insulation. The short-circuiting through metal framing is much greater than that through wood-framed walls; sometimes the insulated metal wall's overall R-value can be as low as half the insulation's R-value.

Thermal conductivity is the quantity of heat transmitted through a unit thickness (usually 1 inch) in a direction normal to a surface of unit area, due to a unit temperature gradient under steady state conditions. It is usually represented by the letter *k* and called k factor. To obtain the “R” value multiply the k factor by the thickness, (in inches). For example if the k factor of a polystyrene foam board is 4.5 btu•in/ft²•°F•h and the board is 3 inches thick then the R-value is 4.5 x 3 = 13.5 ft²•°F•h/btu.

The U value is the reciprocal of the R-value. In the example above the U value of the polystyrene foam board is 1/13.5 or 0.074 btu/ ft²•°F•h

To obtain an overall heat transfer coefficient, the resistances need to be summed. (Do not sum U values.)

$$\frac{1}{U} = \sum R_T = R_1 + R_2 + R_3 + \dots$$

Here is an example:

Element	R (insulated cavity)	R (at the studs)
1. Outside surface, 15 mph wind	0.17	0.17
2. Wood bevel lapped siding	0.81	0.81
3. Rigid foam insulating sheathing	4.0	4.0
4. Mineral fiber batt insulation, 3.5 in.	13.0	--
5. Wood stud, nominal 2X4	--	4.38
6. Gypsum wallboard, 0.5 in.	0.45	0.45
7. Inside surface, still air	0.68	0.68
	R ₁ =19.11	R ₂ =10.49

Types of Insulation:

Batts:

Blankets, in the form of batts or rolls are flexible products made from mineral fibers, including fiberglass or rock wool. They are available in widths suited to standard spacings of wall studs and attic or floor joists. They must be hand-cut and trimmed to fit wherever the joist spacing is non-standard (such as near windows, doors, or corners), or where there are obstructions in the walls (such as wires, electrical outlet boxes, or pipes). Batts can be installed by homeowners or professionals. They are available with or without vapor-retarder facings. Batts with a special flame-resistant facing are available in various widths for basement walls where the insulation will be left exposed.

Blown-in loose-fill insulation:

Blown-in loose-fill insulation includes cellulose, fiberglass, or rock wool in the form of loose fibers or fiber pellets that are blown using pneumatic equipment, usually by professional installers. This form of insulation can be used in wall cavities. It is also appropriate for unfinished attic floors, for irregularly shaped areas, and for filling-in around obstructions.

In the open wall cavities of a new house, cellulose and fiberglass fibers can also be sprayed after mixing the fibers with an adhesive or foam to make them resistant to settling.

Foam spray or boards:

Foam insulation can be applied by a professional using special equipment to meter, mix, and spray the foam into place. Polyisocyanurate is an open-celled foam. Polyisocyanurate and polyurethane are closed-cell foams. In general, open-celled foam allows water vapor to move through the material more easily than closed-cell foam. However, open-celled foams usually have a lower R-value for a given

thickness compared to closed-cell foams. So, some of the closed-cell foams are able to provide a greater R-value where space is limited.

Rigid insulation is made from fibrous materials or plastic foams and is produced in board-like forms and molded pipe coverings. These provide full coverage with few heat loss paths and are often able to provide a greater R-value where space is limited. Such boards may be faced with a reflective foil that reduces heat flow when next to an air space. Rigid insulation is often used for foundations and as an insulative wall sheathing.

Insulated Concrete Forms:

Insulated Concrete Forms (ICFs) are forms or molds that have built-in insulation for accepting reinforced concrete. ICFs are gaining recognition because of low air transfer and high R-value. These large, hollow blocks are stacked right off of the truck and filled with reinforcing bar and concrete. The end result leaves you with a high-performing wall that is structurally sound, insulated, strapped, has a vapor barrier, and is ready to accept final exterior and interior finishes.

Structural Insulated Panels:

Structural insulated panels (SIPs) are building panels used in floors, walls, and roofs for residential and light commercial buildings. The panels are typically made by sandwiching a core of rigid foam plastic insulation between two structural skins of oriented strand board (OSB). Other skin material can be used for specific purposes. SIPs are manufactured under factory controlled conditions and can be custom designed for each home. R-values for SIPs depend on the thickness of the SIP and the type of core material that is used.

Reflective:

Reflective insulation systems are fabricated from aluminum foils with a variety of backings such as kraft paper, plastic film, polyethylene bubbles, or cardboard. The resistance to heat flow depends on the heat flow direction, and this type of insulation is most effective reducing downward heat flow. Reflective systems are typically located between roof rafters, floor joists, or wall studs. If a single reflective surface is used alone and faces an open space, such as an attic, it is called a radiant barrier.

Radiant barriers are installed in buildings to reduce summer heat gain and winter heat loss. In new buildings, you can select foil-faced wood products for your roof sheathing (installed with the foil facing down into the attic) or other locations to provide the radiant barrier as an integral part of the structure. For existing buildings, the radiant barrier is typically fastened across the bottom of joists, as shown in this drawing. All radiant barriers must have a low emittance (0.1 or less) and high reflectance (0.9 or more).

