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Use of Continuous Insulation Helps Industry Move Closer to Sustainability

Cultured Stone® by Boral® Evaluated and Approved for Installation Over Continuous Insulation

The International Energy Agency (IEA) defines primary energy consumption as “direct use of energy at the source or energy that has not been subjected to any transformation.” As a highly industrialized nation, the United States consumes energy in many areas including manufacturing, transportation and construction. According to the U.S. Green Building Council, “buildings account for approximately 40 percent of the total energy used today,[1]” which amounts to higher energy use than in the entire transportation industry.

Upon evaluating various energy reports, the U.S. department of Energy (DOE) mandated that all states update building codes to meet or exceed American Society of Heating, Refrigerating and Air conditioning Engineers (ASHRAE) 90.1. One of the code’s primary requirements is the addition of continuous insulation in both commercial and residential applications.

“The DOE realized that if they were truly going to make a difference in the environment, they had to tackle the biggest culprit – buildings,” said Chris Hines, Technical Leader, Boral Stone Products LLC. “Energy loss from thermal bridging is the greatest challenge with insulated structures. Heat loss at framing members is a huge shortcoming and the DOE aimed to counter it with continuous insulation.”

Transformative Code Introduces Continuous Insulation

Defined by ASHRAE 90.1 as “insulation that is continuous across all structural members without thermal bridges other than fasteners and service openings,” continuous insulation is “installed on the interior, exterior, or is integral to any opaque surface of the building.” Thermal bridging occurs when heat flows through the path of least resistance, such as through the surface of steel or wood framing.

The use of continuous insulation can contribute to improved R-values, as required by building code. The measure of resistance to heat flow through a material’s thickness, R-value is the industry standard for insulation effectiveness. In structures with in-wall insulation less than required by code, builders can make up the difference with increased levels of continuous insulation.

While continuous insulation is not a new concept in the industry, it has remained a mystery to many architects, contractors and building professionals. Only recently have operators realized the potential value of continuous insulation in achieving the desired thermal performance. Considered a best practice in most types of construction, continuous insulation applies to several structural methods – from wood frame to steel stud to precast concrete. Regional climates determine the code requirements of how much continuous insulation is required in application.

“You see more continuous insulation in the northeast region of the U.S., mostly because of colder climate,” Hines added. “The practice is still very effective in warmer climates but builders in the north have latched on to the value.”

The addition of continuous insulation helps moderate temperatures inside the wall cavity – reducing the potential for convective heat loss through the framing systems. Studies done by the Oak Ridge National Laboratory (ORNL) found that thermal bridging through framing components reduces insulation performance by as much as 15-20 percent in wood frame construction and by 40-60 percent in metal

[1] http://www.usgbc.org/articles/green-building-101-why-energy-efficiency-important

framed buildings. The installation of proper amounts of continuous insulation maximizes the full R-value of the insulation materials.
In the "Building America Report,[2]" ORNL researchers noted "the addition of insulation to the exterior of buildings is an effective means of increasing the thermal resistance of both wood framed walls as well as mass masonry wall assemblies." Continuous insulation on outbound exterior walls, alone are in tandem with interior insulation efforts, is the most efficient way of achieving improved R-values.
Rigid foam plastic sheathing materials are commonly used for continuous insulation because of their relatively high R-value per inch and low cost to meet or exceed energy code requirements. Other common solutions include spray foam, fiberglass boards, fiberboard and rock wool.

Boral Stone Products Lays Technical Groundwork
In typical masonry veneer wall construction, steel angle iron fasteners or lintel are used at window and door heads. These fasteners are usually connected directly to the building's framing, offering optimal opportunity for thermal bridging and energy loss. The addition of continuous insulation can improve R-values in these situations.
International Energy Codes state that a cavity space is necessary to the interior of exterior walls. During the adoption of building codes, architects were slow to realize solutions like manufactured stone veneer (MSV). "It's important to understand the wall cavity and its respective moisture issues," said Jason Lamers, Area Sales Manager for Boral Stone Products. "It is vital to treat moisture from the outside and that starts with a cladding product like Cultured Stone® by Boral. MSV may be installed on walls insulated with foam-engineered continuous insulation. Installation of MSV over continuous insulation in situations greater than ½ inch requires an engineered fastening system."
But with heavier cladding products (manufactured stone veneer, fiber cement), builders were forced to reconsider how fasteners were used. The addition of foam continuous insulation be it at ½-inch thick or beyond, increased the distance fasteners traveled before contacting the building's framing. In such situations, fasteners are cantilevered with the balance of the cladding weight held by the framing system.
Long a leader in the manufactured stone industry, Boral Stone Products was first to consider how products could better perform in such code-required situations. As part of these efforts, Boral called upon engineering consultants, other product manufacturers and third party researchers to put products and solutions through rigorous lab testing, modeling and examination. Among the performance attributes evaluated were the installation of Cultured Stone® veneer over wood and metal framing and continuous insulation. Cultured Stone®
Experts developed a chart that explained fastener capacities in situations where cladding weighing as much as 25 pounds ft^2 interacted with continuous insulation. The resulting Technical Evaluation Report was the first of its kind in the industry and offered architects, engineers and developers peace of mind when specifying products in such situations.
"The proper use of continuous insulation is all about paying attention to the details," Hines noted.

