BASIS OF DESIGN

BUILDING ENCLOSURE

WHEN TO USE THIS BASIS OF DESIGN SECTION:

This BOD section should be used for new construction projects and for any projects involving work on the building enclosure, e.g., re-cladding, attic insulation, window replacement, re-roofing. Constructing a good building enclosure will have more impact on saving energy than most if not all other energy conservation measures in new building construction. Modifications to existing building enclosures present significant and uncommon opportunities to move the building in the direction of high performance. A good building enclosure can insure durability and have a positive impact on health and comfort of residents. This section is intended to outline criteria for high performance building enclosure in rehab and new construction projects.

GENERAL REQUIREMENTS:

DESIGN REVIEW

Building enclosure designs shall be submitted to Design + Building Performance Department and/or the energy consultant for review. In new construction projects, include details for all building enclosure components. For renovation projects, include details for all building enclosure components impacted by the project.

- The building enclosure includes all walls, windows, doors, and roofs that are exposed to the exterior, as well as slabs, and basement walls.
- Details must clearly indicate materials or components providing critical control functions. For Description of control functions, see below.
- Architects should provide a thermal boundary drawing showing continuous Insulation for review by Design + Building Performance Department.

QUANTITATIVE PERFORMANCE TARGETS:

The new construction or renovation project shall meet quantitative performance targets for:

- Whole-building enclosure air tightness
- Apartment unit air tightness
- Insulation levels

Note: in cases where applicable local codes or funding requirements indicate more stringent performance targets, these local code or funding requirements shall govern.

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BUILDING ENCLOSURE CONTROL FUNCTIONS:

A fundamental purpose of the building enclosure is to separate the interior environment from the exterior environment. Yes, it's that simple. Most of the time, we want the interior environment to be something different from the exterior environment. In many situations – such as in cold winter weather, rainy weather or during a heat wave – we want the interior environment to be quite different from the exterior environment.

In order to support this environmental separation – where the environment on one side of the enclosure is different from the environment on the other side of the enclosure – the building enclosure must provide the follow 5 critical control functions:

- **Water Control**
- **Air Control**
- **Vapor Control**
- **Thermal Control**
- **Critter Control**

These first four Building Enclosure Control Functions are hierarchical. Air Control really doesn't matter if the roof can't keep the rain out. Thick layers of insulation and sophisticated vapor diffusion control membranes are a waste of effort if there are huge air leaks that allow for bypass of the vapor and thermal control. And so on.

Critter Control is probably closely related to Air Control. Generally, if air can't leak into a building, then it would be hard for pests to gain access to the building. Air control within and between spaces in a building – something often referred to as compartmentalization – goes hand in hand both with effective smoke control and with effective pest control. Water Control and Vapor Control relate to Critter Control as well because preventing moisture problems is essential to making the building unappealing for most typical building pests.

In Building Enclosure design, whether for new construction of renovation projects, the control layers, i.e., the elements providing each control function, should be clearly indicated and called out in design documents.

The critical control functions are each described in more detail below.

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WATER CONTROL

For the purposes of the building enclosures, liquid water is moved by gravity, by air pressures (e.g., induced by wind, stack effect or mechanical systems) or by capillarity (i.e. wicking). Flashings, drainage planes and claddings use gravity to shed water away from the building and to get water out of assemblies should it get in. Seals and air barriers are used to control air pressures that push water through cracks, holes and openings in a building enclosure. Capillary breaks are used to control the water that wicks through a concrete foundation. Capillary breaks are also used to separate slabs on grade from water that wicks through soil.

