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# THERMAL LOSS THWARTED

### THERMAL RESISTANCE

Red hot might be great when it comes to a smash hit, but as this thermal image demonstrates, on buildings, it reflects major heat loss—the result of a poor-performing envelope. Proper insulation can go a long way in improving a building's thermal resistance.



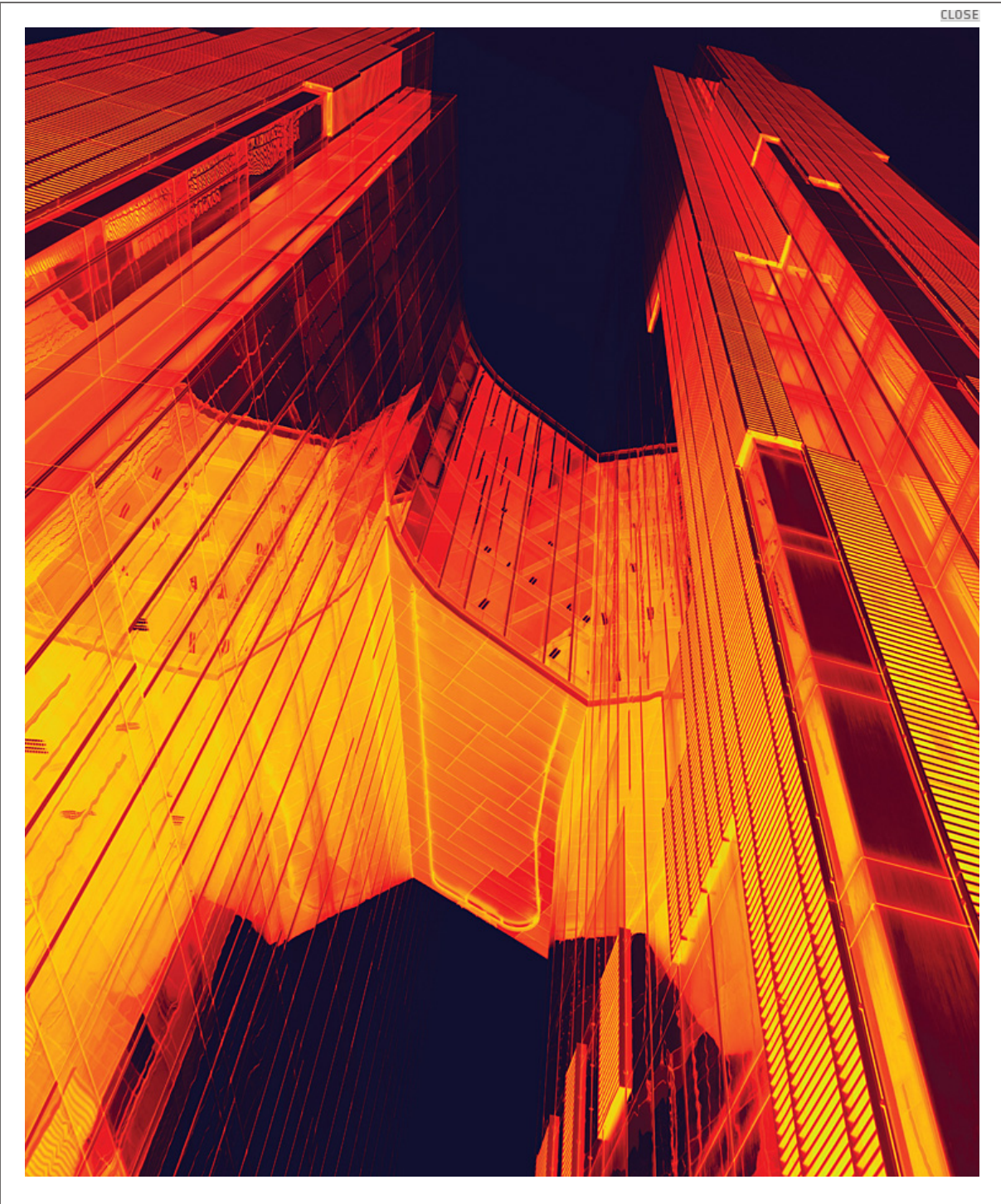
By Alan Weis, Contributing Writer

INSULATION—APPLIED AND INSTALLED PROPERLY—CAN BE AN INTEGRAL MEASURE IN CREATING AN EFFECTIVE AND EFFICIENT ENVELOPE.