Air Sealing:

Air sealing is important, not only because drafts are uncomfortable, but because air leaks carry both moisture and energy, usually in the direction you do not want. For example, air leaks can carry hot, humid outdoor air into your house in the summer, or can carry warm moist air from a bathroom into the attic in the winter. Most people are aware that air leaks into and out their buildings through small openings around doors and window frames. Air can also enter the occupied space from other unheated parts of the building, such as attics, basements, and crawl spaces. Air also travels through:

- any openings or cracks where two walls meet, where the wall meets the ceiling, or near interior door frames;
- gaps around electrical outlets, switch boxes, and recessed fixtures;
- gaps behind recessed cabinets, and furred or false ceilings such as kitchen or bathroom soffits;
- gaps around attic access hatches and pull-down stairs.
- behind bath tubs and shower stall units;
- through floor cavities of finished attics adjacent to unconditioned attic spaces;
- utility chaseways for ducts, etc., and
- plumbing and electrical wiring penetrations.
- Door and window frames.

It is important to seal these potential leaks before installing insulation. Air permeable insulation should not be used to stop leaks, as it is not truly effective. In addition, penetrations of the air barrier should be kept to an absolute minimum to further reduce transfer of air.

Current Practice:

The most common method of insulating cavity walls construction is with fiberglass batts. If all of the control layers are installed properly, it can be effective. However, current installation practices need improvement. In many installations the batt insulation is not cut to fit snugly in the cavities and around obstructions without compression. When batts are cut short, too narrow, or too wide it affects the performance as an effective insulator. Also, when batts have been cut too big for the cavity or have not been cut to adequately accommodate obstructions, there tends to be compression and gaps of incomplete thickness. When batts are compressed into the cavity so that the kraft paper facing can be inset stapled it leaves gaps for convective looping.



Photo – 1: This is an example of compressed insulation, improperly fit around an obstruction, and within the cavity. The overall effectiveness of this insulation is greatly reduced.



Photo – 2: Poorly installed insulation in the ceiling.



Photo – 3: Penetrations of the air barrier allow for high infiltration or exfiltration (air movement between the conditioned space and attic).

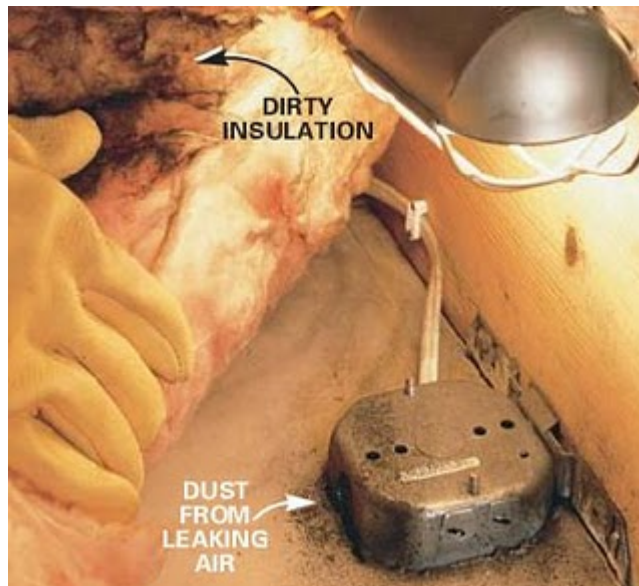


Photo – 4: This shows the evidence that penetrations of the air barrier allow air movement. The fiberglass acts as a filter for the air passing through. Air movement equals energy consumption.



Photo - 5: Complete absence of an air barrier on the underside of the roof trusses allows for excessively high exfiltration and infiltration. Also without support the insulation will fall out. Flexible ducts should not penetrate insulation.



Photo – 6: Inset stapling of the fiberglass allow for convective looping between the kraft paper and the drywall.



Photo – 7: Water stains are from condensation forming on the underside of the roof deck.

Climate Regions:

The International Code Council breaks the United States into various climate regions. These regions are used to determine insulation values. It also helps determine the need and placement of vapor retarder/barriers. The mid-atlantic region is in climate zone 4 & 5. Northeast PA and northern NJ is in climate zone 5A.

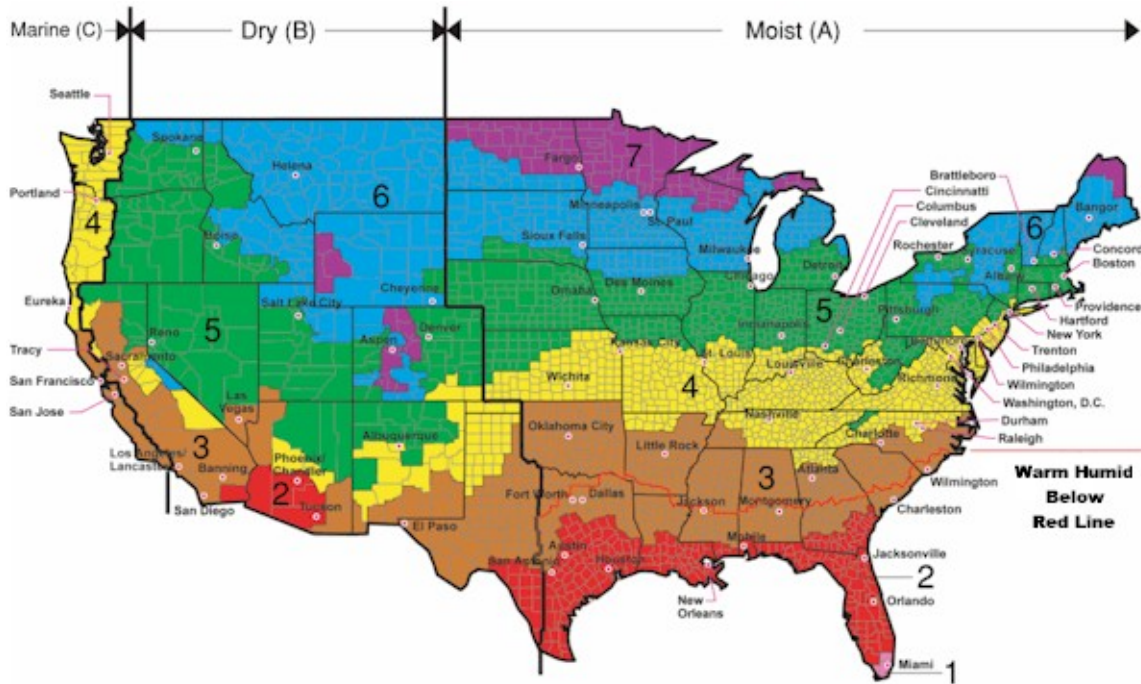


Photo – 7: International Codes Council – Climate Zones. This map is found in the IRC-2009 page 456 and in the IECC-2009 page 10.

