Builder Notes

THE BRICK INDUSTRY ASSOCIATION

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BRICK AND ENERGY EFFICIENCY IN RESIDENTIAL CONSTRUCTION: THE REAL STORY

Misinformation about clay brick masonry veneer walls is often peddled by competitors. Contrary to what you may have heard, clay brick masonry walls perform well, particularly with respect to energy efficiency. Here's the real story, supported by recent research:

Testing Proves that Brick is Much More Energy Efficient than Others Claim

Recent research of common residential wall assemblies shows that clay brick veneer on a wood stud wall reduces the amount of heat transfer through the wall up to 50% - better than fiber cement, vinyl or even EIFS [1]; therefore, brick is more energy efficient than people think.

R-Value is an Incomplete Measure of Energy Performance

When most people talk about the energy-efficiency of a wall, they usually only consider R-value. The R-value of the clay brick material alone is consistent with other standard cladding materials. But walls aren't just made of the cladding materials themselves; they are part of a wall assembly.

Brick wall assemblies possess two unique characteristics – usually not accounted for – that significantly contribute to energy performance and reduce energy costs.

1. Thermal Mass. Thermal mass provides the ability to absorb and store heat thereby slowing heat movement through the wall. As a mass product, clay brick veneer acts similarly, storing a large quantity of heat before releasing it to the cooler side of the wall. This storage of heat can reduce energy costs. The delay in releasing energy means that the HVAC system will run less frequently and operate during off-peak hours when energy costs are lower, as shown in Figure 1.

BRICK VENEER MEETS THE ENERGY CODE

A standard clay brick veneer wall assembly meets the energy code. Assemblies using brick with batt insulation and typical 2x4 or 2x6 wood stud framing meet 2018 International Energy Conservation Code (IECC) requirements for approximately 85 percent of the contiguous United States. For the remaining areas, generally located in cold, northern climate zones, the code requires some continuous insulation, which is easily integrated into the air space behind the brick.

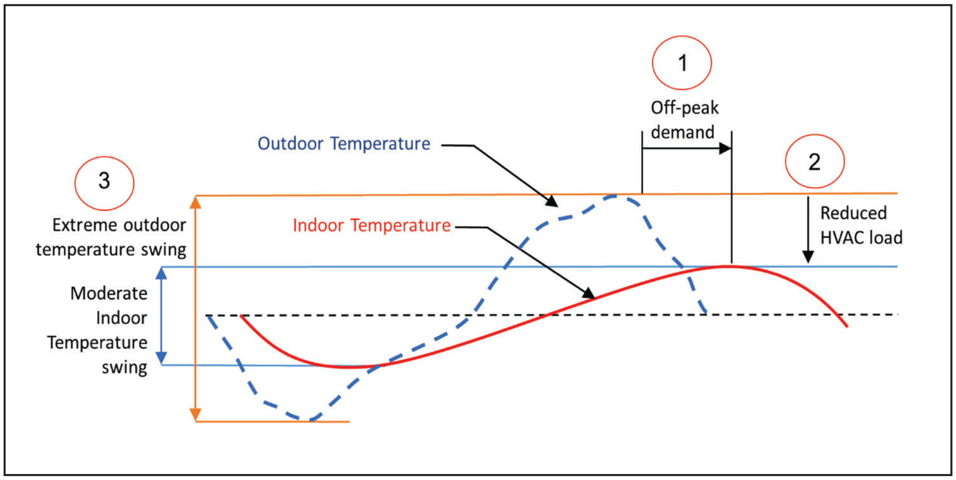

Figure 1. Effect of Thermal Mass on Indoor Temperatures: Thermal mass reduced the indoor temperature swing and shifts the impact of temperature extremes to off-peak hours.