**W**hen it comes to insulation, R-value—the measure of thermal resistance—seemingly rules. In other words, the higher the R-value the better the thermal resistance. But there's more to the story than that according to industry experts. "An insulation product's R-value is only a starting point for understanding how well it works," says James Hodgson, general manager for Premier SIPs.

In fact, Hodgson says it's crucial to evaluate the whole-wall R-value of the assembly, since the insulation is only one part of creating a tight, well-insulated envelope. For example, he claims DOE research shows that a 4.5-in. structural insulation panel (SIP) wall rated at R-14, outperforms a 2 x 6 stud wall with R-19 fiberglass insulation. "It comes down to significantly less air leakage, thermal bridging and convective looping for a better performing assembly," says Hodgson.

Insulation, unfortunately, is too often treated as an afterthought, as Hodgson says it ends up getting fit around the structural systems instead of being an integral part of them, making it difficult to seal leaks. SIPs, he notes, address this by incorporating both in one assembly.



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Insulfoam EPS insulation not only offers a high initial R-value, it also doesn't lose R-value with time. [www.insulfoam.com](http://www.insulfoam.com)  
Circle 519



**NOW VS. LATER**

Longevity is another consideration when it comes to R-values. "It's common for building professionals to look at R-value per inch at the time of installation," says Ram Mayilvahanan, product marketing manager with Insulfoam. "Yet, it makes more sense to evaluate insulation's long-term thermal performance and the return on investment."

His company manufactures HD Composite roof insulation, which bonds expanded polystyrene (EPS) foam to a high-density polyiso cover board, a combination that has high thermal efficiency and provides significant field labor savings. Plus, Mayilvahanan says it can be used to achieve UL Class A fire ratings on combustible roof decks without the use of gypsum or other cover boards.

"Many rigid foam insulations experience thermal drift, which is a loss of R-value over time as insulating gases within them dissipate and are replaced by air," Mayilvahanan continues. "Some materials lose up to 20% of their insulating capacity during their time in service." On the other hand, EPS insulation, he explains, not only offers a high initial R-value, it also doesn't lose R-value with time. And, it can be used in wall, roof, below-grade and under-slab applications.



SIPs incorporate structure and insulation into one assembly, not only providing continuous insulation but also resulting in fewer gaps to seal.

**THE ULTIMATE GAUGE**

R-value aside, there's also the human factor to consider. "Commercial occupants spend an average of eight hours a day in the building, making them the ultimate gauge on the performance and comfort of the structure," says Achilles Karagiozis, PhD, global director of the Building Science Group for Owens Corning. "From pipes leaking and staining the ceiling tile to indoor temperature fluctuations, occupants are the first to feel the effects if the commercial building environment has performance issues."

Of course, moisture management remains another key metric for building performance, notes Karagiozis, adding that proper moisture management addresses air leakage, water and vapor diffusion control and condensation prevention making it a critical component of comfort. His company addresses the issue with its FOAMULAR XPS offering, a key component of the company's Commercial-Complete Wall Systems. Furthermore, Karagiozis notes the product possesses high compressive strength and maintains a high R-value throughout the life of the building. The system, he explains, is water resistant because it is manufactured in a continuous extrusion process. This process produces a homogeneous "closed cell" matrix with each cell fully enclosed by polystyrene. Because of the homogeneous cross section, very little water is absorbed into the cell structure. This also means it will not lose its R-value as easily as other types of foam board.

**NO PENALTY FOR PANELS**

Of course, part of creating a tight envelope is ensuring that all components work well together. "Every building envelope component has an individual thermal performance capability, but it is often the integration of the products that leads to the thermal loss," says Ian Manser, CEM, energy services manager with Kingspan Insulated Panels. "Design detailing for energy efficiency should not neglect how components transition with each other, since the performance of one can greatly affect the performance of another—leading to less than expected overall performance."

The problem, Manser says, is improper installation of insulation in site-built systems, often caused by latent defects in the insulation itself. Insulated metal panels, he argues, provide a factory-built, single-component assembly alternative. Kingspan's system, the Benchmark Designwall Architectural Wall Panel, is a single insulated panel system that con-

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sists of a metal exterior finish and laminated or blown-in insulation. It can be made to a variety of thicknesses and can also speed up installation since the insulation and exterior finish are installed as a single component.

"There is more view toward the entire building envelope as a cohesive 'whole building' system when possible," says Manser. "The insulation solution is the basis for making other decisions like moisture and weather barriers. If it's possible to use fewer components while still achieving the best possible insulation R-values, air tightness, etc., these solutions take precedence over complicated multicomponent solutions."