Residential Code:

Insulation and fenestration requirements for various building components are listed in Table N1102.1 on page 468 of the IRC – 2009. For Climate zone 5A the following are a few of the requirements.

- Fenestration (windows) U = 0.35
- Skylights U = 0.60
- Ceiling or Roof R = 38
- Wood frame wall R = 20 or 13+ 5 *
- Floor R = 30
- Basement wall R = 10/13 **

* R-13 cavity insulation and R-5 insulated sheathing (*Vapor barrier may not be in the correct location with this type. Be cautious.*)

** The first R-value refers to continuous insulation and the second refers to cavity insulation. Either meets the requirements.

The IRC states that if the building's total thermal envelope UA (sum of the U-factor times the assembly area) is less than or equal to the total UA resulting from using the U-factors in Table N1102.1.2 then the building shall be considered to be in compliance. This means if the wall assembly does not meet the required R-value then you can increase the R-value for the other components to make up the difference.

The IRC-2009 has performance requirements for air leakage. Compliance can be by passing a blower door test or from an approved independent third party inspector. The following is from the IRC-2009:

(from the IRC 2009)

SECTION N1102.4 AIR LEAKAGE

N1102.4.1 Building thermal envelope. The building thermal envelope shall be durably sealed to limit infiltration. The sealing methods between dissimilar materials shall allow for differential expansion and contraction. The following shall be caulked, gasketed, weather stripped, or otherwise sealed with an air barrier material, suitable film or solid material.

1. All joints, seams, and penetrations.
2. Site-built windows, doors and skylights.
3. Openings between window and door assemblies and their respective jambs and framing.
4. Utility penetrations.

5. Dropped ceilings or chases adjacent to the thermal envelope.
6. Knee walls.
7. Walls and ceilings separating the garage from *conditioned spaces*.
8. Behind tubs and showers on *exterior walls*.
9. Common walls between *dwelling units*.
10. Attic access openings.
11. Rim joists junction.
12. Other sources of infiltration.

N1101.4.2 Air sealing and insulation. Building envelope air tightness and insulation installation shall be demonstrated to comply with one of the following options given by Section N1102.4.2.1 or N1102.4.2.2.

N1102.4.2.1 Testing option. Tested air leakage is less than 7 ACH when tested with a blower door at a pressure of 50 pascals (0.007 psi). Testing shall occur after rough in and after installation of penetrations of the building envelope, including penetrations for utilities, plumbing, electrical, ventilation and combustion appliances.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed.
2. Dampers shall be closed, but not sealed; including exhaust, intake, makeup air, back draft, and flue dampers;
3. Interior doors shall be open;
4. Exterior openings for continuous ventilation systems and heat recovery ventilators shall be closed and sealed.
5. Heating and cooling system(s) shall be turned off;
6. HVAC ducts shall not be sealed; and
7. Supply and return registers shall not be sealed.

N1102.4.2.2 Visual inspection option. The items listed in Table N1101.4.2, applicable to the method of construction, are field verified. Where required by the code official, an *approval* party independent from the installer of the insulation, shall inspect the air barrier and insulation.

Commercial Code:

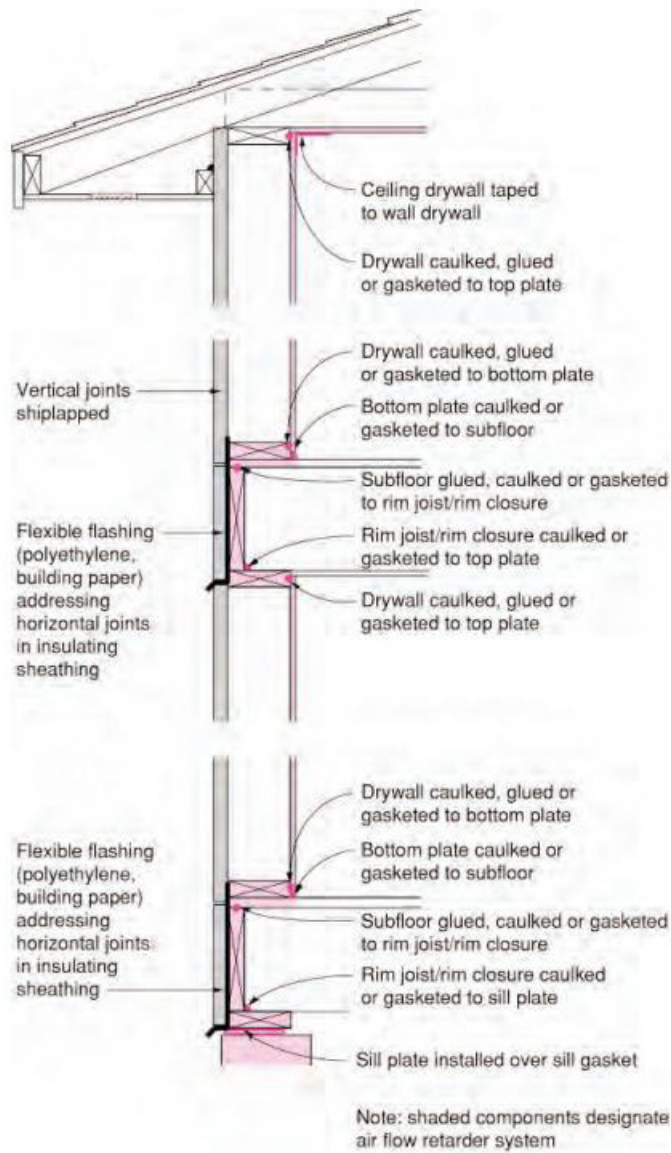
The International Building Code (IBC) refers the reader to the International Energy Conservations Code (IECC). The IECC has similar requirements for insulation and fenestration components based on climate zone.

