

Contractor's Field Guide to The Building Envelope

What is the Building Envelope and why does it matter? How can it fail? What role does tape play in air sealing?

In this post, we demystify the building envelope, helping builders and contractors identify weak spots in building tightness in order to improve air sealing, and create more structures that are sustainable, cost-effective and comfortable in all conditions.

What is a Building Envelope?

By nature, we do not expect our environment to maintain a consistent, 74-degree-Fahrenheit, 50% humidity, climate.

Our perception of comfort is quite adaptive and is based on circumstance, the expectation of environmental conditionals and activities. We use umbrellas when it's raining. We dress in layers when it's cold. We use sunscreen when exposed to summer's intense UV rays.

And yet, we expect our homes to provide thermal comfort and protection from the natural elements, at a consistent 74-degrees, every day.

Walls, roofs, windows, and doors all play a role, but really it's the building envelope that makes this possible.

At its simplest definition, *the building envelope is the exterior or shell of a building that repels the elements.*

At its most complex definition, it's an engineering system that meshes elements such as structural integrity, moisture control, temperature control, and air pressure boundaries into a single design strategy.

It is the physical separator between the conditioned and unconditioned environment of a building including the resistance to air, water, heat, light, and noise transfer. It's the part of the house that you can draw a line around: the roof, the walls, and the foundation.

While the building envelope is a silhouette of sorts, it's important to remember that these are compounded layers. Each part of the building envelope must be thought of as a collection of smaller pieces working together to provide structural support.

The way the foundation and [walls are built](#) is essential in creating a sturdy structure, or a base, for the rest of the building. This is one of the main functions of construction because a well-constructed envelope is necessary to simply keep the structure standing.

The building's design must be measured and carried out meticulously to ensure that there are no open edges, cracks

between the windows and walls and imperfections between the roof and the walls, or between the walls and the foundation. It is all included within the building envelope concept.

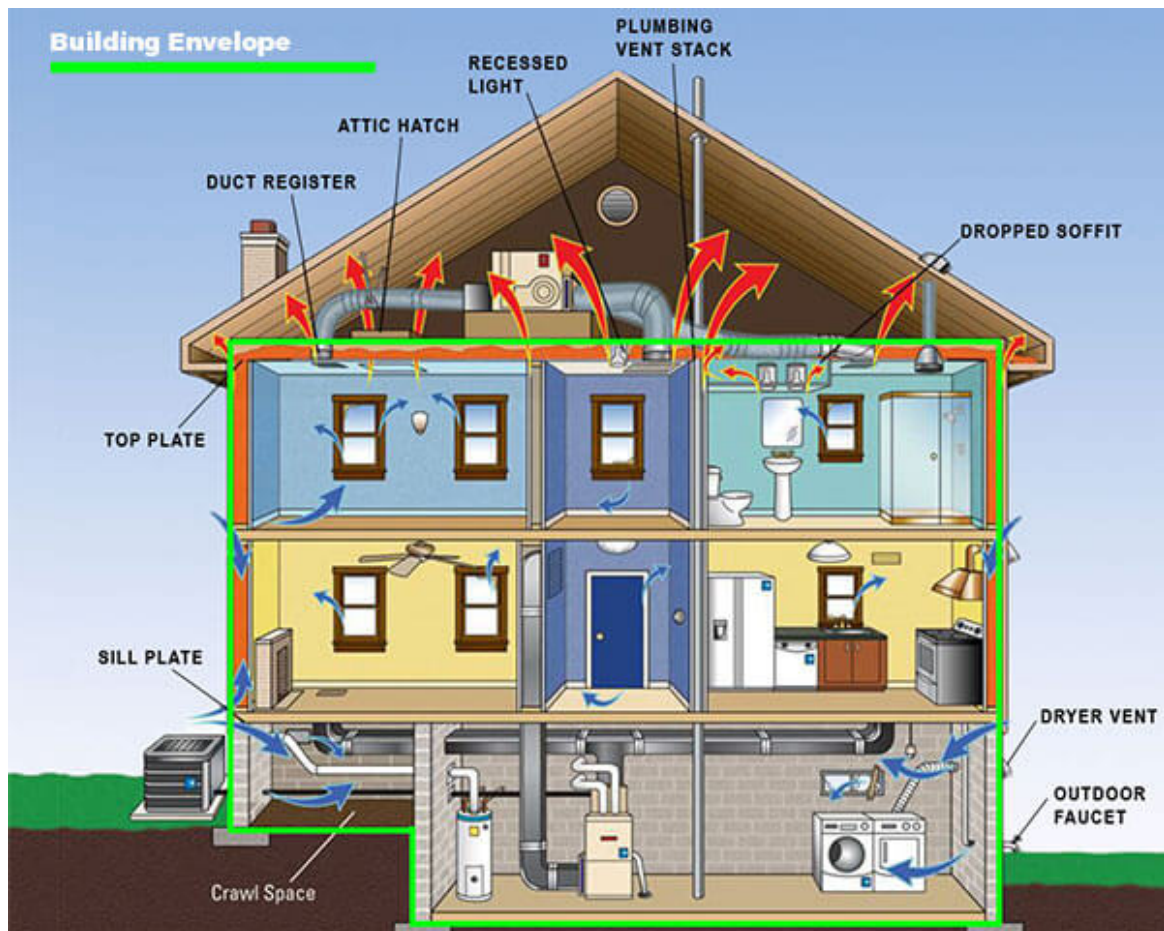
That said, each part of the enclosure faces different challenges.

