THE BRICK INDUSTRY ASSOCIATION

TECHNICAL NOTES on Brick Construction

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Using Brick in Sustainable and Resilient Designs

Abstract: This *Technical Note* addresses ways that clay brick masonry can be used in sustainable and resilient designs for commercial and residential buildings and homes. Clay masonry's inherent values such as fire resistance, impact resistance, ballistic impact resistance, flood resistance, acoustic comfort, reuse potential and other characteristics provide versatility in high-performance designs. Common green building codes and rating systems are discussed, along with the categories in which clay brick can meet the requirements of these programs.

Key Words: adaptive reuse, construction waste, durability, energy efficiency, embodied carbon, environmental product declaration (EPD), operational carbon, recycling, reuse, renovation, resilience, sustainability, VOCs

SUMMARY OF RECOMMENDATIONS:

Holistic Approach

- Achieving a sustainable, resilient design requires balancing many often-competing goals and being responsive to the site in which the building project is located

Green Building Codes and Rating Systems

- Refer to Table 1 for strategies and common green building programs to which brick can contribute
- See *Brick Briefs* for reference: "LEED v5 Credits and Clay Brick Masonry" or "LEED v4 Building Product Disclosure Credits for Brick"

Environmental Product Declaration

- "2025 Clay Masonry Products Industry Average EPD" is a cradle-to-grave assessment showing brick's environmental impact for its entire life cycle

Reducing Embodied Carbon

- Reuse existing brick buildings
- Preserve or salvage and reuse existing facades
- Use reclaimed brick units
- Use interior exposed loadbearing brick masonry
- Brick masonry service life of 150 years
- Average energy to make brick has decreased nearly 10% (2025 IA-EPD vs. 2020 IA-EPD)
- Average GWP (A1-A3) has decreased 25% (2025 IA-EPD vs. 2020 IA-EPD)

Energy Efficiency/Operational Carbon

- Thermal mass reduces peak heating/cooling loads and moderates indoor temperature swings

Permeable Brick Pavement

- Reduces runoff and stormwater flooding
- Removes contaminants from water

Heat Island Effect

- Use brick pavements with solar reflectance (SR) of 0.33 or higher

Resilience – Fire Resistance

- Brick masonry is noncombustible and does not burn, soften, degrade or emit toxic fumes
- Nominal 4 in. thick brickwork alone provides a one-hour fire rating

Resilience – Impact Resistance

- Clay brick masonry resists impacts from flying debris and bullets
- Clay brick masonry meets Florida Building Code basic hurricane protection and ASTM E1996 enhanced protection requirements

Resilience – Flood Resistance

- Use brick below the design flood elevation (DFE)
- Clay brick masonry has an acceptable rating with the National Flood Insurance Program (NFIP)

Resilience – Moisture Control

- Clay brick masonry is inherently mold- and mildew-resistant
- Brick drainage wall provides rainscreen performance
- Provide properly installed flashing

Passive Thermal Design

- Reduces reliance on mechanical systems
- Primarily relies on thermal mass of brick

Interior Benefits

- No volatile organic compounds (VOCs)
- Acoustic comfort; reduces sound transmission
- Mold- and pest-resistant

INTRODUCTION

The terms “sustainable design” and “resilience” are often used interchangeably, but while those terms are related, there are important differences to understand to achieve wide-reaching environmental, ecological and social impact goals. Furthermore, accurate and verified documentation is key to providing the understanding needed for owners, designers and contractors to achieve sustainable and resilient designs. This *Technical Note* provides information on using green codes and rating systems; reuse of materials and building facades; embodied carbon in the brick manufacturing process; and the multi-attribute benefits of brick, including fire and impact resistance, indoor environmental quality, and recyclability.

SUSTAINABILITY VS. RESILIENCE

One definition of sustainable development is “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” [Ref. 2]. Oftentimes, though, sustainable building design focuses primarily on reducing harmful impacts to the environment; this is what is meant by the term “green building.” However, sustainable buildings should balance not only environmental impacts but also societal and economic impacts, and do so both in the present and in the future. This is where resilient design comes in. Resilience, in this context, is characterized by the ability of a building, community, or region to withstand and recover in a timely manner from adverse events or impacts. This concept is illustrated in the FEMA definition [Ref. 10] as “Resilience is the ability to *adapt* to changing conditions and *prepare* for, *withstand*, and *rapidly recover* from disruption.”