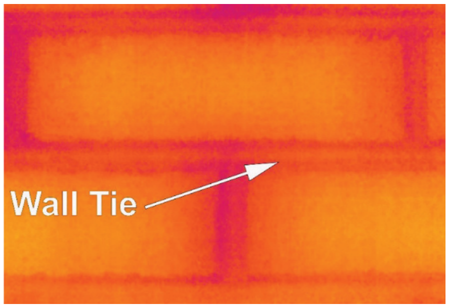

Figure 2. Thermal Imaging of Tie Locations. The maximum temperature difference shown by th ecolors in the image indicates a range of appproximately 1.5 degrees Fahrenheit.

2. Air Space. The air space behind brick veneer serves as an insulating layer within the wall assembly. Even though the air space is connected to the outside via weeps, very little air actually moves within the space. In fact, research has shown that the amount of movement is negligible and can be attributed to the buoyancy of the air as it is heated. (Hot air rises.) This is significant because it helps explain why the air space provides so much thermal benefit.

Additionally, brick ties, which cross the air space and connect the veneer, are often blamed for causing poor thermal performance; however, as shown in Figure 2, these ties are nearly undetectable by thermal imaging. The insulating and thermal storage properties of the brick and the air space typically outweigh the conduction of the ties.

Energy Efficiency is Influenced by How the Entire Wall Assembly – Not Just the Cladding Material Itself – Reacts to Temperature Variations. Two very different tests conducted by the National Brick Research Center (NBRC) confirm clay brick wall assemblies perform better than other wall assemblies.

1. Testing with Fixed Temperature Conditions Proves that Heat Takes At Least Twice as Long to Go Through a Brick Wall Assembly Than It Does Others. This testing involves applying different temperatures on each side of a wall assembly and measuring the heat flow from the warmer side to the cooler side. From these heat flow measurements, the amount of time needed for the wall assembly to reach the same temperature on both sides, also known as equilibrium, is determined. As shown in Figure 3, testing found that it takes a brick veneer assembly nearly 24 hours to reach equilibrium, almost twice that of 1 in. thick EIFS and three times longer than vinyl or fiber cement siding [2].

Key Benefits of Brick Wall Assembly:

- *In a traditional day-night cycle of rising and falling temperatures, the heat flow changes direction before reaching the other side, resulting in less heat passing through the entire thickness of the wall.*
- *The heat storage capacity of the brick wall assembly is twice the storage capacity of the brick alone.*

