THE BRICK INDUSTRY ASSOCIATION
TECHNICAL NOTES on Brick Construction
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Sustainability and Brick

Abstract: This *Technical Note* discusses sustainability, sustainable design and their relationship to brick manufacturing, use and recycling. Sustainable practices in manufacturing are identified, as are ways to utilize brick as part of sustainable design strategies. This document also identifies ways that brick masonry walls and paving systems can be used toward earning points in the LEED and other green building rating systems.

Key Words: environmental impacts, green building, LEED, life-cycle assessment (LCA), recycled content, resources, sustainability, sustainable design, thermal mass, volatile organic compounds (VOCs).

SUMMARY OF RECOMMENDATIONS:

- Sustainable design balances environmental, economic and societal goals in a building's design, construction and use
- Green building codes, standards and rating systems attempt to recognize buildings for the level of sustainable design achieved through certification
- Brick used in sustainable designs can provide structure, finish, acoustic comfort, thermal comfort, good indoor air quality, fire resistance, impact resistance and durability, all in one product
- Brick masonry and paving systems can help meet requirements of many certification rating systems in the areas of rainwater management, heat island reduction, improved energy performance, acoustic performance, building reuse, materials reuse, construction waste management, recycled content and regional materials
- Brick masonry walls and flooring can contribute to improved indoor air quality by eliminating the need for paints and other finishes and the resulting volatile organic compounds (VOCs) and by eliminating a food source for mold
- Brick masonry is durable, having a life expectancy of hundreds of years
- Brick buildings can be and are reused, thereby distributing their environmental impact over an extended life span
- Brick is made from abundant natural resources (clay and shale) and is readily recycled for use in the manufacturing process or other uses
- Brick manufacturers address sustainability by locating plants in close proximity to mines; incorporating waste products and recycled materials into brick; reducing energy use, water use and atmospheric emissions; and utilizing landfill gas and other byproducts from other industries for fuel

INTRODUCTION

"Sustainable design" is a term that has entered the vernacular of building design and construction. As more buildings are designed and constructed using sustainable design principles, the need for information on building products and their sustainable design features also grows. In assessing the sustainable attributes of building products, consideration must be given to how the product is manufactured, used and disposed of. This *Technical Note* provides information on brick usage, manufacturing and recycling as it relates to sustainability.

WHAT IS SUSTAINABILITY?

Sustainability is defined as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" [Ref. 4]. Sustainable buildings are designed in a way that uses available resources efficiently and in a responsible manner, balancing environmental, societal and economic impacts to meet the design intents of today while considering future effects. They should be resilient to withstand the effects of nature with minimal damage. Sustainable buildings are designed to be energy efficient, water efficient and resource efficient. Through their design, they address the well-being of the occupants by providing thermal and acoustic comfort, indoor air quality and appealing aesthetics. They also consider the impact of their construction, operation and maintenance on the environment, and the environmental impact of their constituent materials. Most importantly, a sustainably designed building addresses all these aspects through its entire life cycle, including its operation and maintenance.

GREEN BUILDING RATING SYSTEMS, STANDARDS AND CODES

While there is general agreement on many of the elements of sustainable building design, defining and measuring it poses a challenge. There are several standards, codes and rating systems that have developed requirements for green buildings. Each is somewhat different, but all focus on reducing environmental impacts in the areas of energy use, water use, material/resource use, building sites and improving the building indoor environment. This *Technical Note* considers those programs that are most widely used in the United States, as shown below.

Nonresidential construction green building programs:

- LEED® 2009 (*Building Design and Construction: New Construction and Major Renovations Rating System*) [Ref. 13]
- LEED® v4 (*Building Design and Construction: New Construction and Major Renovations Rating System*) [Ref. 14]
- ASHRAE 189.1 (*Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings*) [Ref. 17]
- IgCC™ (*International Green Construction Code*™) [Ref. 2]

Residential construction green building programs:

- LEED®-Homes (*Building Design and Construction: Homes and Multifamily Lowrise)* [Ref. 12]
- ICC 700 (*National Green Building Standard*™) [Ref. 1]