The global community is increasingly challenged by events that adversely impact communities and our built environment. When a building is damaged due to an adverse event, it is not only the repair or replacement of the building that impacts the environment, but also the cleanup of the building and site from the event, resulting in the use of more energy and resources and causing further air and water emissions. By avoiding these activities, buildings that are more resilient can have a lower lifetime impact on the environment than those that are more easily damaged.

In order to achieve truly sustainable designs, both green building and resilient design must be considered.

GREEN BUILDING ASSESSMENT

Green building assessment can take the form of a rating system or standard that evaluates the performance of a building or building space through a combination of mandatory and optional criteria, or as a code intended to require a minimum performance level through mandatory requirements and adoption by a jurisdiction. Several green building programs are available to evaluate the impacts of buildings on our environment. This *Technical Note* considers some of those programs that are most widely used in the United States:

- Leadership in Energy and Environmental Design (LEED®) rating system [Refs. 17–21]
- Green Globes® whole building certification [Ref. 8]
- Living Building Challenge certification program [Ref. 22]
- ICC 700 National Green Building Standard® (NGBS) certification program [Ref. 13]
- WELL Building Standard™ (WELL) [Ref. 27]
- International Green Construction Code® (IgCC®) [Ref. 14]

Of these, the LEED green building rating system, developed by the United States Green Building Council (USGBC), is one of the most widely used in the United States. Each rating system is somewhat different, but all focus on reducing environmental impacts in one or more areas of energy use, water use, material/resource use, building sites and improving the building’s indoor environment.

Many green building programs have been slow to incorporate the concepts of resource efficiency, resilience and durability into their requirements. As a result, it is important to consider efficient use of materials (such as using elements that can perform multiple functions), designing for durability and longevity (“build it once”), and assessing potential future hazards (such as increased risk of high winds) in any sustainable building design. As the movement to develop more resilient building designs continues to grow, the benefits of durable brick masonry construction are ever more relevant.

ACHIEVING SUSTAINABLE, RESILIENT DESIGNS

Achieving a sustainable, resilient design requires balancing many often-competing goals, as well as being responsive to the site in which the building project is located. While there is no single strategy that guarantees a sustainable, resilient outcome, the strategies that follow offer best practices for achieving many of these goals. Table 1, found at the end of this section, provides a summary of the strategies included in some of the most widely used green building programs. Further information on each of the green building programs can be found in the publications referenced and online.

Reducing Impacts Through Green Building Design

Brick masonry can be used in multiple ways to help reduce impacts from the building on the environment, many of which are recognized by green building programs. The BIA *Brick Brief* "LEED v5 Credits and Clay Brick Masonry" provides a more detailed explanation of LEED v5 credits that are related to brick masonry.

Building Product Reporting. Many green building programs include requirements for reporting environmental information on building products. There are numerous building product reporting and certification labels available. Two of the most common are listed below.

Environmental Product Declarations. Environmental Product Declarations (EPDs) are used to report greenhouse gas emissions of products. However, EPDs report the potential of several other environmental impacts as well. EPDs are based on an assessment of a product that at a minimum extends from raw material extraction to manufacturing (the production stage shown in Figure 1). This is the extent of many building product EPDs and is considered cradle-to-gate in scope. Such EPDs do not consider the transportation to the project site, which for brick is on average 253 miles (407 km) (reference "Clay Masonry Products Industry Average EPD"), or the impacts from maintenance or operation of the building. On the other hand, in the Clay Masonry Products Industry Average EPD, the assessment covers the full life cycle of the product, including construction, operation, and end of life. Furthermore, many brick manufacturers have published product-specific EPDs that cover all life cycle stages (modules A1 through D). These types of EPDs are referred to as cradle-to-grave in scope.