- Roofs are bombarded by heat, rain, and hail
- Walls contend with wind and rain
- Foundations are always surrounded by wet, damp earth

On a construction level, the home's building envelope is a series of composite layers –whether it be wood, glass, veneer, drywall, etc. – each with their own permeable properties that must be considered.

A proper building enclosure works together to achieve the same goals of stopping or slowing the flow of air, water, and heat while still allowing the inevitable intrusion of water as a way to dry out.

Why Do Building Envelopes Matter?



Understanding Air Flow, Air Sealing and the Building Envelope | Image via [U.S. EPA](#)

All told, building envelope components work together to perform four basic, but critical functions: structural support, moisture management, temperature regulation, and air flow.

The latter three—moisture, air and thermal—characterize the “control” functions of the building envelope, those facets that ensure a house is energy efficient, comfortable, and sustainable.

1. Moisture control. The most important element of the envelope's control is its ability to regulate the transfer of moisture. Moisture presents a distinct danger to the overall integrity of a building and must be taken into account.

Moisture can and will impact your building over your head (roof), under your feet (basement/floor), and on your sides (walls). Each component must be addressed to prevent unwanted transfer from causing expensive damage. It's essential in all climates, but cold climates and hot-humid climates are especially demanding.

2. Air control. Controlling air flow is key to controlling energy consumption, ensuring indoor air quality, avoiding condensation, and providing comfort.

Control of air movement includes flow through the enclosure or through components of the building envelope itself, as well as into and out of the interior space. So, for example, when we talk of a house's draftiness, we're talking about the control of air flow.

3. Thermal control. Thermal transfer brings to mind how comfortable we feel inside our own homes.

Is it too hot? Is it too cold? If you want to address this question, it is easiest to look up. As we learned in elementary school, heat rises, and if you don't have enough resistance in the building to prevent heat from rising right through the roof, it is time to raise your building envelope IQ to prevent heat (and money) from escaping.

What is Building Tightness?

Building envelopes are often characterized as either “tight” or “loose.”

A loose building envelope allows more of a natural air transfer to occur, which improves indoor air quality which can remove the need for mechanical ventilation.

These types of building envelopes make the building more drafty and uncomfortable, it also makes the building harder to regulate temperature levels. This creates a higher chance of mold or mildew, and higher quantities of heated or cooled air are able to escape through leaks in the loose building envelope. This will increase energy bills along with negatively impacting the environment by releasing more greenhouse gases.

A tight building envelope allows for a high level of control over indoor air quality, temperature, humidity levels, and energy consumption.

This requires more insulation, caulk, adhesive tape, sealants, and energy-efficient windows to acquire a tight shell for the building. This leads to fewer drafts and a more comfortable building for its occupants, which often results in less waste in heating and cooling costs.

Tight envelopes also have a lower chance of producing mold or

mildew from moisture infiltration, this can help prolong the life of the building components. The downside to a tighter building envelope is it requires more extensive mechanical ventilation systems because it limits how much natural ventilation can occur.

Additionally, good building envelopes which prevent drafts and other air leaks allow for tighter control of the air pressure inside as well as the temperature.

Without that, cooling and heating sources are constantly fighting the exterior elements that are making their way inside the building. Not only is this expensive, it makes being inside the building uncomfortable. For example, a home where the air conditioning system has been shut off all weekend would take longer to cool on Monday morning if the building design allows for leaks and drafts.

The tight envelope provides the ability to adequately control the quality of the air, making the interior of the building more comfortable and pleasant.

What are Best Practices for Building Envelope Systems?

We've said it before and we'll say it again: **Build it tight; vent it right.**

Without a virtually airtight, well-insulated building envelope, achieving the energy performance levels required for current IECC Building Codes and [California Title 24](#) is nearly impossible without a massive investment in renewable energy systems.

The good news for builders is that getting the building envelope right is one of the lower-cost, higher-return investments when designing for net-zero performance. It all boils down to good building practices.