There are also requirements for air leakage (502.4) and sealing of the building envelope (502.4.3) but no requirements for testing or inspection.

Air Barriers and Sealing:

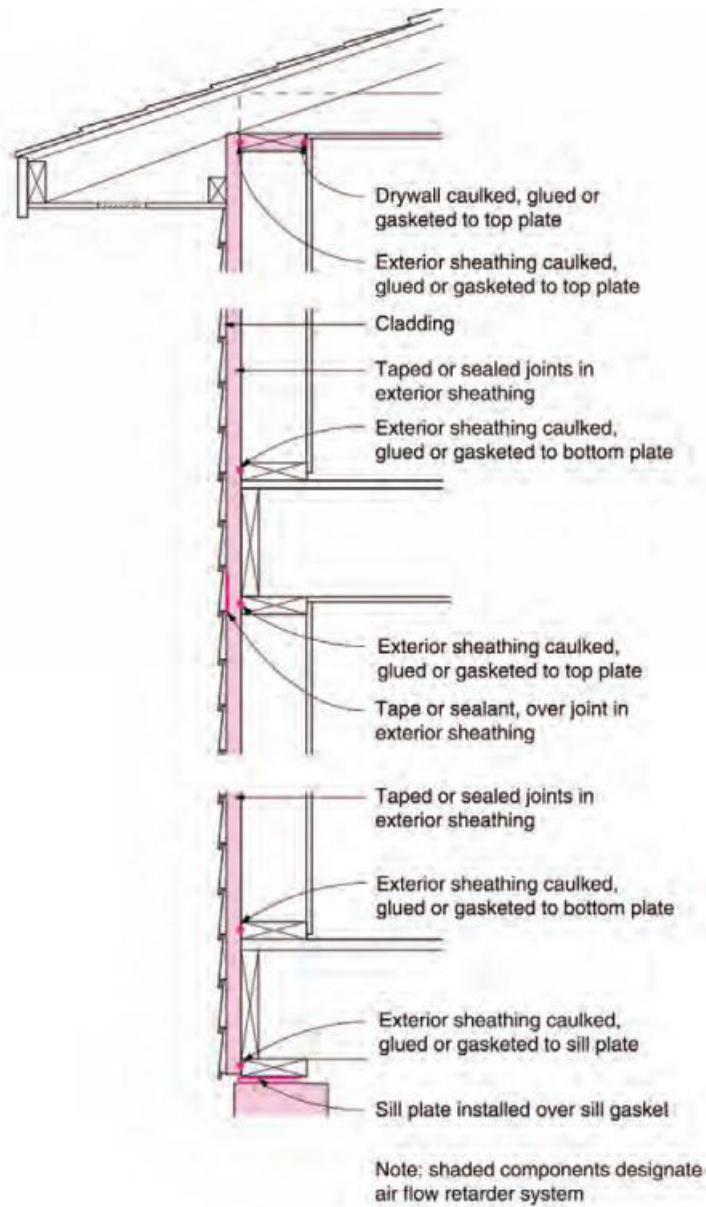
Reducing air leakage is best done by sealing cracks and joints, and installing a continuous air barrier. An air permeable insulation should not be used to seal cracks. Air barriers should be impermeable to air flow, continuous over the entire building enclosure, able to withstand the forces that may act on them during and after construction, and durable over the life expectancy of the building.

Ensure that the air barrier is continuous. Areas often overlooked are behind the tub/shower, built-in cabinets, and the fireplace insert. This is because they are often installed before the insulation and drywall trades are on site.