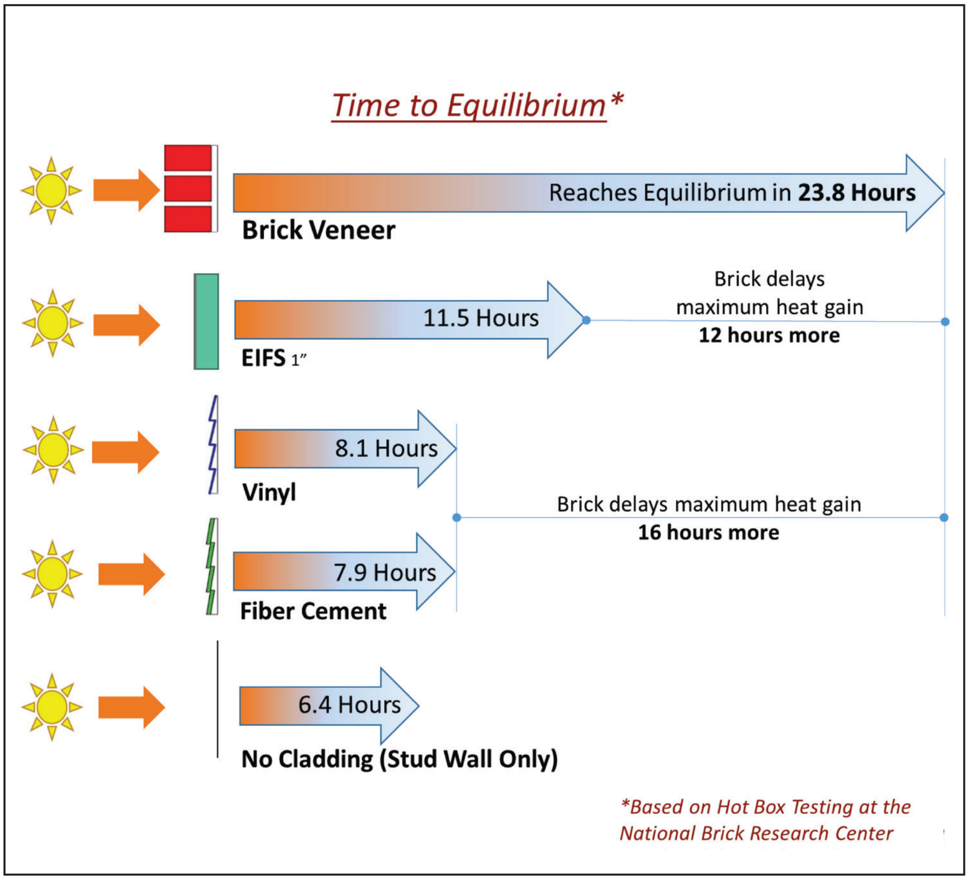

Figure 3. Time to Equilibrium for Various Wall Assemblies.

2. Testing with Varying Temperature Conditions Proves that Brick Walls Reduce Heat Energy Movement by 60% Over The Closest Competing Wall Assembly. Since R-value measurements do not account for the effect of thermal mass and air space found in brick wall assemblies, dynamic testing is the only way to demonstrate brick's true energy performance. Unlike the static R-value, dynamic testing repeatedly cycles temperatures from low to high or vice versa, similar to the rise and fall of the temperature throughout the day and into the night. When the tests simulate an actual climate with a large temperature swing, brick veneer significantly outperforms other systems.

Key Benefits of Brick Wall Assembly:

- *Reduction of Heat Energy through the Wall Throughout The Year. As shown in Figure 4, in the summer, a brick veneer assembly reduces the amount of heat passing through the wall by approximately 50 percent over the other wall systems. Similar results are show in Figure 5 in the winter.*

In conclusion, thermal mass not only has a much more profound impact on thermal performance than is currently realized, [2] but it also helps significantly reduce the heat energy through the wall – regardless of the time of year.

