CLAY MASONRY
OF THE EARTH... FOR THE EARTH...

Sustainable Design and the LEED™ Rating System

WESTERN STATES CLAY PRODUCTS ASSOCIATION
Clay masonry can last a lifetime with little maintenance. Historical buildings in the U.S. and throughout the world are a testimony to the longevity of masonry. As a durable building material, clay masonry is an important element in sustainable building design. Sustainable buildings incorporate materials manufactured utilizing resources responsibly. Clay masonry is made from abundant naturally occurring materials that can be found all over the country and world. Some of the other sustainable attributes of clay masonry include: efficiency in manufacturing, constructed walls providing multiple benefits (acoustical, fire resistance, low maintenance and many others), and favorable life-cycle economics. WSCPA hopes to inform you of sustainable design and masonry, and how clay masonry can be an integral part of a LEED®-certified or other sustainable building.

Evaluating Sustainable Design
Sustainable design refers to the design and construction of buildings in a way that meets the needs of today without compromising the needs of the future. Sustainable design considers the economic and social aspects of the design in addition to the environmental impacts and looks to balance this “triple bottom line”. Determining exactly what qualifies as sustainable design is difficult and subjective, but many organizations have tried. The most widely used rating system in the U.S. is the LEED® Rating System. Other tools used to try to measure sustainable design include, but are not limited to, Green Globes™, the National Green Building Standard™ for residential construction and various state green building programs. In addition, LEED Canada has also developed a rating system that is slightly different from the U.S. version of LEED.

Green Globes is a building rating system promulgated by the Green Building Initiative. First developed in Canada and based on European green building rating system, Green Globes is available in an U.S. version. Green Globes is an online building and management environmental audit for
commercial construction. It allows for either self-assessment or third-party verification of a building’s design and construction. A consensus standard based on the online Green Globes is currently under development.

The 2008 National Green Building Standard™ (ICC 700) is an ANSI-approved standard for residential green building developed by a consensus stakeholder group in partnership with the National Association of Home Builders (NAHB) and the International Code Council (ICC). The National Green Building Standard evaluates single-family and multi-family residential development in six different categories that are designed to reward sustainable building practices in residential construction.

The LEED Rating System is a tool for assessing the energy and environmental impact of buildings that was developed by the U.S. Green Building Council (USGBC). LEED stands for Leadership in Energy and Environmental Design, and the purpose of the LEED Rating System is to lead market transformation in the building industry. The LEED Rating System is a voluntary rating system that provides a third-party certification to define what constitutes a “green” building.

The LEED-NC Canada rating system is based on the U.S. version. Some of the most notable differences for building products are that LEED Canada-NC includes a credit for utilizing durable materials, recognizes differences in method of transport for building products, and uses a specific recycled content calculation for products utilizing cement replacements (supplementary cementing materials).

While each of these rating systems is slightly different in content and approach, there is general agreement on the importance of evaluating:

- energy efficiency
- water efficiency
- land use (sites)
- materials and resources (resource efficiency)
- pollution (global impact)
- indoor environmental quality (health and well being)
- transport
- operations and maintenance

Sustainable Strategies with Clay Masonry

Energy Efficiency
Sustainable design encourages efficient use of energy in buildings. In this way the demand for energy is reduced, and the pollution associated with energy production is reduced. Clay masonry can play a significant role in reducing the heating and cooling energy used by a building. Clay masonry and other masonry materials have high thermal mass. Using clay masonry in the exterior walls and exposed on the interior walls and floors, reduces temperature swings in conditioned space, stores heat/cooling for release at later times and reduces peak energy loads.

Utilizing an energy modeling program such as DOE-2 or EnergyPlus allows a designer to take full account of the advantages clay masonry has to offer. Building designs incorporating passive solar strategies further reduce the amount of outside energy needed. The thermal mass of masonry is a necessary component in passive solar designs to store energy harvested from the sun and moderate temperature swings.

Water Efficiency
The category of water efficiency examines water usage of a building. Water efficiency strategies might include reduction or elimination of landscape irrigation, the use of waterless urinals, and the use of water efficient plumbing fixtures. Clay masonry does not typically have a role in water efficiency strategies.

Land Use (Sites)
The very broad category of land use issues associated with sustainable design includes such items as stormwater and erosion, site/habitat disturbance, urban development,
brownfields, heat island effects and utilizing alternative transportation. Reduction in the quantity of runoff is one of the most effective means to reduce, control and treat stormwater and prevent erosion. One highly recommended strategy is the use of permeable pavements in lieu of the typical paved surfaces on building projects. These areas may include parking lots, driveways, sidewalks, plazas and other paved areas. Pedestrian and light traffic areas are particularly suited to the use of permeable pavements. Clay paver systems can be designed to allow for water to penetrate and drain through the pavement and soil below, thus reducing the amount of runoff and also treating the water that filters through to recharge the groundwater. These mortarless pavements have the advantage of being durable, colorfast and easy to repair if needed.