Airtight Drywall Approach applied to a wood-framed Enclosure

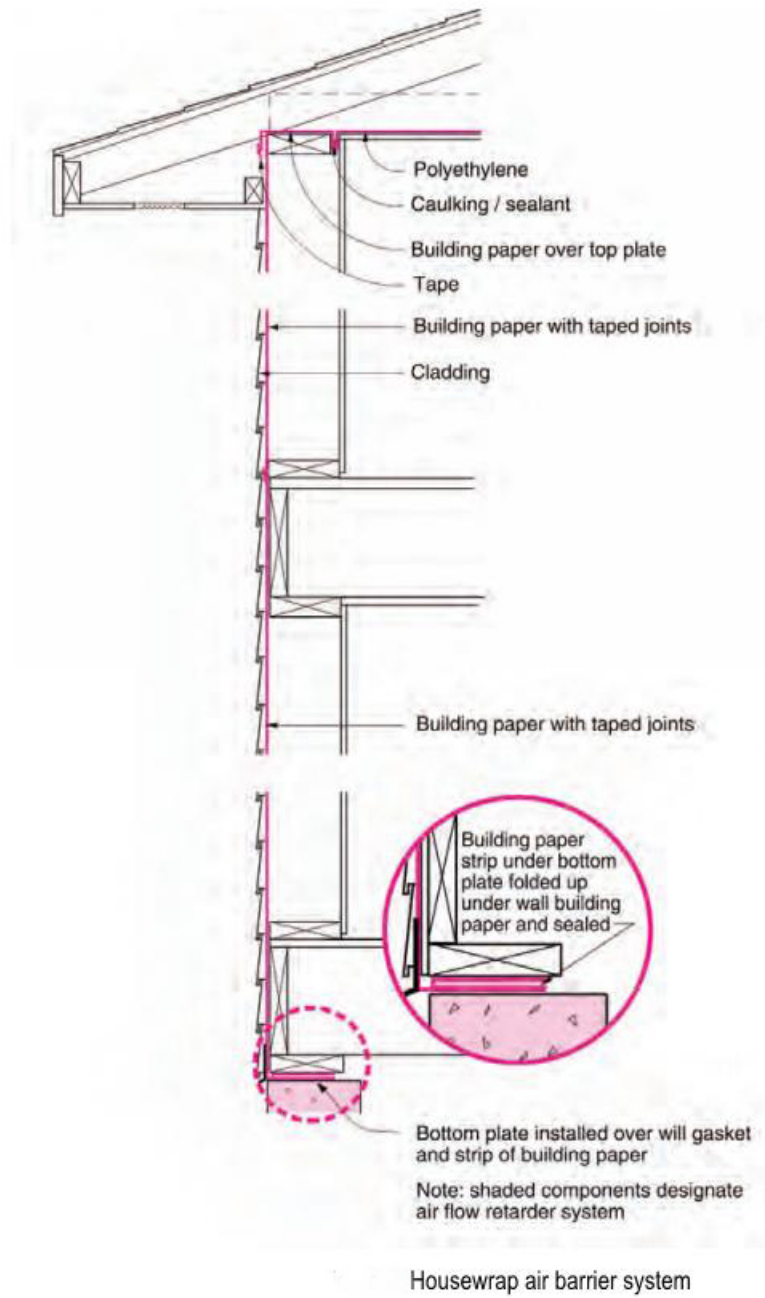
*Drawing – 1 Interior Air Barrier Using Drywall and Framing:
 Drawing courtesy of Building Science Corp.*



Exterior Sheathing (Insulated or not) Air Barrier System

Drawing – 2 Exterior Air Barrier Using Exterior Insulation Sheathing:

Drawing courtesy of Building Science Corp.

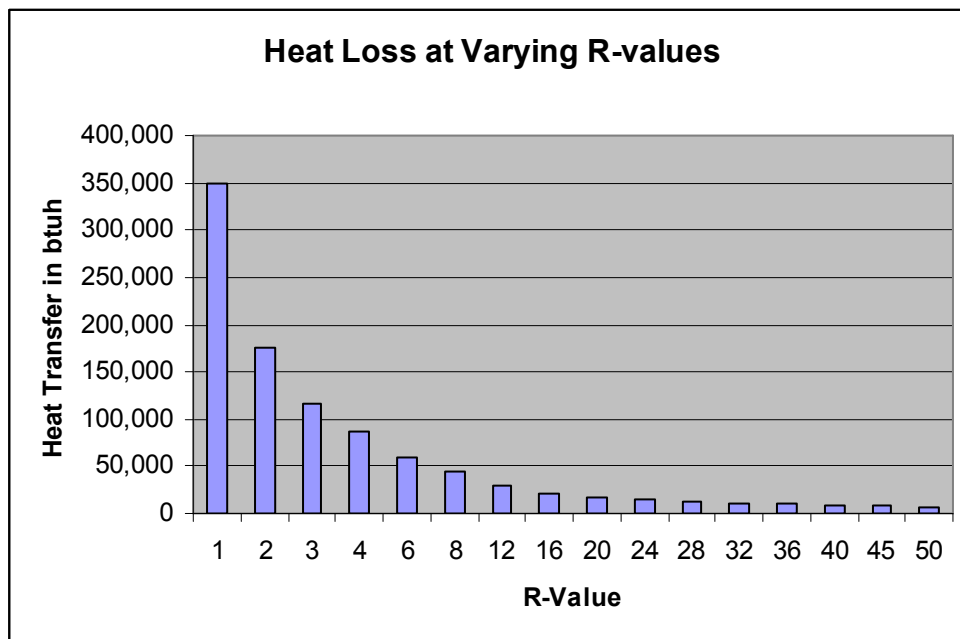


Drawing – 3 Exterior Air Barrier Using Housewrap

Drawing courtesy of Building Science Corp.

Is More Better?:

Is adding more insulation, than required by code, better and cost effective? Certainly as the overall R-value increase, the heat loss decreases. As you can see from the graph below there is a diminishing return as insulation thickness is increased. Increasing the R-value from 1 to 2 provides a 50% reduction in heat loss. But increasing the R-value from R=38 to R=39 only has a 2.5% drop in heat loss. Current code requirements offer a reasonable return on investment. But an economic analysis should be performed.



*The graph above uses the equation $btu/h = A \cdot \Delta T / R$.
For all: $A=5000 \text{ ft}^2$ and $\Delta T = 70 \text{ }^\circ\text{F}$*

Graph – 1:

Vapor Retarders and Barriers:

The function of a vapor retarder is to limit the migration of water vapor. The location of a vapor retarder and its permeability in an assembly is a function of climate zone, the characteristics of the materials that comprise the assembly, and the interior conditions.