Green Building Rating Systems

Green building rating systems are developed as voluntary programs for assessing sustainable attributes of buildings. Rating systems allow the users to select which attributes they want to include, and they reward buildings that include more sustainable attributes with higher levels of certification. The LEED (Leadership in Energy and Environmental Design) green building rating system, developed by the United States Green Building Council (USGBC), is the most widely used green building rating system in the United States. There are currently two versions of LEED available for use: LEED 2009 and LEED v4. LEED v4 (updated in November 2013) made numerous changes to the rating system, but none was as significant as the changes made to the credits in the Materials and Resources (MR) category. Credits that focused on single attributes of materials such as recycled content in LEED 2009 have been replaced with credits focused on life-cycle assessment, product transparency and reporting in LEED v4. Refer to the specific requirements found in the rating systems and *LEED Reference Guide for Green Building Design and Construction* [Ref. 15].

Green Building Standards

Green building standards were first developed to provide users with criteria written in mandatory language that could be adopted by and used by jurisdictions seeking to require green building provisions. Unlike rating programs that allow the user to pick and choose which sustainable strategies to incorporate, standards prescribe minimum requirements that must be met.

ASHRAE 189.1, *Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings* (ASHRAE 189.1) is a standard focused on commercial buildings and high-rise residential buildings. ASHRAE 189.1 covers many of the same topics as the LEED rating systems; however, since it is written in mandatory language, the provisions it contains can be considered minimum requirements for green building.

The *National Green Building Standard,* which is also known as the ICC 700 code, is a standard focused on residential construction. The ICC 700 covers new homes, including high-rise multifamily buildings, home remodeling and additions, hotels and motels, and the sites upon which green homes are located. As a residential standard, it includes many provisions related to characteristics of home construction.

Green Building Codes

Green building codes are developed for adoption by jurisdictions desiring to require green building provisions for all or a segment of building construction under their purview. Like standards, green building codes are written in mandatory language, and they prescribe minimum requirements that must be met. On the national level, the *International Green Construction Code* (IgCC) is a model green building code developed by the International

Code Council. It contains requirements for green building that cover the same general areas as LEED and ASHRAE 189.1, though the specific requirements are not identical. One unique feature of the IgCC is that it permits ASHRAE 189.1 to be used as an alternate compliance path.

Limitations of Green Building Programs

The focus of these and other green building programs is energy use and the environment. All contain numerous requirements and credits intended to reduce building operational energy use, to promote the use of building products with lower environmental impacts and to provide a healthy indoor environment. However, what is often lacking in these rating systems is a means by which to promote and measure the avoidance of negative impacts. For example, efficient use of materials is not well recognized. Brick masonry elements that perform multiple functions avoid the use of other materials, such as paints, sound insulation, etc. Another limitation of these programs is inattention to durability. With the movement to develop more resilient building designs, one can hope that the benefits of durable brick masonry construction will be recognized. Only a whole-building, holistic approach can capture the true intent of sustainable design.

SUSTAINABLE DESIGN ELEMENTS

In the sections that follow, elements of sustainable design are discussed. Those that correspond to a credit or section in one of the green building programs listed previously have the specific credit or section number noted in brackets [ ] at the end of the paragraph. Further information on each of the green building programs can be found in the publications referenced and online. In this *Technical Note,* the following abbreviations are used when referring to the LEED credits:

- BPDO: Building Product Disclosure and Optimization
- EA: Energy and Atmosphere
- IEQ: Indoor Environmental Quality
- LT: Location and Transportation
- MR: Materials and Resources
- SS: Sustainable Sites

Environmentally Responsive Site Planning

Environmentally responsive site planning includes consideration of site selection, site disturbance, rainwater management and effects of the building on its surroundings. The use of brick masonry is an appropriate choice for achieving several elements of environmentally responsive site planning.