Building Familiarity with Continuous Insulation Practices
Effective use of continuous insulation is not without challenges. Initially, contractors were stymied by the practice. Windows, doors and other exterior wall openings posed different challenges, with those elements facing new depths of install. "The additional space between the framing and the cladding (because of the foam continuous insulation) forced contractors to adjust how they approached that part of the building process," Hines added. In these instances, corner and trim details are required to ensure fastening to framing. Many contractors prefer use of furring to provide for siding attachment and securement of continuous insulation.
Researchers also noticed another hurdle in the success of continuous insulation. A study done by Morrison Herschfield noted "all thermal bridges must be considered to determine a structure's overall thermal efficiency.[3]" The main caveat in the success of continuous insulation rests in the fact that it is an uninterrupted barrier. The next step in wall efficiency will be to address anchors and shelf angles, which are currently not considered wall fasteners. Often continuous insulation does not cover these elements, and the low insulative value of the ties greatly reduces the effectiveness of the insulation.

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[2] http://web.ornl.gov/sci/roofs+walls/research/detailed_papers/steel_frame/index.html
[3] MORRIS HERSCHFIELD – (PDF) - "Energy Conservation Benefits of Air Barriers StoGuard®: The Effect on Energy Conservation" By Chris Norris, P.E, P.Eng, LEED AP, CEI

Hines also brought to light the need for quality, experienced installers. “It is critical that the weight of the cladding product is transferred into the framing system,” he said. “Hitting the wooden or steel studs with the fasteners in a plumb, level way seems obvious but it is something that is a must. In continuous insulation systems, the way that the fasteners are cantilevered, getting things set correctly is the difference between success and building failure.”

Builders in residential construction have practiced alternative methods for dealing with the necessary R-values as mentioned in code requirements. In some cases, traditional 2X4 studs are replaced with 2X6 studs. In this instance, additional insulation is added to the stud cavity to balance out the necessary R-value. One issue in this case is that the thicker insulation between the studs does not significantly improve thermal performance. Exterior continuous insulation is the only effective way to overcome the thermal deficit, especially in steel-framed systems.

Breaking Down Performance and Prescriptive Code Paths

The consideration of code compliance can take two different paths – prescriptive or performance. Prescriptive code requires that each component of a structure is built to certain standards. Performance code requires that the building (as a whole) performs to certain standards.

The basis for many energy codes in the U.S., International Energy Conservation Code (IECC), has used both prescriptive and performance paths since its inception in 2000. Typically updated every three years, IECC usually outlines a few mandatory provisions. After those requirements, builders may choose to implement either prescriptive or performance paths to meet compliance.

Although statistics for the number of projects taking each route are not available, prescriptive compliance appears to be more prevalent in the industry. Although it can result in significant savings, the performance path is more difficult to convert, as it requires complex energy modeling software or an energy rater.

Code Results in Improved Energy Savings, Building Costs

With the challenges noted, it is important to recognize that continuous insulation also improves moisture management. “Typically, moisture finds a way to travel through the wall cavity,” Hines said. “Sometimes it’s from the outside-in and sometimes it’s from the inside-out. One thing that continuous insulation helps with is the area at which the dew point occurs.”

For example, in a cold climate, insulation in the wall cavity keeps exterior cladding cool between the studs. When heat transfers through the studs, it has the potential to create condensation between the cladding product and the wall system. This wet environment can result in a number of structural failures, rot and mold. Condensation also reduces the effectiveness of the insulation. Non-insulated sheathings result in colder walls with greater condensation potential.

The strategy of utilizing continuous insulation as a temperature gradient can be effective in any climate and simplify the overall wall assembly. Continuous insulation warms the wall cavity and reduces the potential for condensation. The temperature also has a strong effect on the wall cavity’s drying potential. The warmer the surfaces, the quicker they dry. The conditions of a wall cavity covered with continuous insulation allow moisture to evaporate faster.

In the long run, continuous insulation can dramatically affect building management costs. The resulting reduction in energy consumption may allow owners to specify less expensive HVAC, lighting, and water heating systems. The reduction of heating and cooling efforts minimizes fuel use and greenhouse gas emissions. The American Chemistry Council’s Foam Sheathing Committee noted, “recent energy code improvements, including the use of continuous insulation, can have a break-even mortgage cost in as few as 10 months.[4]”

In turn, the increased code requirements have raised the bar for energy efficiency and sustainability. Voluntary building rating systems such as the Leadership in Energy and Environmental Design (LEED®) program now look to ASHRAE 90.1 as its baseline for credit points. Continuous insulation “can contribute to thermal efficiency when chasing LEED points,” Hines said. The improvements in efficiency, help the building industry move closer to carbon neutrality and a more sustainable environment.

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[4] “Continuous Insulation for Code Compliant High-Performance Walls;” American Chemistry Council® Foam Sheathing Committee; http://fsc.americanchemistry.com/Exterior-Walls/Continuous-Insulation-Educational-Presentation.pdf

*LEED is a registered trademark of the U.S. Green Building Council.

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About Boral USA

Headquartered in Roswell, Georgia, Boral USA, through its subsidiaries, is a leading manufacturer in the building materials industry. Boral USA's subsidiaries include Boral Bricks Inc., a leading manufacturer of brick in the United States; Boral Roofing LLC, the nation's leading manufacturer of clay and concrete roof tiles; Boral Stone Products LLC, manufacturer of Cultured Stone® by Boral®, the most recognized brand of manufactured stone veneer, and Boral Versetta Stone®, the leading brand of mortarless stone veneer; Boral Material Technologies LLC, a leading marketer of coal combustion byproducts; and Boral Composites Inc., manufacturer of Boral TruExterior™ Siding and Trim, pioneer of the innovative poly-ash category of exterior building products.

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