Class I Vapor Retarder:	0.1 perm or less
Class II Vapor Retarder:	1.0 perm or less and greater than 0.1 perm
Class III Vapor Retarder:	10 perms or less and greater than 1.0 perm

A vapor barrier is defined as:

Vapor Barrier: Class I Vapor Retarder

Other terminology used:

Vapor impermeable:	0.1 perm or less
Vapor semi-impermeable:	1.0 perm or less and greater than 0.1 perm
Vapor semi-permeable:	10 perms or less and greater than 1.0 perm
Vapor permeable	greater than 10 perms

The challenge for builders and designers is to “keep vapor out” but “if vapor gets in, let it get out”. Vapor moves by two methods; vapor diffusion and air transport. If we understand these two methods, and know the climate zone, the placement of the vapor retarder can be determined.

Vapor diffusion moves vapor from a higher vapor pressure area to a lower pressure area as well as from a warmer area to a colder area. Vapor pressure is directly related to the concentration of moisture at a specific location. The higher the relative humidity the higher the vapor pressure. Vapor will move from a higher humidity area to a lower humidity area. In climate zone 5A, during the winter, vapor will move from inside to outside. During the summer the vapor will move from outside to inside.

In cold climates and during the heating season, building assemblies need to be protected from moisture vapor that is trying to move from the interior to the exterior. Vapor retarders are installed towards the interior warm surfaces. In addition, conditioned spaces should be maintained at a low relative humidity through the use of controlled ventilation and source control. In cold climates, the goal is to make it as difficult as possible for the building assemblies to get wet from the interior. The first line of defense is the control of moisture entry from the interior by installing interior vapor retarders, interior air barriers, and providing dilution ventilation with exterior air. Where possible, the interior moisture generation should be limited. In cold climate and during the heating periods, building assemblies dry towards the exterior. Therefore, permeable materials are often used as exterior sheathings.

In hot climates and during cooling periods the opposite is true. Building assemblies need to be protected from getting wet from the exterior and allowed to dry towards the interior. Accordingly, air barriers and vapor retarders are installed on the exterior of the building assemblies, and building assemblies are allowed to dry towards the interior by using permeable interior wall finishes, installing cavity insulations without vapor retarders and avoiding interior non-breathable wall coverings, such as vinyl wall paper.

But in mixed climates, such as Climate Zone 5A, the situation becomes more complicated. Building assemblies need to be protected from getting wet from both the interior and exterior and be allowed to dry to either the exterior or interior or both.

This can be accomplished by a number of ways, one of which is to utilize the building mechanical system to pressurize or create a negative pressure, depending upon the season, inside the building to control airflow and the moisture that comes with it. But this is complex and not always effective.

Another method, which is actually the common fiberglass cavity wall insulation practice, is to adopt a flow-through approach by using permeable building materials on both the interior and exterior surfaces of the building assemblies. This allows the water vapor to flow through the building assembly without accumulating. The problem with this approach is there is usually high air transfer through the assembly.

The more practical approach is to install the vapor retarder roughly in the middle of the assembly from a thermal perspective. This is typically accomplished by installing an impermeable or semi-impermeable insulating sheathing on the exterior of the framed cavity wall and installing a permeable-type insulation in the cavity space. The actual thicknesses for the impermeable insulation and the amount of permeable insulation depends upon the climate zone and the approximate relative humidity inside the building. The goal is to prevent condensing surface temperatures at the interface of the permeable and impermeable insulation.

Insulation for Condensation Control:

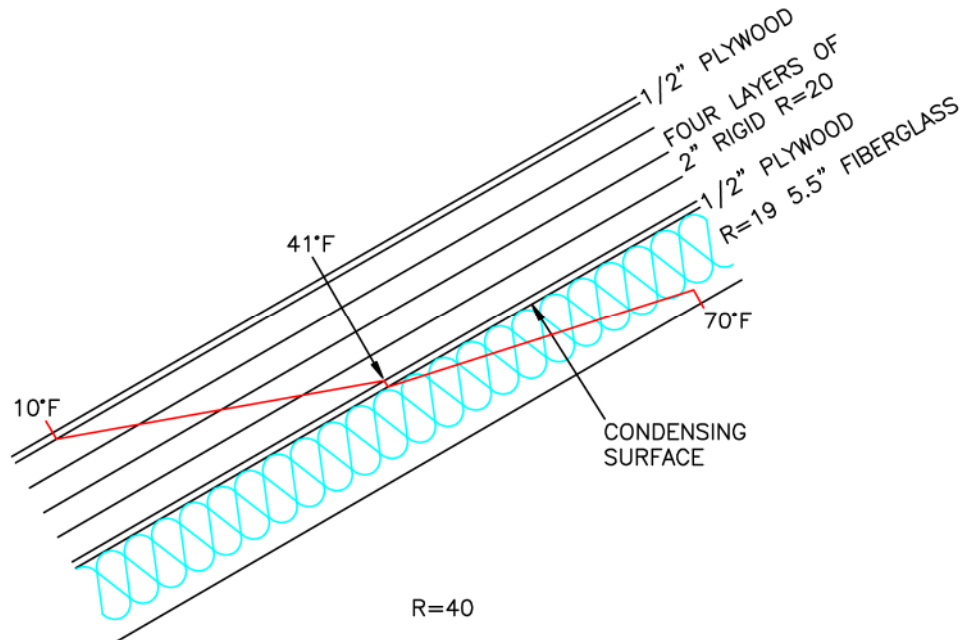
Listed below in the table are the IRC-2009 minimum R-values for the rigid insulation to be installed above the roof deck when an air-permeable insulation is installed in the roof cavity below the roof deck.

