tech primer

Wall Insulation

High performance insulation improves comfort and saves energy while reducing utility bills and long-term maintenance costs.

tech overview

applicable building types
all buildings

when to implement
at mid-cycle or refinance

fast facts
- reduces GHG emissions
- improves acoustics
- improves comfort
- reduces heat and cooling loss
- enhances building performance

costs & benefits*

GHG Savings

Tenant Experience Improvements

Utility Savings

Capital Costs

Maintenance Requirements

*ratings are based on system end use, see back cover for details.

be ex STL

getting to know wall insulation

Insulation, in tandem with other elements of the building envelope, plays a critical role in moderating indoor comfort. Optimizing the type, amount, and location of insulation can hugely improve comfort and lower utility bills.

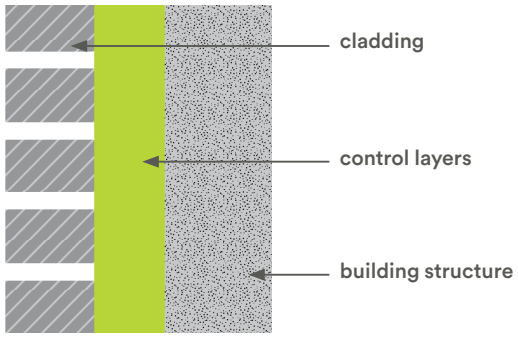
why upgrade wall insulation?

For older buildings and new buildings pursuing high levels of performance, insulation upgrades are one of the most effective ways to reduce energy use and improve interior comfort. When completing upgrades in existing buildings, insulation can be applied to either the interior or exterior, as preferred. Coupled with high performance windows and proper air sealing, insulation upgrades can, in some cases, eliminate the need for perimeter heating.

Learn More
See the **Roof Insulation** and **High Performance Windows Tech Primers** to learn more about these critical components of a high performance building envelope. BE-Ex's **Insulation Playbook** looks at insulation solutions for challenging situations, and the report, **Pursuing Passive**, examines strategies and benefits of upgrading wall insulation in existing buildings.

The envelope of a building keeps the outside outside — controlling the transmission of heat, air, water vapor, and moisture. All of these factors are managed by a series of control layers, including insulation, which must be correctly installed and coordinated in order to successfully create a protective enclosure. Each control layer interacts with, and influences, the others. Improper design or installation of control layers can result in the uncontrolled intrusion of water, air and vapor, leading to occupant discomfort, high energy bills and even structural damage.

Fig 1. Basic wall construction



Envelope control layers include:

- **Thermal barrier:** The combination of materials (mostly insulation) that reduces heat loss or gain between conditioned spaces and the outside.
- **Air barrier:** A continuous set of materials that prevents the movement of air through the envelope, especially at penetrations. Poor air barriers are responsible for the vast majority of heat loss and moisture intrusion, undermining the effectiveness of insulation. Window and door assemblies are part of the air barrier, which can also include sealants, fluid and sheet membranes, and weather-stripping. Every building requires a continuous air barrier.
- **Vapor control:** Distinct from the air barrier, the vapor control layer mitigates the diffusion of water vapor through building materials. The type and position of required vapor control is determined by the type of wall assembly, local climate, and anticipated pressure conditions. The importance of vapor control increases with the level of insulation and airtightness.
- **Water barrier:** The layer of materials, often a fluid-applied or sheet membrane, that keeps water out of the building interior.

Assess
Always consult a qualified service provider before undertaking any building upgrades.

Coordinate for Maximum Savings
Optimize upgrades to wall insulation by ensuring that the airtightness and vapor control layers are correctly specified and insulated.

To maintain comfortable and efficient indoor space temperatures, optimize all of the control layers in the wall assembly.

Plan Ahead for Success
The best time to implement insulation upgrades is during refinancing or other scheduled envelope improvements.

Consider upgrading insulation during scheduled window replacement or air-sealing upgrades to reduce costs and tenant disruption.

how to upgrade wall insulation

Upgrading wall insulation in conjunction with air sealing and the installation of high performance windows and doors completes a whole building envelope retrofit that will greatly enhance building performance.

retrofit solutions

Applying insulation to the exterior is always preferred. But other factors —including historic preservation restrictions, costs, zoning requirements, space restrictions, and aesthetics— may dictate that an interior application be considered. The target for insulation performance should be based on long-term planning of all building systems, not just meeting current code. In any case, designers should use WUFI or other software to analyze the movement of heat and moisture through the assembly, and carefully analyze any thermal bridging conditions.

A **Exterior Insulation:** Rainscreen systems offer the highest performance as well as the greatest durability and most flexible aesthetics. External Insulation and Finishing Systems (EIFS), though not as durable and with limited aesthetic options, are far less expensive and are the most prevalent exterior insulation method.