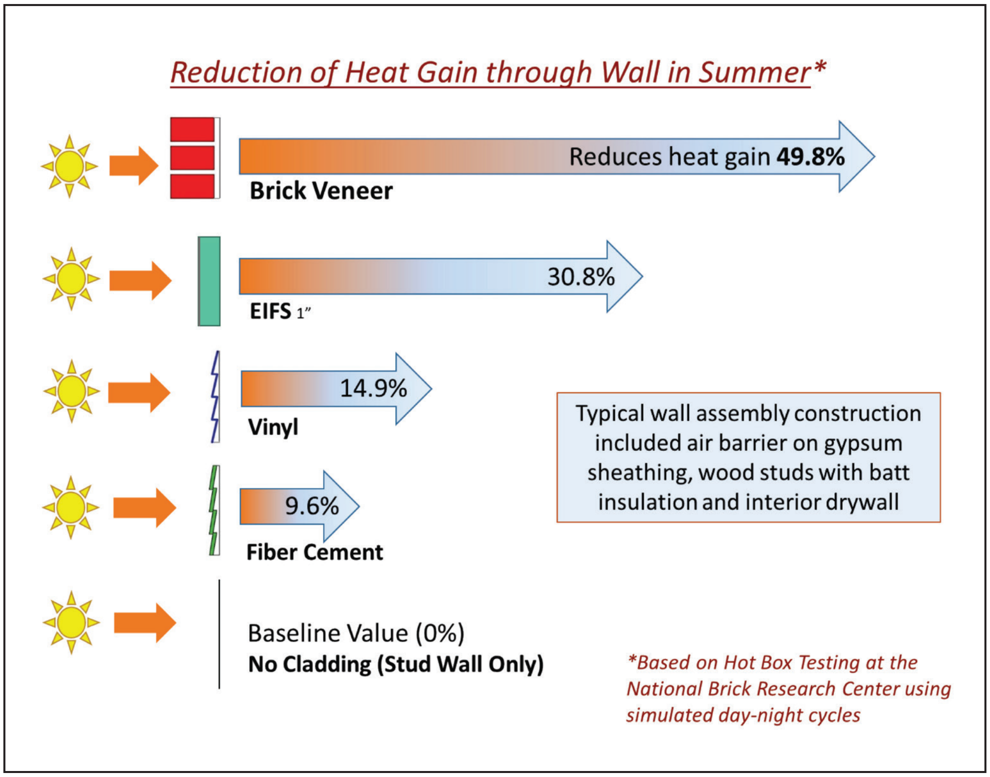

Figure 4. Reduction of Heat Transmission in Summer for Various Wall

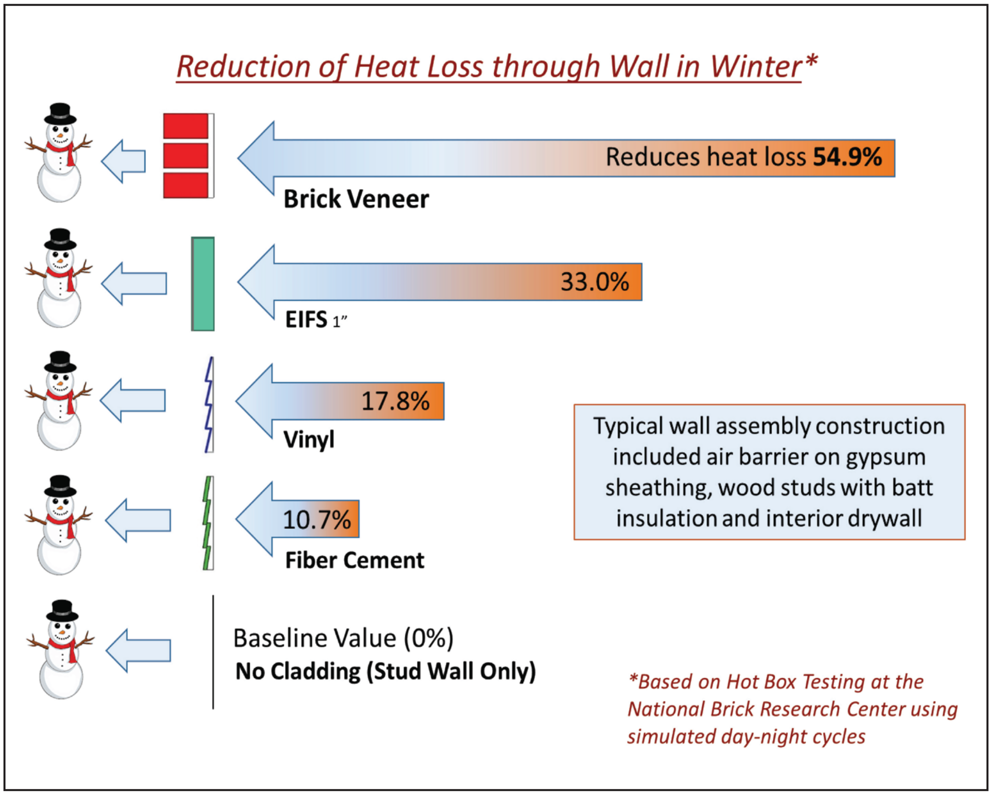

Figure 5. Reduction of Heat Transmission in Winter for Various Wall Assemblies.

Note: The temperature cycle used in the dynamic testing is called a "Sol Air" cycle, which represents the difference in day-to-night temperatures associated with the southwest and western portions of the United States. Other areas of the country can still benefit from the thermal mass of masonry, but the effect is reduced when the temperature change from day to night is less extreme.

Enhancing Your Brick Project's Energy Efficiency

While a standard brick veneer wall assembly will outperform other wall systems, don't forget that the wall itself is only one element to consider when enhancing the energy efficiency of a project. Area of windows, insulated glass, and a well-detailed air barrier along with wall insulation all work in combination to create a comfortable interior environment.