Photo 1
Reused (Left) and New Brick Buildings

Reuse and Renovation. The first step in site planning is selection of the building site. Reuse or renovation of an existing building (see Photo 1) can result in significant reductions in environmental impacts as compared with new construction. Because of aesthetic appeal, durability and historic value frequently associated with brick masonry buildings, they often are chosen for reuse. In many cases, load-bearing brick buildings are reused in their entirety. In other cases, the brick façade is retained while a new structure is constructed. By adapting existing structures to new uses, both resources and energy are saved, and environmental impacts are reduced. This adaptive reuse of brick masonry buildings is a testament to the longevity and durability of brick masonry. [LEED 2009 MR credit Building Reuse; LEED v4 MR credit Building Life-Cycle Impact Reduction; ASHRAE 189.1 Sec. 5.3.1.1; ICC 700 Sec. 305, 403.9 and Ch. 11]

Managing Rainwater. 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 pavements to allow percolation of rainwater through the pavement, thereby reducing runoff, recharging groundwater aquifers and removing contaminants from surface water (see Photo 2). [LEED 2009 SS credit Stormwater Management; LEED v4 SS credit Rainwater Management; ASHRAE 189.1 Sec. 5.3.4; IgCC Sec. 403.1; LEED-Homes SS credit Rainwater Management; ICC 700 Sec. 403.5 and 503.4]

Photo 2
Permeable Clay Pavement

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 a three-year aged solar reflectance (SR) of 0.28 or higher on pavements and walkways on the building site, or even on vegetated roofs to provide access paths to reduce this effect. Though lighter colors often are associated with high SR values, many brick pavers, even some that are dark in color, can meet this requirement. [LEED 2009 SS credit Heat Island Effect; LEED v4 SS credit Heat Island Reduction; ASHRAE 189.1 Sec. 5.3.5.1; IgCC Sec. 408 and A104.9; LEED-Homes SS credit Heat Island Reduction; ICC 700 Sec. 505.2]

Energy Efficiency

Energy efficiency of the building is an important aspect of sustainable design. It includes not only the building envelope, but also the efficiency of the mechanical equipment, lighting and other building systems. Increasingly, whole-building energy analysis is used to simulate the energy use of the building over a 24-hour cycle for an entire year. This approach captures the diurnal temperature swings and dynamic nature of heat transfer and is the best way to account for the benefits of thermal mass associated with masonry construction. Incorporation of 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 simulations consistently suggest 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. In interior applications such as these, the thermal mass is contained within a protective layer of insulation, which further enhances the ability of the brick masonry to control the gain or release of heat. Studies of residential wall systems indicate that assemblies with exposed interior brickwork or brick cavity walls would use up to 23 percent less energy than similarly insulated wood-framed wall assemblies with lightweight claddings [Refs. 10 and 19]. Brick veneer, even backed by wood framing, has demonstrated benefits of thermal mass when compared with lightweight wall systems [Ref. 6], requiring up to 7 percent less energy for cooling and heating than an otherwise identical structure with plywood siding [Ref 5]. [LEED 2009 and v4 EA credit Optimizing Energy Performance; ASHRAE 189.1 Sec. 7.5; IgCC Sec. 602; LEED-Homes EA credit Annual Energy Use; ICC 700 Sec. 702 and 703.1.3]

Passive Design. Passive design is an important aspect of sustainable and resilient building design. Passive design strategies 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, while useful, often require energy to run and may be compromised during extreme events. Building orientation, solar energy, shading and incorporation of thermal mass are essential elements of passive design. Interior brick walls and paving can be used to store heat and moderate temperature swings. A University of Newcastle study [Ref. 10] demonstrated that the amount of energy needed for heating and cooling decreased by 14 to 34 percent when an exposed brick thermal storage wall was added to the interior of experimental housing units. [IgCC Sec. A106.5; LEED-Homes EA credit Building Orientation for Passive Solar; ICC 700 Sec. 403.2, 703.1.3 and 703.6]

Environmentally Preferable Materials and Products

Consideration of the environmental attributes and impacts of building materials is an important element in a sustainable design, although it is only one of several criteria to be considered for product selection. There are numerous strategies that can be employed, from use of regionally manufactured materials to incorporation of recycled content. Several strategies are discussed below.