1) Rainscreen Systems

- Includes a grid-like frame attached to the façade, with control layers installed between and beneath the framework. Exterior panels are also attached to the framework.
- Control layers are typically separate.
- They can either replace or cover existing exterior finishes (bricks, panels, etc.) .
- Points of attachment must be carefully designed to limit thermal bridging.

2) Exterior Insulation and Finish Systems (EIFS)

- Incorporates all control layers into one system.
- Install options: Either adhere directly to existing brick, or, if brick is not sound enough, mechanically fasten exterior sheathing to brick, then adhere system to sheathing.
- Adhesive acts as air barrier.
- Pay special attention to proper drainage, as standing moisture within EIFS can cause significant damage.

B **Interior Insulation:** Adding insulation to interior walls preserves the aesthetic of the exterior but carries risks due to moisture intrusion and freeze-thaw cycles.

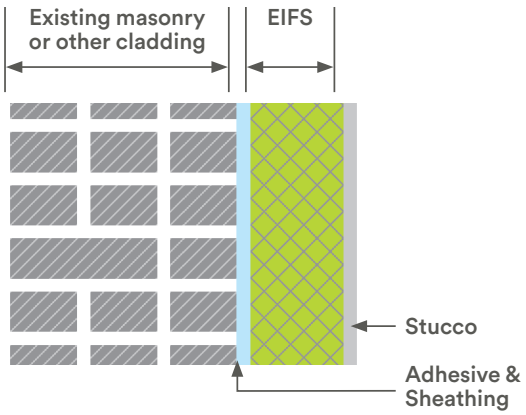
1) Analyze Conditions

- Before insulating, confirm the wall is not exposed to excessive water and analyze moisture, and freeze-thaw cycle impacts on the assembly to determine location and type of vapor control layer(s).
- Apply form fitting insulation such as batts at interior face of exterior wall, typically with inboard air barrier.
- Walls and floors that meet the exterior walls represent thermal bridges; determine mitigation measures, if any.

2) Install Insulation System

- If insulating between studs, provide a continuous layer over or behind studs to mitigate thermal bridges.
- Stagger and tape all joints.
- Use loose fill to close gaps or cavities (avoid high toxicity products like spray foams).
- Carefully seal around all wall penetrations (most especially joists)

Fig 2. EIFS typically contain a layer of sheathing fastened to the existing brick or other cladding material, with the insulation adhered directly to the sheathing.



costs & benefits of insulation upgrades*

Greenhouse Gas (GHG) Savings

A moderate reduction in heating and cooling related GHG emissions can be expected from a wall insulation upgrade, depending on the existing condition of the building envelope and the current heating and cooling demand. Air sealing is critical to realizing these reductions, and are multiplied if window improvements are also undertaken.

Tenant Experience Improvements

When combined with comprehensive airsealing, wall insulation upgradeswill significantly improve resident comfort by eliminating drafts, improving temperature distribution, and reducing pollution and noise infiltration.

Utility Savings

A moderate amount of utility savings can be achieved through the reduction of heating and cooling loads inherent in improving building envelope performance.

Capital Costs

Wall insulation upgrades require a large capital investment, and are best implemented when other repair work is scheduled.

Maintenance Requirements

Properly designed and installed exterior insulation systems (EIFS, rainscreen, etc.) should require little maintenance. If insulation is applied to the interior of brick facades, regular re-pointing is critical to minimize rainwater penetration and freeze-thaw damage. Regular inspection and cleaning of weep holes is critical to ensure proper water drainage.

**The Costs & Benefits rating system is based on a qualitative 1 to 4 scale where 1 (●○○○) is lowest and 4 (●●●●) is highest. Green correlates to savings and improvements, orange correlates to costs and requirements. Ratings are determined by industry experts and calculated relative to the system end use, not the whole building.*

Note: GHG and utility savings are dependent on existing wall conditions and are based on heating and cooling loads. Assumes existing walls have minimal insulation with no consistent air barrier.

take action

This document is one of more than a dozen High Performance Technology Primers prepared by Building Energy Exchange and its partners to introduce decision-makers to solutions that can help them save energy and improve comfort in their buildings. Access the complete Tech Primer library: **be-exstl.org/building-blocks**

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The Building Energy Exchange (BE-Ex), located in New York City, has served as a trusted resource for the real estate, design, and construction industries for over a decade. BE-Ex supports the growth of centers of excellence across the country dedicated to reducing the effects of climate change by improving the built environment.

Launched in Spring 2021, BE-Ex STL will utilize the deep resources and expertise of BE-Ex in New York, while also creating a customized approach to services and programs in our city.

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