According to [ProBuilder.com](#), to make air sealing your top priority, concentrate on insulation. Focus on sealing the areas along the top and bottom plates, particularly around the perimeter in the attic area and along the foundation, whether it's a basement, crawlspace, or slab, so that you're not getting convective loops in your walls.

Why Do Building Envelope Systems Fail?

When the building envelope system is designed and constructed properly, very few occupants pay attention. But when the building envelope fails (and even the best-built projects do in time), everyone notices.

Those failures can include aesthetic loss, corrosion, poor indoor air quality, energy inefficiencies, and, in some cases,

life-threatening structural failure and eventual litigation—a builder’s worst nightmare.

1. Design deficiencies. Architects occasionally specify materials or design systems that are inappropriate for their intended use. Common mistakes include specifying materials that are incompatible with materials with which they come into contact or have inadequate performance criteria for thermal movement, structural capacity, or water penetration resistance.

Issues also arise when subcontractors try to reduce the weight, size, or amount of building envelope components (aluminum, glass, sealants, flashing, etc.) required on a project. This can lead to inadequate performance or capacity of the materials specified.

2. Material failure. It’s also common for properly specified materials to fail to meet the published performance levels. This could be a result of errors in the manufacturing, handling, or storing of the product or components within the product.

Common examples include degrading sealant adhesion, laminated glass delamination, and metal fatigue. While the anticipated performance levels are often based upon measured statistical performance, the strength of materials varies.

3. Poor workmanship. During construction booms, the problem of poor workmanship is exasperated as a result of having many inexperienced, unsupervised, and untrained personnel working

on projects. It is common to find building envelope components not installed per the manufacturing specifications.

Word to the wise: Putting the right people in the right job goes a long way toward proper installation and overall profitability.

4. Acts of nature. Even with flawless installations, bad things can happen to good work when environmental conditions exceed those that were anticipated during design. The effects of hurricane-force wind loads, driving rain, and extreme temperature fluctuations can overload a properly designed and constructed building envelope, causing damage to the system and making it vulnerable to further deterioration or failure.

While failures of this type cannot be stopped, many can be prevented through routine inspection and maintenance to identify small problems before they become big ones.

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10 Reasons Contractors Should Use Tape to Seal the Building Envelope

As customers demand more energy-efficient homes and building energy codes become stricter, more and more contractors are using adhesive tape to seal the building envelope.

Today's newer and higher-performing [seaming tapes](#) offer

builders better choices and multiple advantages over conventional building materials.

These tapes actually stick better over time, are more durable and are more weather resistant. Indeed, modern adhesive technology is much more sophisticated as a whole.

But don't just take our word for it. **Here are 10 great reasons to seal the building envelope with tape.**

1. **No holes.** Unlike nails or rivets, tape does not make holes. Fewer holes mean less opportunity for air leakage.
2. **Clean, easy application.** Unlike liquid and foam sealants, adhesive tape is not messy and it's easier to apply.
3. **It's affordable.** Using tape to seam is more affordable than spray foam or liquid adhesives.
4. **Versatility.** Unlike other construction materials, tape has a unique ability to withstand extreme temperatures, harsh environments and to bond securely with a host of different substrates and materials
5. **It's energy efficient.** Using tape to seal the building envelope is the standard in Europe where passive house (a.k.a. Passivhaus) is the norm. Passive Haus results in ultra-low energy buildings that require little energy for space heating or cooling. In fact, tape experts cite Europe as the best example of overall

utilization of acrylic tapes in construction. “In Europe, they tape up everything when building or retrofitting to create an air-tight seal,” says David Joyce, nationally known construction and tape expert, and owner of Synergy Companies Construction LLC. “Energy costs are much higher there, and it’s a matter of necessity.”

6. **The Department of Energy recommends it.** Direct quote from [Building Energy Code Resource Guide](#): To limit air leakage, builders use tapes to seal the seams of a variety of membranes and buildings products, including housewrap, polyethylene, OSB, and plywood. Tapes are also used to seal duct seams, to seal leaks around penetrations through air barriers – for example, to seal around plumbing vents – and to seal sheet goods to a variety of materials, including concrete.
7. **The Green Building Advisor is obsessed with tape.** Check out these articles: [Backyard Tape Test](#) and [Air Sealing Tapes and Gaskets](#).
8. Leaders in performance building, like **Matt Rissinger**, use it all of the time. Check out [Tight House Construction](#) and [4 Tips to Building an Efficient House](#), for example.
9. And **Hank Spies**, who uses tape in [metal roof sealing](#). [Quoted here:](#) *The most effective approach is to seal all joints with butyl*

sealing tape... It is more effective than caulk, and since the butyl does not cure, it tends to creep within joints to absorb the movement of the metal with changes in temperature.

10. **Twice as nice.** More and more builders are using [double-sided tape](#) as a housewrap tape so they can overlap seams and ensure no water gets through.