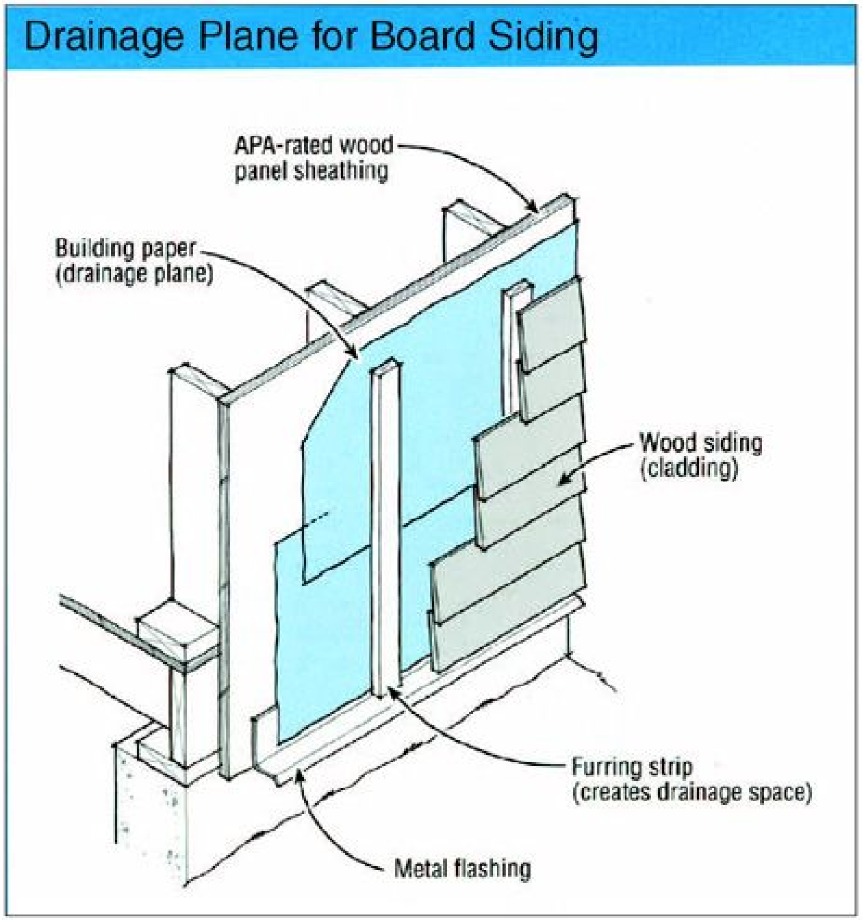
> *Of course, water is also conveyed by plumbing and sometimes carried around by people. But managing this potential water load is outside of the scope of the building enclosure.*

KEY TERMS:

DRAINAGE PLANE:

The drainage plane is the component or material that prevents further penetration of water into the assembly and on which water can be safely managed. Drainage planes are impervious to water.

- Examples:
  - At a sloped roof: underlayment, ice and water membrane
  - At a wall: single-lapped building wrap, shingle-lapped tar paper or building felt, a fully-adhered sheet membrane, a fluid-applied membrane, rigid insulation with taped seams, structural sheathing panels with integral water control membrane and taped seams



BASIS OF DESIGN

FLASHING:

Flashing is a water impervious component that 1) diverts water away from openings in- or vulnerable areas of- the enclosure, and/or 2) directs water inside an assembly to the exterior.

- Examples:
  - Diversion flashing: kick-out flashing at roof-wall interface, step flashing at a roof-wall interface, cap flashing (if sloped to the exterior) above a window, roof edging with a drip leg, saddle flashing over a joist or other structural element that penetrates a wall.
  - Flashing to direct water to exterior: sill pan flashing in a window opening, through-wall flashing for a brick cavity wall.

CLADDING:

A durable component/material that provides rain shedding and that protects the drainage plane from UV and direct weather exposure. Cladding provides aesthetic finish at the building exterior.

- Examples:
  - At a sloped roof: asphalt shingles, metal roofing, clay tiles
  - At a wall: fiber cement lapped siding, metal panels, EIFS, brick masonry, vinyl siding

CAPILLARY BREAK:

A non-water porous, water impervious material placed between two capillary active (water wicking) materials to prevent the capillary transfer (wicking) of water to moisture sensitive materials.

- Examples:
  - Foam gasket, bituminous membrane or sheet metal placed between concrete and wood framing (not that this application is not limited to the framing sill at the top of a foundation wall, it applies to all wood-concrete interfaces), free-draining gravel beneath a concrete slab, 10 mil polyethylene sheet placed between a concrete slab and ground/insulation, damp-proofing applied to a foundation wall, bituminous membrane placed on top of a footing before casting the foundation wall.

DESIGN DOCUMENT REQUIREMENTS:

Clearly indicate the materials or components performing the water control function in an assembly or detail.

APPLICATIONS:

ROOF:

In a pitched roof configuration, it is the shingles, metal roofing, clay tiles, etc. serve as the primary rain shedding layer or cladding while the roof underlayment (e.g., 30# building felt, ice and water membrane) serves as the drainage plane. One of the functions of cladding is to protect the drainage plane.