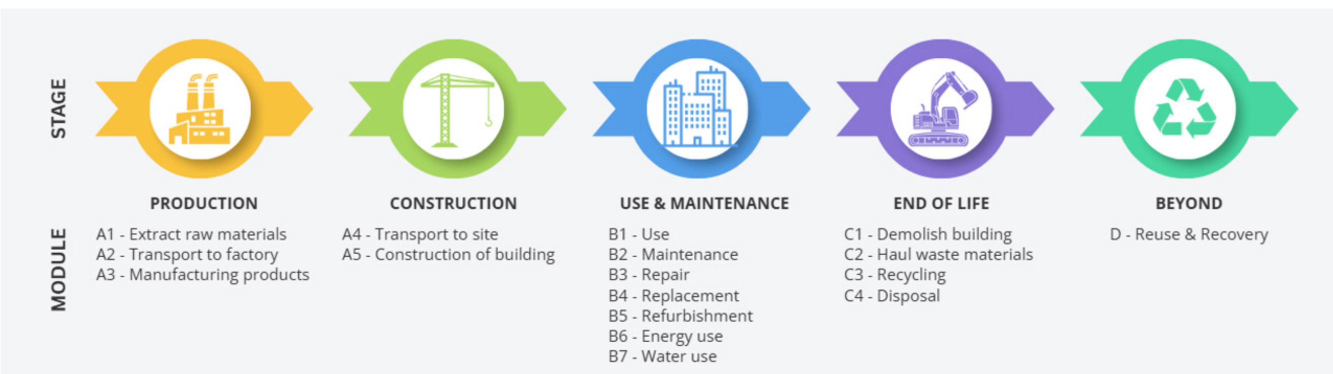

Figure 1
Life Cycle Stages Including Modules A1–D

Health Product Declarations. A Health Product Declaration (HPD) reports the potential impacts on human health associated with the manufacture of a product. An HPD is based on the Health Product Declaration® Open Standard developed by the HPD Collaborative [Ref. 12]. This certification program assesses the raw ingredients from which a product is made. HPDs are available for many masonry materials, including clay brick products.

Building Reuse and Renovation. It is sometimes said that the greenest building is the one already built. Selecting materials and systems that are durable results in buildings that are more likely to be reused. Reuse or renovation of an existing building (Photo 1) can significantly reduce environmental impacts compared with new construction, particularly in the area of greenhouse gas emissions (otherwise known as carbon emissions or embodied carbon). Because of the aesthetic appeal, durability, and historic value frequently associated with brick masonry buildings,

Photo 1
Textile Mill Repurposed into Retail and Office Space

Photo 2
Color of Brickwork Modified with Limewash Finish

they often are chosen for reuse. In many cases, loadbearing brick buildings are reused in their entirety. In some cases, the brick facade is retained while a new structure is constructed. Although the natural finish of the reused brick masonry is typically preferred, treatments are available to modify brick masonry's appearance if desired (Photo 2). Guidance for this process is provided in *Technical Note* 6.

The adaptive reuse of brick masonry buildings is a testament to the longevity and durability of brick masonry. By adapting existing structures to new uses, both resources and energy are saved, and environmental impacts are reduced. Tools such as the Carbon Avoided Retrofit Estimator (CARE) provide a way for users to estimate carbon impacts avoided by reuse and renovation (reference https://www.caretool.org/).

Reuse of Materials. Use of salvaged materials avoids the environmental impacts associated with new products. Brick masonry is unique in that after many decades of use, brick units used on exterior and interior walls, as well as in paving applications, can be reclaimed and provide many more decades of benefits. Unlike other recyclable materials (such as glass, steel and aluminum), brick does not have to be reprocessed and reshaped at the cost of additional energy and an increased carbon footprint. It only has to be cleaned of existing mortar and perhaps shipped to a new site. Units from walls constructed with lime mortars, as is common with historic structures, are easier to clean than those laid with cement-based mortars. Additionally, it is important to determine the properties of the reclaimed brick to ensure adequate performance in new applications. Refer to *Technical Note* 15 for best practices regarding the selection and use of reclaimed or salvaged brick for new construction.

While reuse is often assumed to involve installing reclaimed brick in new mortar, reclaimed brick masonry can also be reused in other creative ways. Resource Row in Copenhagen, Denmark (Photo 3), is a unique example of brick masonry reuse. In this case, new cladding was made by cutting brick veneers from abandoned buildings into panels and mounting them on steel frames.