IRC - 2009 Table R806.4

Climate Zone	Minimum Rigid Board on Air-Impermeable Insulation R-Value
2B and 3B tile roof only	0 (none required)
1, 2A, 2B, 3A,3B,3C	R-5
4C	R-10
4A, 4B	R-15
5	R-20
6	R-25
7	R-30
8	R-35

Condensation can occur when moisture-laden air comes in contact with a material with the surface temperature below the dewpoint of the air. In a cold climate assembly, this usually occurs at the back face of the exterior sheathing when moisture from the conditioned space penetrates into the assembly through vapor diffusion or air movement. The addition of insulating sheathing to the exterior of an assembly in colder climates can

provide some condensation resistance if the thickness causes the condensing surface to be above the dewpoint temperature of the air at the surface.



This shows an example of a roof assembly that complies with IRC – 2009 Table R806.4. The rigid insulation is four layers of 2" with joints staggered and taped. The vapor barrier is between the rigid insulation and plywood on the interior side. The cavity is filled with R-19 fiberglass without a vapor barrier on the interior surface.

Drawing – 4:

The requirement for the rigid board insulation and specific thickness based on climate zone is to ensure that the inside surface temperature of the condensing surface is above the dewpoint and condensation does not occur inside the assembly. There are no similar code requirements for walls or floors in either the IRC or IBC. But why not? There is no difference between a roof and wall or floor from a moisture transfer standpoint and the potential for condensation to occur. Similar requirements of IRC-2009 Table R806.4 should be used for walls and floors.

Temperatures in Degrees Fahrenheit

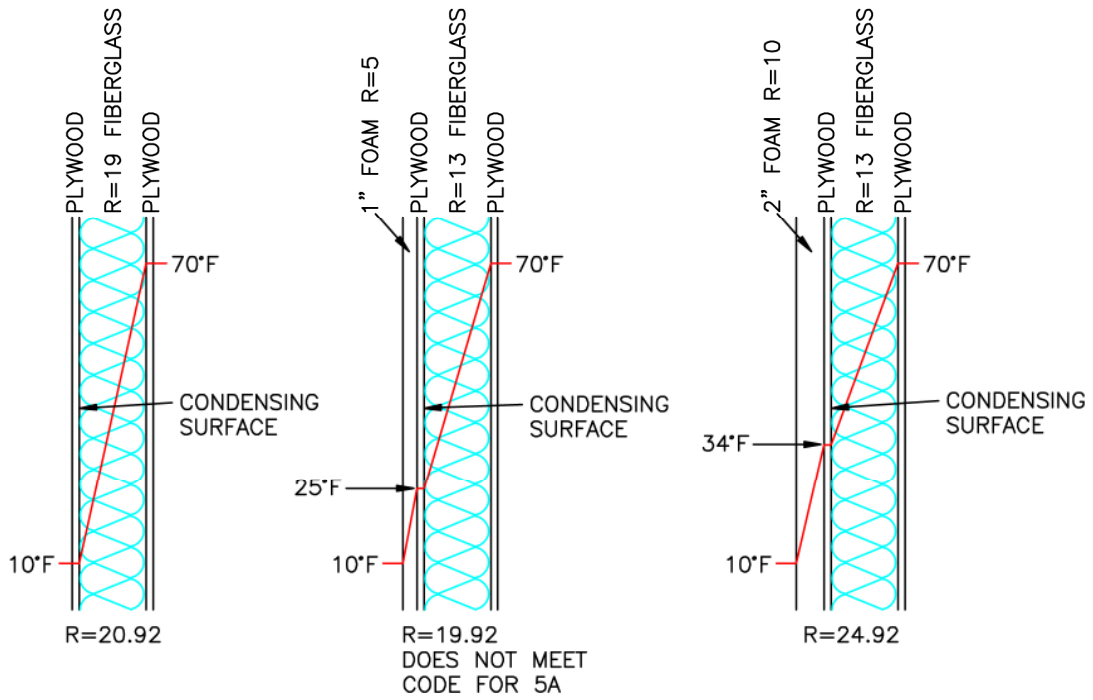
Air Temp ° F	% Relative Humidity																		
	100	95	90	85	80	75	70	65	60	55	50	45	40	35	30	25	20	15	10
110	110	108	106	104	102	100	98	95	93	90	87	84	80	76	72	65	60	51	41
105	105	103	101	99	97	95	93	91	88	85	83	80	76	72	67	62	55	47	37
100	100	99	97	95	93	91	89	86	84	81	78	75	71	67	63	58	52	44	32
95	95	93	92	90	88	86	84	81	79	76	73	70	67	63	59	54	48	40	32
90	90	88	87	85	83	81	79	76	74	71	68	65	62	59	54	49	43	36	32
85	85	83	81	80	78	76	74	72	69	67	64	61	58	54	50	45	38	32	
80	80	78	77	75	73	71	69	67	65	62	59	56	53	50	45	40	35	32	
75	75	73	72	70	68	66	64	62	60	58	55	52	49	45	41	36	32		
70	70	68	67	65	63	61	59	57	55	53	50	47	44	40	37	32			
65	65	63	62	60	59	57	55	53	50	48	45	42	40	36	32				
60	60	68	57	55	53	52	50	48	45	43	41	38	35	32					
55	55	53	52	50	49	47	45	43	40	38	36	33	32						
50	50	48	46	45	44	42	40	38	36	34	32								
45	45	43	42	40	39	37	35	33	32										
40	40	39	37	35	34	32													
35	35	34	32																
32	32																		

The dewpoint of 70 °F db and 35%rh is 40 °F.