On a low-sloped roof, the roof membrane often serves as both the rain shedding layer and the water control layer. In some configurations pavers and insulation, ballast, or even a green roof is placed on top of the roof membrane and provides a degree of protection for the drainage plane.

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ROOFING BOD SECTION https://www.poahbod.org/roofing

WALL:

At walls, the cladding that provides the primary rain shedding and protection for the drainage plane may be fiber cement lapped siding, metal panels, EIFS, brick masonry, vinyl siding, etc… The drainage plane of the wall could be single-lapped building wrap, shingle-lapped tar paper or building felt, a fully-adhered sheet membrane, a fluid-applied membrane, rigid insulation with taped seams, structural panels with integral water control membrane and taped seams.

FOUNDATION/SLAB:

Foundations use the slope of grade to divert surface water away from the foundation. Drain tile and sump pumps may be used to intercept ground water and keep it from the foundation or slab.

OPENINGS AND PENETRATIONS:

Flashings are required at:

- openings in the enclosure, such as window and door openings,
- penetrations through the water control layer, such as for pipes, conduits or structural members.

The flashing must be configured so that it:

- diverts water away from the hole or opening, and
- directs water that gets into the opening safely to the OUTSIDE over the drainage plane or cladding.

WINDOW FLASHING DETAILS https://www.poahbod.org/windows#windows-index-requirements

AIR CONTROL

Air control is about keeping the inside air in and the outside air out. In order to control the condition (i.e. the temperature, humidity) of the air within a building, one first needs to contain it.

Air control is achieved by connecting air tight materials to form a continuous, unbroken (unless doors or windows are open) 3-dimensional wrap around the building interior. Think of a balloon with no holes. Materials must be joined in an airtight and durable manner that allows for building movement as well as thermal expansion and contraction of materials. Transitions between building assemblies, for example between walls and the ceiling/roof, require particular attention to maintain continuity of the air control. Openings in assemblies, such as windows and doors, are places where careful detailing and installation is needed to achieve airtight and durable seals to connect the various materials coming together at these locations. Attached elements such as porch roofs, decks and entry canopies present challenges to airtightness.

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It is also important to have good air control between various spaces within the building. This is referred to as **compartmentalization** – a complicated word for a relatively simple idea. An air tight enclosure around an apartment unit is needed to prevent airborne contaminants, smoke and odors in one apartment from spreading to neighboring apartments. Robust compartmentalization also diminishes the forces acting on a building that move air into or through the building. For example, the ground floor of a multi-story building would be less subject to drafts, and out-swinging doors would be easier to open in cold weather, if a building is well compartmentalized.

Airtight enclosures also support the operation of conditioning and ventilation systems by making it easier to control the pressures and direction of air flow between spaces. For example, if we want a corridor to be slightly pressurized relative to apartments so that odors from apartments do not migrate into the corridor, then it helps to have an airtight enclosure of that corridor space. The more airtight an enclosure the less airflow is needed to pressurize or depressurize the space with the enclosure. Therefore, with better airtightness it is possible to maintain the desired pressure relationships while using less energy and installing smaller ducts and equipment.

Don't buildings need to breathe?

This is a very common misconception. It's close, but not correct. People need to breathe; buildings need to be able to dry. Moisture sensitive building materials need to be able to dry out should they get wet. It is a good practice to deliberately allow for this in design. But it is important to understand the difference between air movement and drying by diffusion. Air leakage can certainly move moisture – but not always in a direction or to a location that is helpful! Diffusion drying can be thought of as evaporation through solid materials. There is more on diffusion in the Vapor Control section of this document. For more on the people needing to breathe thing, consult the Ventilation Basis of Design section.

VENTILATION BOD SECTION

https://www.poahbod.org/ventilation

Airtightness is sometimes regarded as a proxy for overall construction quality. The airtightness of a building and of apartments within buildings are properties that can be measured.

The common method for testing and verifying the airtightness is through the use of a calibrated fan and pressure measuring gauges. In the construction industry the common term for this testing apparatus is "blower door". The widespread availability of **blower door equipment** and qualified technicians allows for quantitative airtightness targets to be established for new construction and renovation projects.

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REQUIREMENTS:

DESIGN DOCUMENT REQUIREMENTS:

Clearly indicate the materials or components performing the air control function in an assembly or detail. In the design documents it should be evident how the air control function is transitioned from one component or assembly to another.