Rasmus Hjortshøj

Photo 3
Panelized Reclaimed Brick Masonry (Resource Row)

Addressing Embodied Carbon. Embodied carbon (see sidebar) is a more recent focus in many green building programs. Most programs focus on reducing the greenhouse gas (GHG) emissions associated with the manufacture of building products as reported in Environmental Product Declarations (EPDs). However, it is important to recognize that maintenance, repair, and replacement cycles can impact the total embodied carbon over the life of a building. The 2025 industry-average EPD (IA-EPD) for clay masonry products reports the impacts over an entire 75-year building life cycle and recognizes a reference service life of 150 years for clay masonry. This IA-EPD shows that clay masonry products have significantly decreased the average embodied carbon since the 2020 IA-EPD was produced. The GWP reported for modules A1–A3 in the 2025 IA-EPD for clay brick products is on average 25% lower than that reported in the 2020 IA-EPD. In the case of clay brick products, minimal GHG emissions occur during the maintenance and use phase of the building. For less durable products, perceived savings

Embodied Carbon and LCA

The term “embodied carbon” refers to the greenhouse gas emissions associated with the energy used to manufacture, install, repair, maintain and dispose of building products over the life of a building. Embodied carbon is measured through a life cycle assessment (LCA) of a given product. LCA examines inputs and emissions from raw material extraction to end of useful life.

The long life of brick masonry (150 years or more) means that impacts associated with its manufacture are spread over a building lifespan of more than 75 years. Life cycle assessments for whole buildings consider all the materials used in the building, the impacts of the construction stage and maintenance over the building’s lifespan until demolition at a specified point in time.

in GHG emissions from the manufacturing stage may be consumed or exceeded by the emissions from repair and replacement or recycling/reuse.

The embodied carbon of a building can also be reduced by using materials efficiently and avoiding use of unnecessary ones. Structural clay masonry walls are one strategy that can be employed to provide structural loadbearing capacity, along with lateral load resistance and story stiffness, and finished interior and exterior walls in a single product. Walls constructed with hollow clay masonry units have compressive and shear strengths that can exceed walls made with other masonry units. On the interior, structural masonry walls provide a durable, integral finish that is impact resistant and does not require maintenance.

Brick manufacturing is a highly efficient process. Brick are made primarily from clay and shale, which are abundant natural resources [Ref. 7]. Most brick manufacturing facilities are located near the clay and shale mining sites—many less than a mile away—and larger cities often have multiple brick plants within a 500-mile radius and typically have at least one in very close proximity. By selecting materials from regional sources, environmental impacts associated with the transport of materials can be reduced, and the local economy is supported. Recycled materials incorporated into the clay/shale mixture can lower the embodied carbon of brick. The primary fuel source for the industry is natural gas; however, some manufacturers use waste products—such as sawdust and methane from landfills, hydrogen, or biogas—to totally or partially fire their kilns, which reduces embodied carbon. Brick manufacturing is more energy efficient now than ever. From 2007 to 2012, brick manufacturers reduced their average energy use by 30%. According to the 2025 industry-average EPD for clay products, average energy use in manufacturing decreased an additional 9.8% from 2020 to 2025. From raw material acquisition to production, brick manufacturers incorporate many sustainable practices. *Technical Note* 9 discusses the manufacture of brick in detail.

Energy Efficiency and Reducing Operational Carbon. Energy efficiency of the building is an important aspect of sustainable design. The energy use associated with operation of a building is known as operational carbon (Figure 1), and is influenced by the building envelope, as well as the efficiency of the mechanical equipment, lighting and other building systems. To properly evaluate building energy performance, whole-building energy analysis should be used to simulate the energy use of the building for an entire year. This approach captures the diurnal temperature swings and dynamic nature of heat transfer in 24-hour cycles and is the best way to account for the benefits of thermal mass associated with masonry construction.

Incorporation of brick's thermal mass provides numerous energy benefits, including the reduction of peak heating and cooling loads, moderation of indoor temperature swings (improved thermal comfort), and potential reduction in the size of the HVAC system. Experience and energy modeling have consistently indicated that the thermal mass benefit of brick masonry is most pronounced when it is exposed on the interior of the building or used as part of a cavity wall system. Studies of residential wall systems indicate that assemblies with exposed interior brickwork or brick cavity walls would allow up to 23% less heat transfer than similarly insulated wood-framed wall assemblies with lightweight claddings [Refs. 9 and 26]. Brick veneer, even backed by wood framing, has demonstrated benefits of thermal mass when compared with lightweight wall systems [Ref. 5], requiring up to 7% less energy for cooling and heating than an otherwise identical structure with plywood siding [Ref. 4]. Prescriptive energy code compliance allows for the benefits of thermal mass through reduced levels of insulation for mass walls. For other wall assemblies with brick, the non-prescriptive compliance paths in the energy code better reflect the contribution and performance of the brick masonry. See BIA publications "Choose Brick for Energy-Efficient, High-Performance Wall Assemblies," Brick Builder Note "Brick and Energy Efficiency in Residential Construction: The Real Story," and the *Technical Note* 4 Series for more information.