Salvaged Materials. Use of salvaged materials avoids the environmental impacts associated with new products. Brick is unique in that after many decades of use, brick used on exterior and interior walls, as well as in paving applications, can be salvaged and provide many more decades of benefits. Refer to *Technical Note* 15 for best practices regarding the selection and use of salvaged brick for new construction. [LEED 2009 MR credit Materials Reuse; LEED v4 MR credit Building Product Disclosure and Optimization – Sourcing of Raw Materials; ASHRAE 189.1 Sec. 9.4.1; IgCC Sec. 505.2.1 and A105.3; LEED-Homes MR credit Environmentally Preferable Products; ICC 700 Sec. 603 and 11.603]

Recycled Content. Many environmentally preferred product listings focus on materials that incorporate recycled content. By utilizing recycled materials, the assumption is that the environmental impact is lowered. Brick units may incorporate recycled materials such as sawdust, fly ash, recycled brick and metallic oxides. Mortar and grout can include recycled materials, such as fly ash, and most steel reinforcement used in reinforced brick masonry has a high recycled content. [LEED 2009 MR credit Recycled Content; LEED v4 MR credit Building Product Disclosure and Optimization – Sourcing of Raw Materials; ASHRAE 189.1 Sec. 9.4.1; IgCC Sec. 505.2.2 and A105.3; LEED-Homes MR credit Environmentally Preferable Products; ICC 700 Sec. 604 and 11.604]

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. Packaging from brick is minimal and easily recycled. Brick 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 for landscaping (see Photo 3), baseball diamonds and tennis courts. Recycled brick also can be used as sub-base material for pavements, on quarry roads or even as aggregate for concrete. Green building programs encourage the recycling of construction waste and minimization of total waste generated. [LEED 2009 MR credit Construction Waste Management; LEED v4 MR credit Construction and Demolition Waste Management; ASHRAE 189.1 Sec. 9.3.1; IgCC Sec. 503, A105.1 and A105.2; LEED-Homes MR credit Construction Waste Management; ICC 700 Sec. 601.3, 605 and 11.605]

Photo 3
Recycled Brick Chips

Regional Sourcing. By selecting materials from regional sources, environmental impacts associated with the transport of materials can be reduced, and the local economy is supported. Most brick are manufactured from materials obtained from within a few miles of the manufacturing plant. As shown in Figure 1, larger cities often have many brick plants within a 500-mile radius and typically have at least one in very close proximity. Approximately 15 percent of brick are transported to the distributor's yard or jobsite by rail and 85 percent by truck, with an average shipping distance of 150 miles. [LEED 2009 MR credit Regional Materials; ASHRAE 189.1 Sec. 9.4.1; IgCC Sec. 505.2.5; LEED-Homes MR credit Environmentally Preferable Products; ICC 700 Sec. 609 and 11.609]

Life-Cycle Assessment. Rather than considering a single sustainable material strategy (e.g., recycled content), life-cycle assessment (LCA) is a tool that considers numerous aspects of building products. LCA incorporates information on the raw ingredients of building products, how they are made and the impacts to the environment from the process. The most accurate life-cycle assessments evaluate products over their entire life cycle, from raw material extraction to end of useful life. The long life of brick masonry means that impacts associated with its manufacture are spread over a life span of 75 years or more. Life-cycle assessment also can be done for a whole building by considering all the materials used in the building, the impacts of the construction stage and maintenance over the building's life span until demolition at a specified point in time. [LEED v4 MR credit Building Life-Cycle Impact Reduction; ASHRAE 189.1 Sec. 9.5.1; IgCC Sec. 303; ICC 700 Sec. 610.1.1 and 11.610]