PERFORMANCE TARGETS:

- Project managers should budget for blower door testing at the following times:
  - **Before construction (Rehab)** in order to establish baseline.
  - **During construction (Rehab)**, based on scope of work, test when sufficient work is complete to identify leaks in new work
  - **During construction (New)**, test after insulation but before sheetrock is installed
  - **After construction (Both)** is finished, to verify performance.
- Architects should include performance targets in specifications and drawings.

NEW CONSTRUCTION:

Measured air leakage shall not exceed the following thresholds:

- Whole building enclosure: 0.4 cfm / ft2 enclosure at a pressure difference of 75 Pascals (0.3 inch water gauge).
- Individual apartments: 3 ACH 50 (3 air changes per hour at a pressure difference of 50 Pascals).

New construction whole building enclosure airtightness shall be measured in accordance with ASTM E 779:

- Test airtightness at a pressure differential of 0.3 inch water gauge (75 pascals)
- Result of test should shall calculate air leakage rate of building thermal envelope at or less than 0.4 cfm/ft^2 (0.2 L/s * m^2)

New construction apartment airtightness shall be measured in accordance with RESNET testing and sampling protocols.

REHAB:

Retrofit and renovation projects should target reductions in the measured air leakage. For retrofit and renovation the appropriate airtightness improvement target will depend upon the scope of the project. Suggestions for air leakage reduction targets associated with various scopes are provided below:

AIR LEAKAGE REDUCTION (Rehab)	
Scope	**Reduction Target**
Wall re-cladding	30-40%
Attic air sealing	15-30%
Converting from vented to conditioned attic	30-50% (low-rise construction)
Window replacement	10-30%

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RENOVATION, MAINTENANCE, AND COMPARTMENTALIZATION:

Measures to improve compartmentalization should also be incorporated into any interior renovation scope. This is particularly important in occupied buildings as the opportunities to make improvements within occupied spaces is rare. Even regular maintenance activities can be leveraged to improve compartmentalization of apartments. Examples of typical renovation or maintenance scopes and associated opportunities for airtightness improvement are lists below:

- **Flooring replacement:**
  - Seal the wallboard to the floor at the base of the wall (full perimeter of the floor).
- **Painting:**
  - Slide escutcheons away from the wall and seal around pipe penetrations.
  - Remove ventilation and heating/cooling register grilles. Extend and seal the register boot ductwork to the wallboard or ceiling.
  - Seal the wallboard to the ceiling at the top of the wall (full perimeter of the ceiling).
  - If using a dropped ceiling, ensure the demising walls are continuous and seal to the underside of the floor deck above.
  - Temporarily remove switch plate and outlet covers, caulk between electric box and wallboard.
- **Plumbing repairs and maintenance:**
  - Use elastomeric sealant and, where necessary, backing, to seal pipe penetrations behind toilets, shower heads, hot water heaters and under bathroom vanities and kitchen sinks.
  - Slide escutcheons away from the wall and seal around pipe penetrations.
- **Electrical renovations and repairs:**
  - Seal electrical penetrations at all walls and ceilings: electrical panel box, data boxes (i.e. phone), outlets, and switches, behind oven/fridge, telephone box, intercom, in closet ceilings/floors with caulk, foam or with a gasket.
  - Foam penetrations made by electrical fixtures and wiring in attic.
  - Seal ceiling penetrations at light fixtures with foam. When possible switch to surface mounted LED fixtures.
  - When replacing ceiling-recessed fixtures use only Insulation Contact (IC) and Airtight (AT) rated fixtures.
- **Duct cleaning and HVAC maintenance:**
  - Seal exhaust fan housing to ceiling. Remove grilles and seal fan housing to gypsum wallboard with foil mastic tape with UL 181 label.
  - Seal heating and cooling duct boots/register boxes to ceiling/wallboard. Remove register grilles. Install sleeve to extend duct boot to back of wallboard if needed. Tape duct boot (to sleeve and) to wallboard or ceiling with a foil mastic tape carrying UL 181 label).
- **Bathroom renovation:**
  - Tub replacement: ensure that the drywall surrounding the tub is continuous to the floor behind the tub.
  - Use elastomeric sealant and, where necessary, backing, to seal pipe penetrations behind toilets, shower heads, and under bathroom vanities.
  - Use surface mounted medicine cabinets or mount recessed cabinets in an airtight enclosure.
  - Seal at base of bathtubs, toilets and top of shower tile with caulk.
- **Unite entry door maintenance, painting or replacement:**

- Replace entry door weather stripping if necessary; use V-seal if possible.
- Caulk door frame to wall and floor.
- Foam inside door latches making sure foam fills cavity above, below, and sides of latch opening. Cut any foam that interferes with latch operation.