Construction Waste and Recyclability. Building construction can generate significant amounts of waste. Because of the small, modular nature of brick, on-site construction waste can be dramatically reduced through careful design and detailing. Placement and sizes of openings designed with the modular nature of masonry in mind can minimize the need for cutting and waste on-site. Packaging from brick is minimal and easily recycled. Brick themselves can be recycled in many ways. Scrap brick and brick from demolition can be crushed and recycled into new brick or used as brick chips (Photo 4) for landscaping, baseball diamonds and tennis courts. Recycled brick also can be used as subbase material for pavements, on quarry roads or even as aggregate for concrete. When recycling whole brick units, an approach focused on deconstruction rather than demolition is key to maximizing brick masonry's potential for reuse in new assemblies. Green building programs encourage the recycling of construction waste and salvaging of building products.

Photo 4
Recycled Brick Chips

Photo 5
Permeable Clay Pavement

Rainwater Management. By managing rainwater, increasing on-site filtration, and eliminating contaminants, the disruption and pollution of natural water flows are limited. Flexible brick pavements can be designed as permeable to allow percolation of rainwater through the pavement, thereby reducing runoff and recharging groundwater aquifers (Photo 5). This strategy can also be an effective tool in reducing flooding from stormwater runoff and thus improving resilience of a site.

Reducing the Heat Island Effect. Building and pavement surfaces can have a warming effect on surrounding air temperatures, particularly in urban areas. One strategy that can be used to help reduce this heat island effect is to use materials that have an initial solar reflectance (SR) of 0.33 or higher on pavements and walkways on a building site or roof. Many brick pavers can meet this requirement.

Avoiding Fumes from Volatile Organic Compounds and Other Toxic Substances. Fumes from volatile organic compounds (VOCs) and other toxic substances such as per- and polyfluoroalkyl substances (PFAS) can negatively affect the indoor environment. Unlike other finishes, brick masonry is recognized as inherently free of organic or other toxic components that can result in issues with VOCs or PFAS. For brick, the manufacturing process burns off all organic compounds. As a result, brick masonry can be used on the interior of a building, serving as a structure and/or a finish without the need for VOC-emitting paints or coatings, thereby avoiding VOCs and improving indoor air quality. Interior brick flooring can be used in lieu of carpeting, particularly in high-traffic areas, thereby eliminating VOC content associated with carpet and adhesives and eliminating the need for regular replacement of flooring due to wear. In addition, because the appearance of brick will last a lifetime without costly repainting and other maintenance typically associated with interior finishes, this benefit continues for the life of the building.

Acoustic Comfort. Reducing sound penetration through walls is a key element in a superior indoor environment. Most green building programs incorporate criteria for acoustic performance that include sound transmission class (STC) requirements, background noise limits, and other requirements. Brick masonry walls provide superior resistance to sound penetration as compared with other framed wall systems. Brick masonry walls built with nominal 3 in. (75 mm) thick face brick provide an STC of 43 for the brick alone [Ref. 24]. Brick masonry walls built with 4 in. face brick have an STC of 45 for the brick alone (see *Technical Note* 5A for more information), far superior to vinyl and other lightweight cladding materials. By comparison, a complete vinyl-clad wood framed wall assembly, including sheathing and insulation, achieves an STC of only about 38 [Ref. 25].

Where outdoor-indoor transmission class (OITC) requirements apply, wall assemblies that incorporate brick masonry provide superior resistance to sound penetration. For comparison, exterior wall systems with fiber cement cladding provide OITC values ranging from 26 to 36 depending on the framing and insulation. A single wythe of brick veneer alone, on the other hand, has an OITC value of 38, which increases when the contribution of the backing and insulation is included.