Clearly, the home's building envelope is a critical concept to grasp. At [ECHOtape](#), we've embraced the fact that a better building envelope leads to a healthier, more sustainable building.

We're excited about the expanding role [adhesive tape](#) will play in building envelope design, or redesign, and our goal is to help builders and contractors find the weak spots in building tightness, improve air sealing, and create more structures that are sustainable, cost-effective and comfortable in all conditions.

Because a well-maintained and regularly observed building envelope doesn't just save on energy bills; it will be better built to stand the test of time and mother nature.

Why Thermal Bridging and Thermal Breaks Matter in Construction

Thermal bridging reduces the overall performance of a home. *Thermal breaks* are the answer to this problem. Simple in theory, but thermal bridges have been challenging high-performance home builders for decades. It affects [HERS ratings](#). It impacts [continuous insulation](#). It affects saleability. It affects home [comfort](#). So it's a topic worth revisiting.

What is Thermal Bridging?

Thermal bridging occurs when a more conductive (or poorly insulating) material allows an easy pathway for heat flow across a thermal barrier. A classic example of this is the use of steel studs to bridge an insulated wall. The steel creates a pathway for heat to travel out of the home at a much higher rate than the rest of the wall. It's often hidden—the most common is wall studs—but, you must keep it in mind when thinking about heat loss (and the heating bills) at your home.

Areas in the wall assembly can transfer heat quicker than the insulation around it, like studs, plates, headers, and wall

posts. In a wood stud wall with R-20 batts, thermal bridging can bring the effective R-value down as low as R-15. If you put an R-20 batt into a steel stud wall, you may only get an *effective* R-value of approximately R-4. The keyword here is “effective”. Because building codes are beginning to require effective R-values rather than the number on the package, thermal bridging becomes more important.

But this isn’t about just meeting code; it’s also about energy bills. Energy prices tend to go up, so an investment in using less energy is an investment that pays bigger dividends every year.

Another issue with thermal bridges in insulated walls is moisture accumulation. You can see it inside the house as dark stains that telegraph framing members. It happens on ceilings and in closets where a lot of framing gets mashed together. This is often called ‘*ghosting*’ because the moist cool air attracts dust and forms dark lines on the ceiling which ‘ghost’ the joists.

How to Prevent A Thermal Bridge

So, if thermal bridging acts as a pathway for heat to escape the building more rapidly, a *thermal break*, or thermal barrier, helps block that pathway. Scientifically speaking, it’s an “element of low thermal conductivity placed in an assembly to reduce or prevent the flow of thermal energy

between conductive materials.” For example, insulated glazing is the thermal break for windows. The air or gas between the panes stops the conductive thermal energy from passing through the glass.

In metal and wood-framed buildings, wrapping a building’s envelope with a layer of continuous insulation cuts off *thermal bridging*. However, common issues to look out for include discontinuities in the insulation, particularly at junctions and around openings. Insulating materials such as rigid foam should be cut to fit tightly together and sealed with a [thermal break tape](#) to further prevent gaps.

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Common Ways to Reduce Thermal Bridging in Construction

There are a number of ways contractors and builders accomplish thermal breaking. Here are some of the most common:

- Use [advanced framing techniques](#), which reduce the amount of wood by increasing the spacing between framing members. For example, 16 inches on center becomes 24 inches on center for a stud-framed wall. A thermally broken double-stud wall can also be used with advanced framing. (The whole cavity is filled with insulation. This can eliminate thermal bridging in the walls, but it

does not address the floor. You can insulate the rim joist, but all of the other floor joists telegraph to the outside.)

- Consider adding a [continuous layer of exterior insulation](#), such as rigid foam or rock-wool (mineral fiber) board, over the wall before sheathing it.
- A newer approach involves applying strips of insulation over the wood studs to provide a thermal break.
- Use an alternative wall system. For example, the wood I-joist splines in structural insulated panels are thinner than most studs, and panels are usually 48 inches on center (or more), which further reduces thermal bridging.
- Implement proper insulation and thermal breaks around the foundation/slab. A well-insulated slab may mean two pours: one for the foundation wall and one for the slab, so you can provide a layer of rigid foam between the two components.
- Avoid metal fasteners of any kind that span the entire wall assembly.
- Design your basement wall so it is [better protected against moisture and water damage](#). This can allow you to use wood instead of switching to metal as a durability precaution.

As building codes evolve and homeowners become more savvy, more attention is going to be placed on thermal bridging, at every level. Whether you're building a new home to be [Zero Energy Ready](#), or retrofitting an existing building, care should always be taken to minimize and eliminate unnecessary



thermal bridging. If you're looking for a high-performance adhesive tape to help with your next project, [contact us](#). We love solving tape challenges!