- **Stair tread replacement or stair renovation:**
  - Caulk gaps around risers, treads, and stringers.
  - Caulk between stringers and walls.
- **Attic hatch installation:**
  - Glue 2 layers of 2 inch rigid foam to back of hatch and use gasket or weather stripping to seal hatch to opening.
  - Ensure the hatch engages gasket or weather stripping when placed in opening.
- **Kitchen renovation:**
  - Repair drywall (ensure it is continuous) and seal all holes and cracks in the drywall behind cabinets and appliances
  - Seal the wallboard to the floor.
  - Seal all penetrations through the wallboard and use a metal mesh backer for openings wider than 3/8".
  - If the kitchen includes a dropped soffit, ensure that wallboard at the back of the soffit is continuous to the underside of the floor above.
  - Seal around the range hood exhaust duct penetration through the ceiling/wallboard with appropriate sealant.

VAPOR CONTROL

Vapor Control is about preventing condensation within walls, roof assemblies, finished basement walls, carpets, the backs of cabinets or wherever moisture can cause problems in a building.

Generally, water vapor moves from warm to cold: Think of a cold can on a warm day or the fog that develops of glasses when one comes out of the cold into a warm coffee shop. Water vapor also moves from more to less, that is from a higher concentration to a lower concentration: Think of how the steam from a hot shower dissipates when the bathroom door is left open.

For the building enclosure it is useful to think of airborne moisture this way:

- The **interior** airborne moisture tends to move from the **inside** to the **outside** in **cold weather**.
- The **exterior** airborne moisture tends to move from the **outside** to the **inside** in **warm weather**.

The strength of water vapor movement in or out increases with the difference in temperature and humidity between the inside and the outside.

In heated and occupied buildings, airborne moisture tends to move through building assemblies toward the outside **unless** and **until** it encounters something vapor impermeable (metal, glass) or a material that resists the diffusion of moisture (OSB, plywood).

In an air-conditioned building, airborne moisture from the exterior tends to move inward through the building assemblies **unless** and **until** it encounters something vapor impermeable such as polyethylene, foil

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faced gypsum, glazed tiles or something that offers significant resistance to vapor diffusion such as the back of pressed board cabinets.

For buildings that are in very cold climates and that do not have air conditioning, the inside-to-outside vapor drive is the greater concern. The appropriate vapor control strategy for these situations is to either

- Maintain moisture sensitive materials above the dew point of interior air (e.g., through the use of insulation exterior to those materials), or
- Promote drying to the exterior by using vapor permeable materials in the enclosure assembly and providing ventilation of sheathing (e.g., through the use of a vented cladding).

For **any air-conditioned building** and for buildings in hot humid climates the outside-to-inside vapor drive is the greater concern. The appropriate vapor control strategy for these buildings is to **avoid the use of significant vapor retarders to the interior side of the enclosure** and one or both of the following:

- Prevent circulation of exterior air into the enclosure assemblies (e.g., with an airtight enclosure and positive pressurization of the building)
- Use a vapor control material (vapor retarder) to the exterior side of the enclosure.

Most climates in the US present both periods of interior-to-exterior and exterior-to-interior vapor drive.

Water vapor can move through some materials in the direction of drying (toward drier air). Such materials are considered vapor permeable. Examples of vapor permeable materials include uncoated wood boards, uncoated gypsum wallboard, brick, cellulose, air. Water vapor cannot move through vapor impermeable materials. Such materials may be referred to as **vapor barriers** and include 6 mil or thicker polyethylene, metal, foil facings, glass. Then there are materials that restrict water vapor diffusion but still have some permeability. Vapor semi-impermeable materials include asphalt impregnated kraft facing (e.g., kraft-faced batts), most building felts*, OSB*. Vapor semi-permeable materials include plywood, gypsum wallboard with latex paint. (*What makes things a little more complicated/interesting, is that many common building materials change their vapor permeability with relative humidity.)

Designers must be aware of the vapor permeability of materials used in design or in an existing assembly. Caution and care is required regarding vapor impermeable materials in a building assembly.