Reducing Impacts Through Resilient Design and Durability

Resilient buildings are designed to adapt to changing conditions and to withstand the hazards they are exposed to with the ability to recover rapidly. Resilient buildings avoid environmental impacts by reducing or eliminating the need for repair and replacement. While there are many things to consider as part of resilient building design, designing with durability in mind can create a robust building capable of withstanding both expected and unexpected conditions. Brick masonry provides the benefit of resistance to many hazards as discussed herein.

Durable designs should consider the materials used and their interactions with one another as part of the whole design. For example, brick masonry has a life expectancy of 150 years or more. Fired clay brick has outlasted all other building materials but stone, with evidence of use as far back as 2000 B.C.E. [Ref. 23]. It is important to recognize this fact when detailing those elements that interface directly with brick masonry that have shorter life expectancies or require more frequent maintenance. One example of this is flashing. Some flashing materials, such as stainless steel and copper sheet metal, have been documented to have a life expectancy of more than 100 years. The detail shown in Figure 2 is designed with service life in mind. The metal counter flashing and roof membrane will require periodic replacement. By utilizing separate components, these parts can be replaced without damage to or repointing of the brick masonry wall. Such a detail is not required by the International Building Code [Ref. 15] but can extend the service life of a wall. In this way, the durability of the entire wall system is considered.

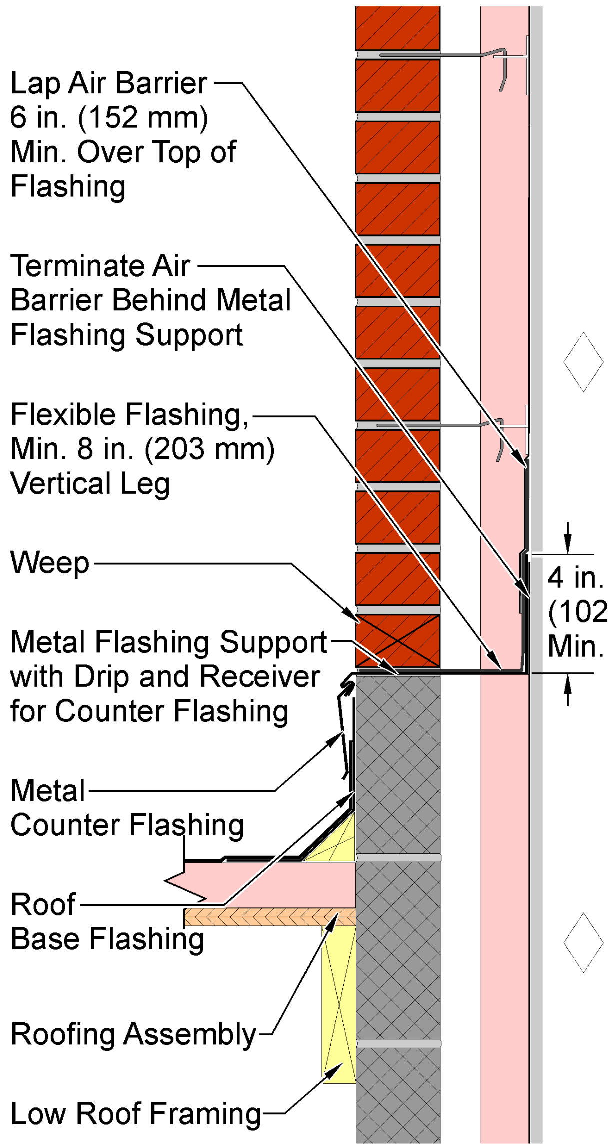

Figure 2
Wall/Roof Intersection

Fire Resistance. Brick is not only noncombustible; it will not burn, soften, or degrade and does not emit toxic fumes when exposed to flames or heat. The temperatures experienced in the kiln during manufacturing are significantly higher than those of typical building fires; as a result, clay masonry was frequently used as fire protection of steel framing in early 20th-century buildings. This essential attribute is key to providing resistance to both building fires and wildfires (Photo 6 and Photo 7). A brick unit with a nominal 4 in. thickness will provide a 1-hour fire resistance rating on its own regardless of the type of backing system. The fire-resistance rating of hollow clay units is similar, with a different equivalent thickness accounting for the increased void area. See *Technical Note* 16 for more information. As a noncombustible material, brick masonry meets the International Wildland Urban Interface Code (IWUIC) requirements for exterior walls for all levels of fire hazard [Ref. 16]. Similarly, brick pavements used as patios or plazas and brick fences adjacent to buildings also comply with IWUIC requirements as noncombustible materials.