However, one can certainly attain even more efficiency with a brick veneer wall assembly with the addition of continuous insulation, which is especially beneficial in cooler, northern climates.

Increasing the size of the air space allows continuous insulation to be added to supplement the insulation between the studs, as shown in Figure 6.

A minor increase to the width of the foundation wall will permit the inclusion of continuous insulation with no change to the interior space of the building or the exterior appearance.

Whatever brick assembly one chooses, homeowners will benefit from the fact that brick has better energy efficiency and more stable temperature swings than competing wall systems.

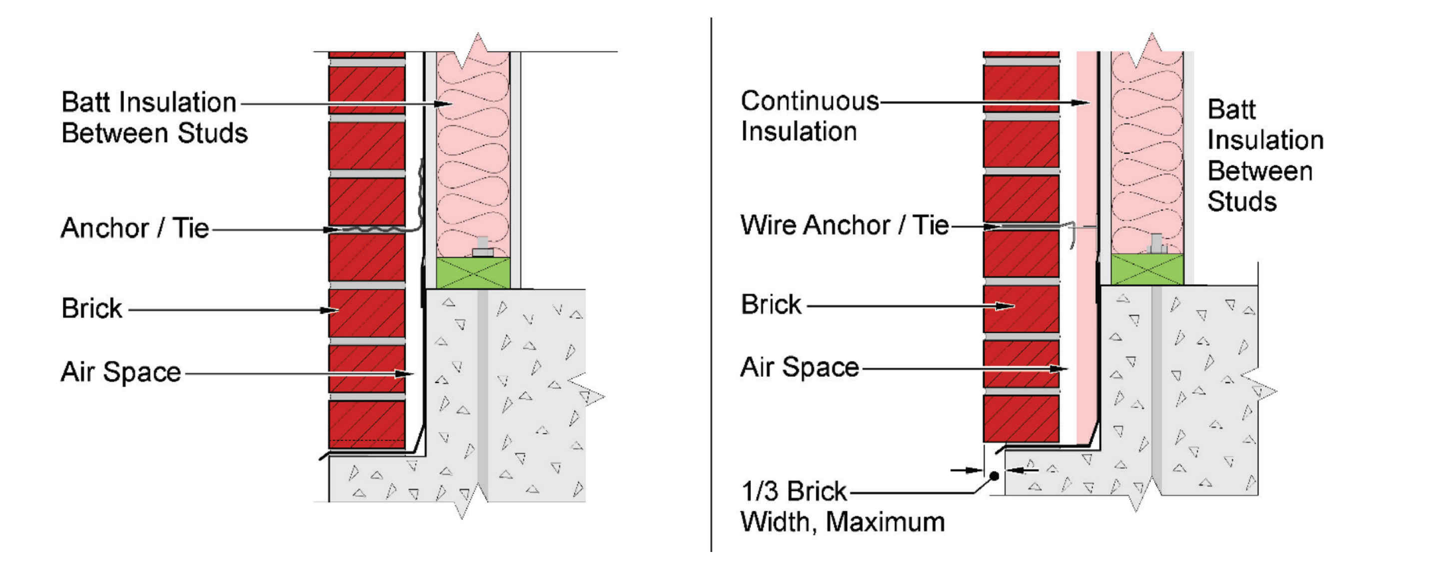

Figure 6. Brick Veneer Wall Assemblies. Typical (Left) and with Continuous Insulation (Right)

Note that the addition of continuous insulation requires the use of wire anchors/ties.

References

[1] Sanders, J., Carrier, J., Clark, C., and Huygen, N., "Dynamic Thermal Performance Measurements of Clay Brick Masonry," 13th Canadian Masonry Symposium, Halifax, Nova Scotia, Canada, 2017.

[2] Sanders, J., Carrier, J., Huygen, N., "Dynamic Thermal Performance Measurements of Residential Wall Systems," ASTM STP 1612, Masonry 2018 Symposium: Innovations in Collaborative Research, Development and Applications, San Diego, CA, 2018.

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