For more information see BSC documents Info-312: Vapor Permeance of Some Building Materials, and BSD-106: Understanding Vapor Barriers

Vapor Control for Slabs and Foundation Walls

A slab on grade or foundation wall (applies to finished basement) is something of a special case for vapor control. These ground-coupled elements tend to be below the dew point of ambient air in warm weather. Insulating the slab or foundation wall from the ground (e.g., with insulation) will thermally decouple the slab from the ground and reduce the risk of condensation.

The risk of condensation on ground-coupled slabs and foundations is increased when these are insulated on the interior side with an air permeable insulation. Using fiberglass insulation to the interior of a foundation wall should be avoided. But who would ever insulate the top side of a slab on grade? Actually, carpet on a concrete floor acts as insulation and increases the risk of condensation and elevated humidity (i.e. increased risk of biological growth and support of dust mites) at the floor slab. Carpet should not be installed – or allowed to remain – on uninsulated slabs on grade.

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O.K. strictly speaking, all materials have some degree of permeability. But for practical purposes, it is helpful to think of relative vapor permeability and to regard some materials as non-vapor-permeable.

The IBC and IRC define vapor permeability of vapor retarders this as follows:

- **Class I**: 0.1 perm or less
- **Class II**: greater than 0.1 perm, less than or equal to 1.0 perm
- **Class III**: greater than 1.0 perm, less than 10 perm.

THERMAL CONTROL

Once design has established robust water control, air control and vapor control, then it is appropriate to determine how to provide thermal control. Thermal control, like air control, will have a direct impact on resident comfort and on energy bills. Maximizing thermal control will generally allow for heating loads to be met with smaller equipment. High levels of insulation may provide greater flexibility in mechanical system design by making feasible certain heating and cooling strategies that are not appropriate for conventionally insulated buildings. Insulation can also serve as a vapor control strategy where insulation is used to decrease condensation risk and promote drying.

For opaque building enclosure components and assemblies, the insulation value or *resistance to heat flow* is typically expressed as **R-value**. For windows and glazing the pertinent thermal control is both in terms of heat conduction, or **U-factor**, and radiant transfer of heat. With windows the **solar heat gain coefficient (SHGC)** and U-factor are important criteria of window selection. See the Windows BOD section for window requirements and further guidance.

Target opaque element R-values for POAH projects are provided by the International Energy Conservation Code (IECC).

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Control heat flow by using the following minimum R-value requirements.

THERMAL ENVELOPE MINIMUM R-VALUE REQUIREMENTS (New Construction)								
*ci = continuous insulation | *NR = no requirement | *LS = liner system								
Climate Zone	**1**	**2**	**3**	**4 Except Marine**	**5 and Marine 4**	**6**	**7**	**8**
Roofs								
Insulation entirely above roof deck	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-30ci	R-35ci	R-35ci
Metal buildings	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-25 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-49	R-49	R-49	R-49
Walls Above Grade								
Mass	R-5.7ci	R-7.6ci	R-9.5ci	R-11.4ci	R-13.3ci	R-15.2ci	R-15.2ci	R-25ci
Metal Building	R-13 + R-6.5ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-19.5ci	R-13 + R-19.5ci
Metal framed	R-13 + R-5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-15.6ci	R-13 + R-17.5ci
Wood framed and other	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-7.5ci or R-20+ R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-15.6ci or R-20 + R-10ci
Walls Below Grade								
Below grade wall	NR	NR	NR	R-7.5ci	R-7.5ci	R-7.5ci	R-10ci	R-12.5ci
Floors								
Mass	NR	R-8.3ci	R-10ci	R-10.4ci	R-12.5ci	R-12.5ci	R-16.7ci	R-16.7ci
Joist/framing	NR	R-30	R-30	R-30	R-30	R-30	R-30	R-30
Slab On Grade Floor								
Unheated slabs	NR	NR	NR	R-10 for 24" below	R-10 for 24" below	R-15 for 24" below	R-15 for 24" below	R-20 for 24" below
Heated slabs	R-7.5 for 12" below	R-7.5 for 12" below	R-10 for 24" below	R-15 for 24" below	R-15 for 36" below	R-20 for 48" below	R-20 for 48" below	R-20 for 48" below
Opaque Doors								
Nonswinging	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75

For thermal requirements for windows and doors, see their corresponding BOD sections:

BOD DOOR SECTION https://www.poahbod.org/doors

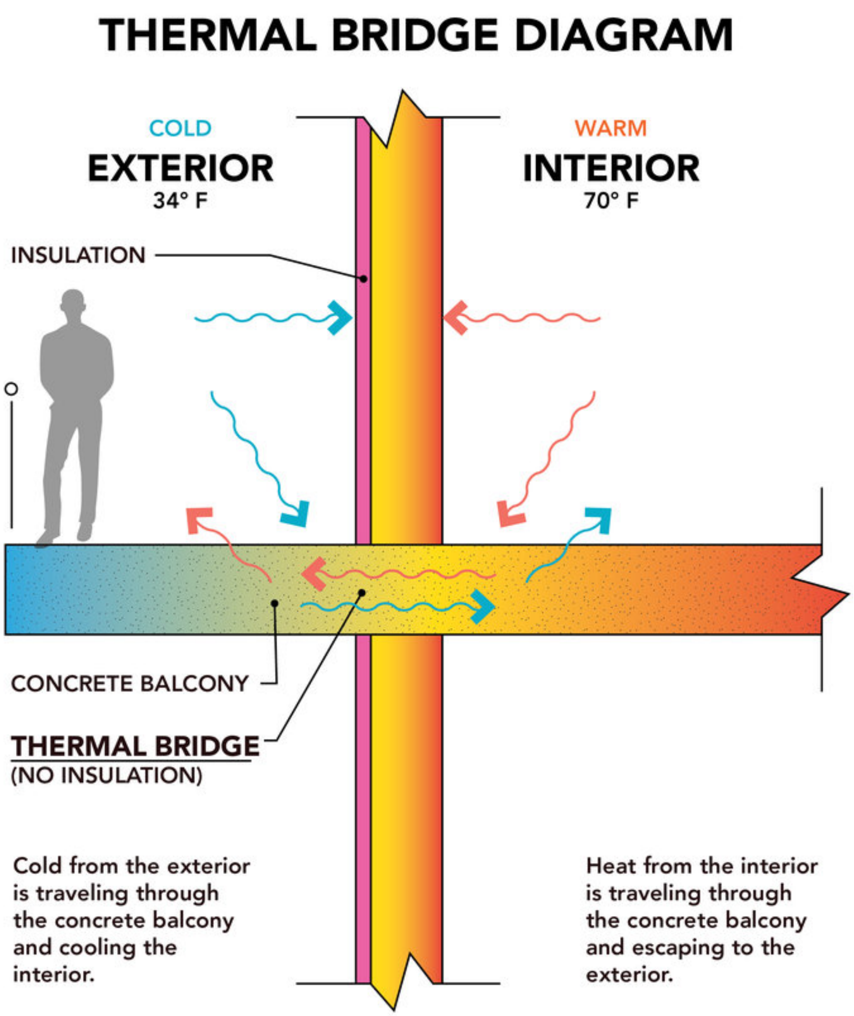
BOD WINDOW SECTION https://www.poahbod.org/windows

BASIS OF DESIGN

One factor that can have a large impact on thermal control is **thermal bridging**. Thermal bridging is the term used for a conductive element that conducts heat energy through or around the insulation. Common examples include steel framing in an insulated assembly, the metal spaces at the perimeter of an insulated glazing unit (IGU), the bare wood panel attic hatch to an otherwise insulated attic… Thermal bridging can significantly degrade the overall thermal resistance of an assembly. The IECC (in Table C402.1.4.1) provides values for Effective R-value for walls with steel studs. For example, a wall with R13 insulation between nominal 3 ½" studs at 16" o.c. would have an effective R-value of less than R6 and a wall with R19 insulation between nominal 6" studs at 16" o.c. would have an effective R-value of about R7. In both cases, this is assuming the insulation is properly installed.

Note that continuous insulation – as required by code in some circumstances – precludes the use of framing through the insulation layer. Where rigid insulation on the outside of a building is interrupted by Z furring, the insulation is not continuous. There are numerous approved methods to attach and support cladding over continuous insulation. It is important that POAH project managers do not allow designers to take the lazy way out by trying to pass off interrupted exterior insulation as continuous insulation.

Architects should include a thermal boundary drawing showing continuous Insulation for review by Design + Building Performance Department.



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COMPONENTS OF ENCLOSURE

- CRAWLSPACES + BASEMENTS
- DOORS https://www.poahbod.org/doors
- ROOF/ATTIC https://www.poahbod.org/roofing
- SLAB ON GRADE
- WALLS
- WINDOWS https://www.poahbod.org/windows