Impact Resistance. Buildings can suffer impacts from flying debris during tornado or hurricane events or from intentional attacks such as from gunfire. Brick veneer meets the basic hurricane protection requirements of the Florida Building Code and the enhanced protection requirements of ASTM E1996, *Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes* [Ref. 1] by being able to stop a 9 lb projectile at speeds up to 79 mph. [Ref. 3] In the case of windborne debris from tornados, structural brick masonry is capable of obstructing these projectiles and frequently

Photo 6
Brick Building Undamaged After Fire Destroys Neighboring Building

Photo 7
After Palisades Wildfires, Only Brick and Masonry Chimneys Remained Intact

serves as the wall assembly enclosing storm shelters. Brick veneer has also demonstrated resistance to penetration by bullets [Ref. 11].

Flood Resistance. Consideration of flooding is part of climate resilience. Building codes and green programs may include requirements related to flood hazards, including ensuring that all structural materials, finish materials and connectors used below the design flood elevation (DFE) are flood resistant. Brick masonry has an acceptable rating for flood damage resistance per National Flood Insurance Program (NFIP) Technical Bulletin 2.

Mold Resistance. Mold is an area of concern for indoor air quality. Mold can occur when moisture is present, and when there is a source of food such as building products made with cellulose (wood products, paper-covered gypsum board, etc.). Brick masonry is not a food source for mold. As a result, it does not promote mold growth, even when wet. Other interior wall materials can deteriorate and be literally consumed by mold if moisture problems occur. By using materials such as brick that do not support mold growth and are not damaged by water, more resilient designs can be achieved.

Pest Resistance. In residential construction, resistance to pests such as termites is also a concern. There are many strategies that can be used to provide pest-resistant construction. Since brick cannot be eaten by insects or rodents, utilizing masonry for walls and patios is one such strategy.

Moisture Control. Longevity of buildings and building materials is improved by controlling potential sources of moisture ingress, such as rain and water vapor (humidity). As a result, green building programs contain requirements that limit condensation, reduce indoor humidity and provide means for water drainage within the wall assembly.

Inert and naturally water resistant, brick masonry performs well when moisture is a concern. Because of its lack of organic materials, it does not degrade when exposed to moisture.

Although absorptive and vapor permeable, brick units do not permit bulk water to pass through. Incidental moisture that penetrates the interface between brick units and mortar is managed by either a cavity behind the brickwork or the reservoir capacity of the masonry. When present, the cavity is nominally 1 in. or wider in dimension, allowing for airflow to encourage drying and providing rainscreen performance.

Incorporation of properly installed flashing is important for moisture management in any brick masonry wall assembly, including drainage walls, multi-wythe mass masonry walls or single-wythe walls. The *Technical Notes* 7 Series on water penetration resistance provides information for best practices for detailing of brick masonry.

TABLE 1
Green Building Programs with Strategies Related to Brick

	Nonresidential Construction Programs						Residential Construction Programs	
Strategy and Characteristics	**Green Globes[1]**	**LEED v4/v4.1 BD+C[2]**	**LEED v5 BD+C[3]**	**IgCC[4]**	**Living Building Chall.[5]**	**WELL[6]**	**LEED v4 Residential: Multifamily Homes[7]**	**ICC 700 National Green Building Standard[8]**
Building reuse and renovation	x	x	x	x	x		x	x
Reuse of materials	x	x	x	x	x		x	x
Addressing embodied carbon	x	x	x	x (assessment only)	x	x	x	x (life cycle assessment only)
Building product reporting	x	x	x	x	x	x	x	x
Energy efficiency and reducing operational carbon	x	x	x	x	x		x	x
Construction waste and recyclability	x	x	x	x	x		x	x
Rainwater management	x	x	x	x	x		x	x
Reducing the heat island effect	x	x	x	x	x		x	x
Avoiding VOCs	x	x	x	x	x	x	x	x
Acoustic comfort	x	x		x	x	x	x	x
Assessing future hazards (resilience)	x	x (pilot credit)	x					x
Fire and/or wildfire resistance	x	x (pilot credit)						x (lot design only)
Impact resistance	x	x (pilot credit)						x (structural design for wind)
Flood resistance	x	x (pilot credit)						x (structural design for wind)
Mold resistance						x	x	x
Pest resistance						x		x
Moisture control						x		x
Passive thermal design		x (pilot credit)			x (indirectly)			