The dewpoint of 90 °F db and 60%rh is 74 °F.

Table - 1: Dewpoint Table

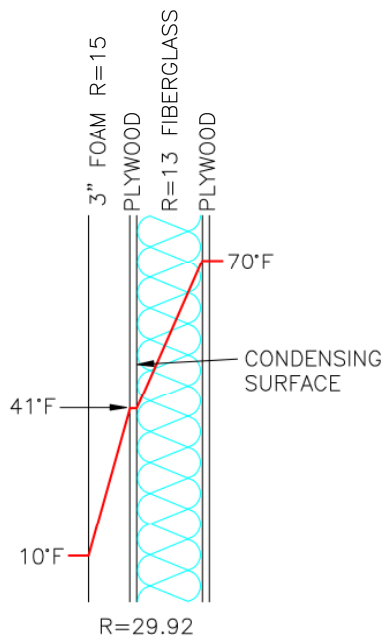
Using an outdoor temperature of 10°F and indoor temperature of 70°F the temperature gradient through various wall sections are shown below:



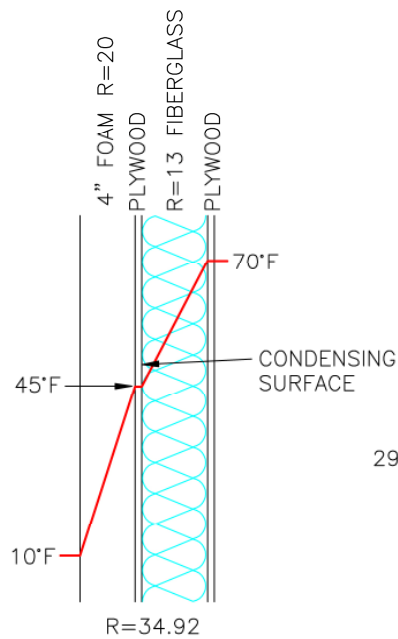
Drawing – 5,

Drawing – 6

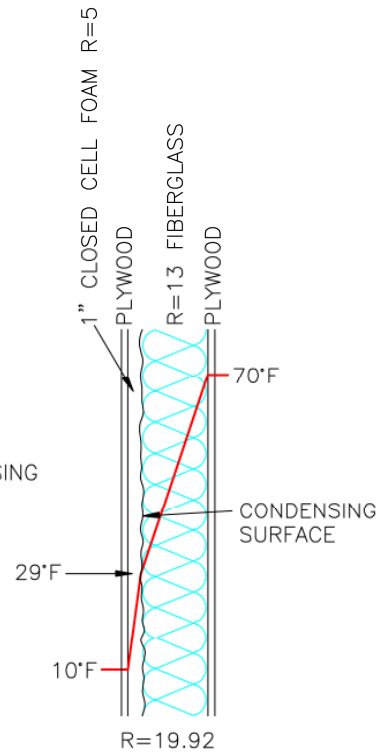
Drawing – 7:



Drawing – 8



Drawing – 9



Drawing – 10:

If the indoor space conditions are 70°F db and 35%rh the dewpoint is 40°F. Based on this a minimum of 3" rigid (R=15) should be used for condensation control with dewpoint at the midpoint of the assembly.

Cladding Gap

In a mixed climate zone it is important that the wall assembly be able to dry to the exterior and dry to the interior. Spray cavity foam, SIPs, ICFs, and rigid foam board sheathing does not allow cavities or the plywood sheathing to dry easily when it gets wet because there is not much energy available to move the water vapor out. Foam insulation is impermeable which means it does not allow air to pass.

To help out the drying process there should be a 3/8" gap between the cladding and housewrap/OSB interface, especially with air-tight claddings such as stucco, brick, and manufactured stone veneer. Typical vinyl siding has plenty of air gaps so an additional gap is not needed.

The primary function of the gap is to prevent the buildup of hydrostatic pressure across the water control layer by draining the water that penetrates, down inside the gap, and out the bottom through weep holes.

Here is an example: When it rains the stucco, manufactured stone veneer, and brick type materials get wet and absorb the water. When the sun comes out and beats on the cladding it warms the material and drives the water and vapor into the building. It reaches the house wrap/OSB, condenses and makes it wet. After the sun goes down and the cladding cools, more condensation occurs. But the water cannot easily pass back through the masonry material. The OSB stays wet longer, which results in deterioration and mold. With a drainage air gap the water can drain out and the space can breathe. A polypropylene mesh or “crinkled” housewrap can be used to provide the air gap.

Summary:

The greatest single change designers can make is to move the insulation package and the air/moisture/vapor barrier package to the exterior of the structure. In a construction environment that uses steel stud exteriors, codes have enabled the false sense that R-19 fiberglass in a 6” steel stud exterior wall actually provides an R-19 basis for the wall. It does not! The Effective Framing/Cavity R-Value of a 6” stud cavity with R-19 fiberglass is 7.1. Simply adding 1” of rigid insulation to the wall will increase the R-value by 70%!

The choice of insulation to use is up to the designer and will be based on personal preferences, economics, and desired performance. Regardless of which materials are used, it is important to ensure that it works effectively with the other three control layers: rain control layer, air control layer, and vapor control layer. While energy use is becoming more of a concern and more stringent code requirements are being enforced, it is critical to make a concerted effort to install the insulation and vapor barrier properly and to seal the cracks and seams in order to minimize air transfer. Lastly, as the building gets tighter, serious consideration should be given to using an energy recovery ventilation unit to control moisture and indoor air quality.

End

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