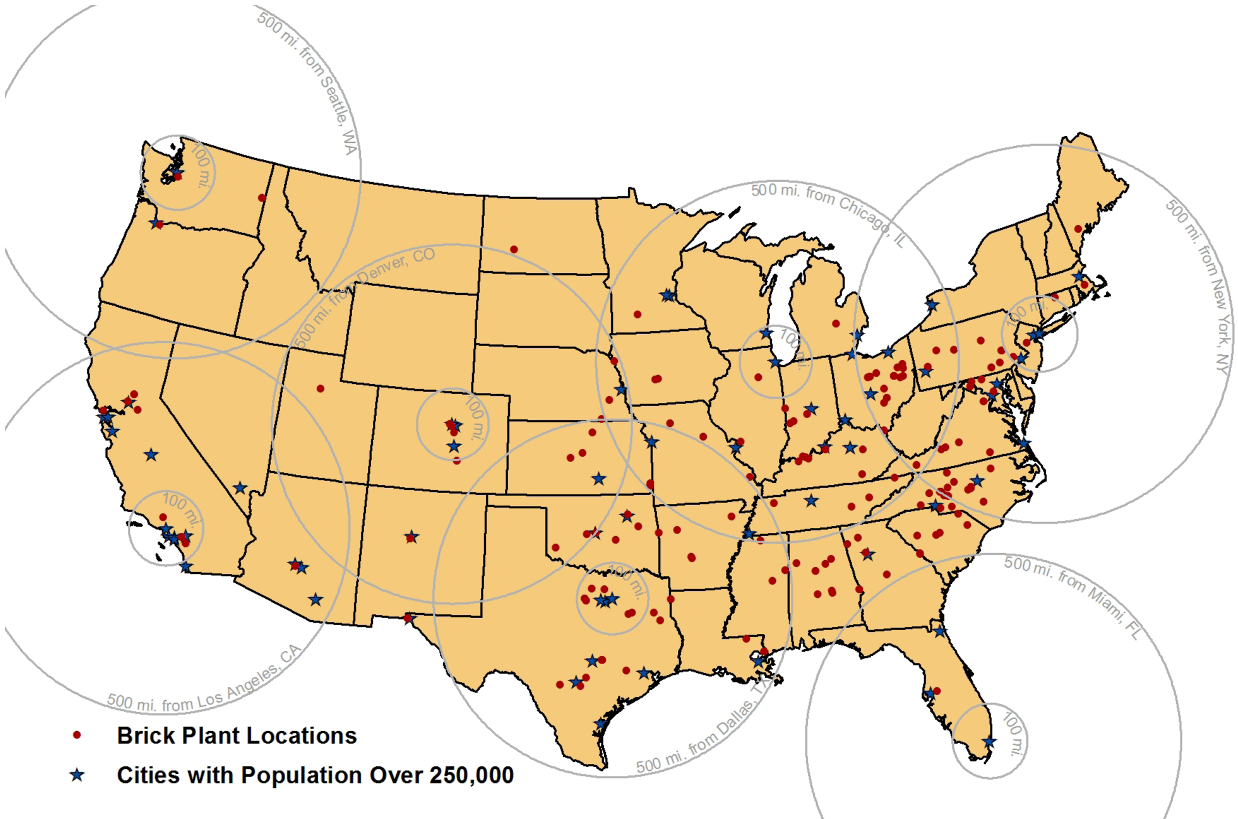

Figure 1
U.S. Brick Manufacturing Plants

Durability and Designing for Longer Life Expectancy

Designing a high-performance wall considers not only the multiple functions a wall can perform, but also the different life expectancies of those elements that make up the wall. As J. Patrick Rand writes, it is important "when designing systems with many components, such as curtain walls, endeavor to make all components equally durable to prevent premature failure of one part of the system. When possible, provide for easy inspection, maintenance, and/or replacement of less durable components" [Ref. 16]. [ASHRAE 189.1 Sec. 10.3.2.3; IgCC Sec. A105.4; LEED-Homes MR credit Durability Management Verification; ICC 700 Sec. 602]

This approach is especially important in achieving a sustainable building design. Brick masonry is extremely durable, having a life expectancy of hundreds of years. Repointing may be required only every 50 years or longer. 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, have been documented to have a life expectancy of more than 100 years.

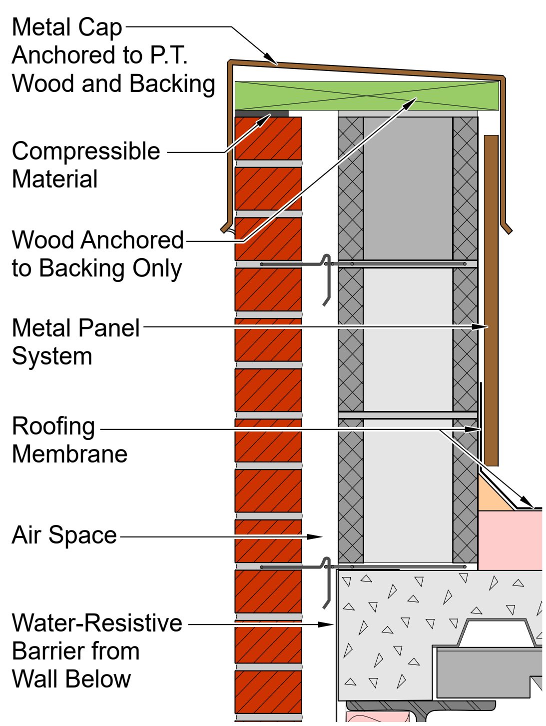

Figure 2
Detailing for Longer Life Expectancy

The detail shown in Figure 2 is designed with service life in mind. The metal cap 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 building code but can extend the service life of a wall.