1. Green Globes® ANSI/GBI 01-2024, Assessment Protocol for Design, New Construction, and Major Renovations [Ref. 8]
2. LEED® for Building Design and Construction: New Construction and Major Renovations Rating System, v4/v4.1 (LEED BD+C) [Refs. 18 and 19]
3. LEED® for Building Design and Construction: New Construction and Major Renovations Rating System, v5 (LEED BD+C) [Ref. 17]
4. 2024 International Green Construction Code® (IgCC) [Ref. 14]
5. The Living Building Challenge certification program [Ref. 22]
6. WELL Building Standard™ version 2, (WELL) [Ref. 27]
7. LEED® Residential Building Design and Construction: Multifamily Homes [Ref. 20]
8. 2020 ICC 700 National Green Building Standard™, (NGBS) [Ref. 13]

Passive Thermal Design. Passive thermal design is an important aspect of sustainable and resilient building design. Passive thermal design strategies, often integral with vernacular architecture, rely upon the sun, wind and building materials to naturally heat and cool the building, reducing the reliance on mechanical systems and thereby decreasing energy use. Active techniques such as air conditioning, while useful, require energy to run and may be compromised during extreme events. Maintaining thermal comfort during power outages is characteristic of resilient building designs, and many regional resilience codes incorporate requirements for thermal mass to help ensure passive survivability [Ref. 6]. Building orientation, solar energy, shading and incorporation of thermal mass are essential elements of passive thermal design. Interior brick walls and flooring can be used to store heat or to cool and moderate temperature swings. A University of Newcastle study [Ref. 9] demonstrated that the amount of energy needed for heating and cooling decreased by 14% to 34% when an exposed brick thermal storage wall was added to the interior of experimental housing units. Thermal storage walls, historically referred to as Trombe wall systems, can be vented, supplying heat by radiation and convection, or unvented, supplying heat through radiation alone.

Passive thermal design shares some principles but differs from “Passive House,” which is a specific method used to achieve increased energy efficiency by limiting air infiltration and increasing insulating properties of the exterior building envelope.

SUMMARY

How a building material is used should be considered when examining its sustainability. Brick masonry walls are able to perform multiple functions that, in other wall systems, often require several components. Designing walls that perform multiple functions allows for more efficient use of materials. This translates into reduced environmental impacts for the building. A single brick wythe can do all of the following:

- Serve as a loadbearing structural element.
- Provide an interior or exterior finish without the need for paints or coatings.
- Provide acoustic comfort with an STC rating of 45 or greater and an OITC rating of 38 or greater.
- Regulate indoor temperatures as a result of thermal mass.
- Provide fire resistance (a nominal 4 in. [100 mm] brick wall has a one-hour fire rating).
- Provide impact resistance from wind-borne debris, projectiles or ballistic impact.
- Improve indoor air quality by eliminating the need for paint and coatings (no VOCs).
- Provide a noncombustible material that does not emit toxic fumes in fires.
- Provide an inorganic wall that is not a food source for pests or mold.
- Serve as a heat-storing element in a passive solar design.
- Last for generations.

This *Technical Note* provides information on resilient and sustainable designs as they relate to brick and brick masonry. The Brick Industry Association is committed to sustainable and resilient design and has adopted the following environmental policy statement:

The brick industry recognizes that the stewardship of our planet lies in the hands of our generation. Our goal is to continually seek out innovative, environmentally friendly opportunities in the manufacturing process and for the end use of clay brick products. As demonstrated over time, we are committed to manufacturing products that provide exceptional energy efficiency, durability, recyclability and low maintenance with minimal impact on the environment from which they originate. We will ensure that our facilities meet or exceed state and federal environmental regulations, and we will continue to partner with building professionals to help them in using our products to create environmentally responsible living and working spaces for today’s and future generations.

> *The information and suggestions contained in this* Technical Note *are based on the available data and the combined experience of engineering staff and members of the Brick Industry Association. The information contained herein must be used in conjunction with good technical judgment and a basic understanding of the properties of brick masonry. Final decisions on the use of the information contained in this* Technical Note *are not within the purview of the Brick Industry Association and must rest with the project architect, engineer, and owner.*

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