**LAYERING**

This hybrid approach is shared by CertainTeed, although sans the metal panel. "A hybrid insulation system combines the best attributes of two or more insulation products to provide an airtight seal around the structure and superior moisture control," says Lucas Hamilton, the company's manager of building science applications. Hybrid insulation solutions, he says, eliminate unwanted hot or cold spots in the building, improving acoustic control and reducing energy consumption and moisture infiltration. The thermal performance extends to complex cavities and other hard-to-reach, often-unprotected areas where leakage can occur, such as around wires, pipes and other fixtures. In addition, the insulation will not settle over time, ensuring long-lasting energy efficiency.

- The company manufactures a set of products to create a total hybrid system. Hamilton explains it, layer by layer:
1. Begin with a 1-in. to 2-in. coat of closed-cell spray foam insulation, applied against the interior surface of the exterior sheathing—this contributes a thermal resistance of up to R-6.4 per in. of installed thickness.
  2. Add fiberglass-based blown-in insulation to fill the remainder of the wall cavity.
  3. Install a vapor retarder and air barrier film over the closed-cell spray foam insulation, which allow excess moisture to escape while maintaining its air barrier performance.
- Combining these three materials in the wall cavity, Hamilton says, provides air tightness similar to a full cavity of spray foam, but at a significantly lower installed cost.

**RIGID ROOF**

No sound insulation system is complete without considering the roof. While part of the envelope, roofs have their own sets of requirements, and can also provide a simple but effective strategy to improve energy efficiency of the building. According to Jim Lambach, a building and construction expert, with Bayer MaterialScience, insulation can usually be added without significant changes to architectural design. "Considering that it requires repair or replacement on average every 15-20 years, low-slope roofing provides one of the most cost-effective opportunities for increasing the energy efficiency of the existing buildings."

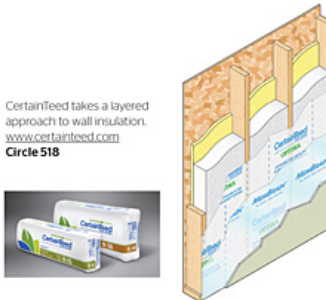
Bayer manufactures polyiso board, which Lambach explains is a typical insulation solution for low-slope roofing assemblies since it carries FM Class I approval for installation directly to metal decks. It offers good thermal resistance per inch, low weight and resistance to damage from foot traffic, he explains.

Polyiso board, combined with closed-cell spray polyurethane foam (cc-SPF), such as the company's EcoBay CC and CC Polar, can be used for continuous insulation of exterior walls as well. The board is attached to the underlying structure with gasketed nails or screws, and adjacent boards are taped to provide a continuous sealed plane. The board can be cut to fit around cladding attachments and other penetrations, then taped or caulked to seal. If cc-SPF is used as the insulation material, it expands in place to help reduce the likelihood of infiltration and adheres well to most building materials.

Another advantage of rigid board, says Tom Boissy, building science specialist with Atlas Wall CI Board Division (maker of Atlas Wall CI Board), is its ability to achieve proper fit-up in the field—which can prevent costly breaks in the barrier. The product can function as insulation, a water resistive barrier, air barrier, vapor barrier or radiant barrier depending on installation and building needs.

"Improperly sealed or ill-fitting insulation that leaves gaps will allow air and moisture to penetrate the system," he explains. "As time passes, certain types of insulation can shift or settle creating uninsulated areas."

In contrast, Alex Minné, director of marketing with Atlas Wall CI Board Division, notes rigid foam boards are "somewhat mistake-proof" when it comes to installation and can provide the same air sealing, moisture and vapor control as spray-applied foams when board joints are taped and sealed.



**LIGHTEN THE LOAD**

Despite all the considerations when it comes to insulating a building's envelope, it's possible to overdo it. "One mistake we commonly see is over-engineering the insulation, particularly in under-slab applications," says Insulfoam's Mayilvahanan. "The typical design practice is to assume that loads placed on slabs transfer to the underlying insulation and soil at a 45 degree angle instead of a more uniform distribution. The result is that compressive resistance of under-slab insulation is often over-designed by a factor of 10 or more. The cost of using higher-strength insulation than the application requires is substantial."

He notes that his company is working to educate people that ultra-high strength insulation isn't necessary in many cases, saying that it often makes more sense to take the money saved from over-engineering for strength and putting it toward improved thermal performance—which, in the end, takes more than just an optimized envelope.

"The push toward comprehensive green design has raised awareness that many building systems must work together for optimum performance," says Mayilvahanan. "It's not just insulating the structure appropriately, but also right-sizing the HVAC systems and educating owners and occupants on how to operate the building for high energy efficiency." □