Moisture Control. Longevity of buildings and building materials is improved by addressing potential sources of moisture, such as rain and water vapor (humidity). Green building programs contain requirements that limit condensation, reduce indoor humidity and provide means for water drainage (flashing). In addition to these, a brick masonry rain screen wall is a special type of wall that can equalize pressure to minimize rain penetration. Details of the design of pressure-equalized rain screen brick masonry walls can be found in *Technical Note* 27. [ASHRAE 189.1 Sec. 8.3.6; IgCC Sec. 507; ICC 700 Sec. 602.1 and 602.1.9(5)]

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 termite-resistant construction. Since brick cannot be eaten by insects, utilizing masonry for walls and patios is one strategy that can be used. [ICC 700 Sec. 602.1.6]

Resiliency

Brick masonry is resilient and is able to respond to extreme events. Brick masonry promotes occupant health and safety through fire-resistant construction and resistance to impacts from wind-borne debris. Brick is noncombustible — it will not burn and does not emit toxic fumes. 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. 3], and has even demonstrated resistance to penetration by bullets [Ref. 11]. In addition, the durability of brick masonry gives long-lasting results.

Superior Indoor Environmental Quality

Acoustic Comfort. Reducing sound penetration through walls is a key element in a superior indoor environment. Many 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 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. 18]. 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. [LEED v4 IEQ credit Acoustic Performance; ASHRAE 189.1 Sec. 8.3.3; IgCC Sec. 807]

Avoiding Volatile Organic Compounds. Gypsum board may be sanded several times when used as an interior finish. It is then primed and one or more coats of paint are applied, and typically reapplied many times during a building's life cycle. This process can be a significant source of volatile organic compounds (VOCs). Because brick masonry can be used on the interior of a building, serving as structure and/or a finish without the need for paints or coatings, the VOCs avoided result in improved indoor air quality. Brick masonry is an inherently non-emitting material and meets VOC criteria without any special testing or manufacture, unlike other finish materials. 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. 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. [LEED 2009 and v4 IEQ credit Low-Emitting Materials; ASHRAE 189.1 Sec. 8.4.2; IgCC Sec. 806 and A108; LEED-Homes Low-Emitting Products; ICC 700 Sec. 901.7 and 11.901.7]

Resisting Mold. Mold is another 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 be literally eaten up by mold if moisture problems occur. [ASHRAE 189.1 Sec. 8.3.6]

Masonry Fireplaces and Heaters. Fireplaces with gasketed doors, outside combustion air and a means of sealing the flue provide heat without compromising indoor air quality or heat loss. Masonry heaters of brick are energy efficient and clean burning and provide heat from a renewable resource. [LEED-Homes IEQ credit Combustion Venting; ICC 700 Sec. 901.2.1 and 11.901.2.1]

Efficient Use of Materials

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

- Serve as a load-bearing 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.
- 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 or projectiles.
- 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 mold.
- Serve as a heat-storing element in a passive solar design.
- Last for generations.

[ICC 700 Sec. 601.2, 601.7, 601.9, 11.601.2 and 11.601.7]

Reduced Thickness. Brick manufactured to a reduced thickness use less raw material. Brick manufactured to meet ASTM C1088, *Specification for Thin Brick Veneer Units Made from Clay or Shale,* have a maximum thickness of 1¾ in. (44 mm). When adhered or attached to a load-bearing wall substrate, these units can provide a brick finish with minimal use of raw material. For more information on thin brick construction, refer to *Technical Note* 28C.

Anchored masonry veneer can be as thin as 2⅝ in. (67 mm), according to the *Building Code Requirements for Masonry Structures,* which is referenced by the *International Building Code.* Such brick are available from most brick manufacturers and often are used in residential applications. Table R703.3(1) of the *International Residential Code* requires a minimum thickness for anchored masonry veneer of 2 in. [ICC 700 Sec. 608 and 11.608]

Hollow Brick. Brick units meeting the requirements of ASTM C652, *Specification for Hollow Brick,* utilize less raw material than solid brick used in anchored veneers while performing the same function. [ICC 700 Sec. 608 and 11.608]

BRICK MANUFACTURING AND SUSTAINABILITY

Brick manufacturing is a highly efficient process. From raw material acquisition to production, brick manufacturers incorporate many sustainable practices. *Technical Note* 9 discusses the manufacture of brick in detail, but some of the sustainable practices are highlighted below.

Raw Materials

Brick is made primarily from clay and shale, which are abundant natural resources [Ref. 7], and most brick manufacturing facilities are located near the clay and shale mining sites — many less than a mile away. Once the clay is mined, it is ground to suitable particle size, mixed with water and formed into brick. Recycled materials frequently are incorporated into the clay/shale mixture. Recycled waste from other industries — such as bottom ash and fly ash from coal-fired generators, glass, stone dust and ceramic tile — may be incorporated. Reclaimed industrial metallic oxides can be used as colorants in brick. Because fired brick are inert, brick can safely encapsulate many materials.

Sustainable Practices in Manufacturing

Manufacturing of brick is an efficient process in many ways. On average, only about 5 percent of all material mined to make brick is lost in the mining process. About 3.5 percent of the manufactured product ends up as scrap, most of which is returned to the manufacturing process or recycled for secondary uses such as structural fill. Water used in brick production and heat from kilns are both recycled and reused.

Brick manufacturing is more energy efficient now than ever. As recently as 2007, the energy needed to dry and fire brick was in the range of 1200 to 1300 Btu per pound of brick produced. In 2012 a rough estimate of the average energy needed dropped to the range of 800 to 900 Btu per pound of brick produced — a reduction of an additional 30 percent. Contemporary brick manufacturing continues to improve in efficiency. These improvements include providing more energy-efficient kilns, increasing production of brick that require less energy to make and installing energy-efficient lighting. Several manufacturers have been recognized for their efforts in improving efficiency, with at least one plant achieving LEED Gold certification [Ref. 9].

Many manufacturers are using methane gas from landfills or sawdust to partially or totally fire their kilns, while the primary fuel source for the industry is clean-burning, abundant natural gas [ICC 700 Sec. 606.3]. Using these supplemental fuel sources for the brick manufacturing process reduces a manufacturer's reliance on more traditional fuels and makes use of valuable byproducts from other industries that might otherwise become a waste.

Brick manufacturers comply with all state and federal regulations for clean air and the environment, and many go beyond the minimum requirements. Manufacturers have been recognized for their efforts to treat stormwater, establish wetlands, reduce waste, recycle and conserve water, reclaim mining sites and more [Ref. 8]. Commitments to corporate sustainability and manufacturing policies are also recognized by many of the green building programs. Criteria can include reporting on raw material and source extraction, supplier practices and manufacturer certifications. [LEED MR credit BPDO – Sourcing of Raw Materials, MR credit BPDO – Material Ingredients; ICC 700 Sec. 611.1]

SUMMARY

This *Technical Note* provides information on sustainability and sustainable design as it relates to brick manufacturing, use and recycling. The Brick Industry Association is committed to sustainable design and has adopted the following environmental policy statement:

> The manufacture of clay brick requires the use of energy to transform raw materials into a durable, sustainable, long-lasting quality building material. Clay brick manufacturers and distributors nationwide operate in a sustainable manner, while minimizing environmental risk and protecting employee health and safety. The clay brick industry understands the importance of reducing greenhouse gas (GHG) and other air emissions and is committed to measures advancing this goal. This includes minimizing energy consumption, pursuing alternative energy sources and improving manufacturing processes and technologies. The clay brick industry encourages balanced policies that protect the environment while allowing for responsible economic growth. Accordingly, the industry will continue to seek ways to reduce emissions in a manner consistent with the affordable production and distribution of quality clay brick.

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