Utilizing reflective units for pavements can also provide a reduction in the heat-island effect. The heat island effect is extra heat retained around a building, particularly in urban areas, due to the presence of a large amount of dark colored surfaces such as found on asphalt roads, parking lots, and roofs. Reflectance is measured by the Solor Reflective Index, or SRI. Materials with a Solor Reflective Index of 29 or higher are considered beneficial in reducing the heat island effect. Because color alone does not indicate solar reflectance, light colored, buff and red units can all have a Solor Reflective Index of 29 or higher, depending upon composition.

Sustainable design also encourages minimizing the impact of construction on the building site. Building in areas with existing development and infrastructure takes advantage of investments already made in buildings and infrastructure, minimized the impacts associated with new roads, and often encourages revitalization of downtown areas. Clay masonry is particularly suited to construction in urban areas. Clay masonry blends well with many existing downtowns, can be configured to unusual footprints easily, provides the fireproof material needed for infill construction, and requires minimal staging areas and space during construction.

In addition, because of its small unit size and the minimal construction space needed, clay masonry can be a key strategy in minimizing the amount of site disturbed during construction in more open, natural areas.

Materials and Resources (Resource Efficiency)

There are three distinct aspects of materials to be considered in a sustainable design: reuse of materials and buildings and the durability of each; efficient use of materials (includes construction waste and resource efficiency); and material manufacturing.

Reuse
One of the basis tenants of sustainable design is to first reuse whenever possible. Reuse of materials and buildings reclaims the embodied energy, raw materials, and other components for a new life. Material reuse includes use of salvaged materials in new construction or for new uses. Mortarless clay pavers can easily be reclaimed and reused. Clay brick bonded with mortar can be salvaged and reused if certain precautions are taken. Care must be taken to remove all traces of old mortar from salvaged units so that proper bond with new mortar can occur. In addition, historic units, particularly those taken from building interiors, should be carefully evaluated to ensure satisfactory performance in exterior applications. Older units may not be as durable as newly manufactured brick.

Whole buildings can also be reused. Clay masonry buildings are particularly attractive and are often renovated and reused. Many developers find the exposed brick masonry interiors common in older brick buildings a desired feature.

Of course, for reuse to occur, one must start with durable materials. LEED Canada-NC includes a credit for creating a durable building – one whose predicted service life exceeds the design service life established in CSA S478-95 (R2001) – Guideline on Durability in Buildings. Clay masonry is a durable material whose service life is often more than 100 years.

Resource Efficiency
Resource efficiency is defined as using resources efficiently, reducing or eliminating waste and utilizing materials that can serve more than one function. Clay masonry excels in this area. Because of the small unit size, construction waste can be nearly eliminated on projects by utilizing modular brick units and modular openings in walls. By considering coursing and the modular nature of brick when laying out doors, windows and other openings in a masonry wall, odd cuts

Fossil Trace Golf Club is one of Denver, Colorado’s premier public golf courses designed by renowned golf course architect Jim Engh. Located in Golden, Colorado - Fossil Trace Golf Club is nestled adjacent to the foothills of the Rocky Mountain Front Range on a
and waste pieces can nearly be eliminated.

Unused brick can be reused on another project or donated to a charity such as Habitat for Humanity. Broken or waste brick can be crushed and used as landscape chips. Waste brick can also be safely used as fill since brick is inert.

Another often overlooked aspect of resource efficiency is using one material to perform several functions. Clay and other types of masonry are unique as compared with other building materials in the synergypossibility with using a single material. Clay brick provides an attractive finish without painting or coating. It moderates temperature swings on the building interior. It is fireproof. It blocks sound transmission. It is resistant to hurricane and wind damage. When used on the interior as well as the exterior, clay masonry walls provide double benefits. Furthermore, clay masonry walls combine all of these functions without special construction. For example, to equal the sound transmission performance of a 6-inch single wythe clay masonry wall, a wall made

transportation, manufacturing, packaging and transportation to the jobsite. In some cases, even demolition and recycling/reuse are considered. Because life cycle assessment can be difficult and costly, it is not yet commonplace. However, many aspects of life cycle assessment can be evaluated to give a better understanding of the sustainability of a building product.

Recycled content of building products is one area that information is becoming more widely available, and the use of products containing recycled content is encouraged in the various green building rating systems. Brick culled from the manufacturing process, though not considered recycled content, are reused in the manufacturing of clay units. Clay brick may also contain colorants, grog or other additives from a recycled source. One clay brick manufacturer has used waste manganese from a battery manufacturer to provide color to the brick. Other examples of recycled or waste materials used in clay brick include contaminated clay, sludge, soils otherwise headed to a landfill, recycled glass, and scrap materials from a porcelain manufacturing plant.

reclaimed clay mine from Lakewood Brick & Tile Company. This is a great example of how beautiful, green and innovative ideas have come from the clay mine reclamation process, having a positive impact on the surrounding environment.

with gypsum board must use special materials or techniques to achieve the same result. [Ref. BIA Tech Note 6A and Sound, Noise & Vibration Control, by Yerges] This is especially important in school construction.

Another area of resource efficiency occurs when clay masonry walls are prestressed. Prestressing capitalizes on the inherent compressive strength of structural clay masonry. Prestressing allows for thinner wall sections, resulting in larger interior square footage. Similarly, reinforced clay masonry reduces the amount of materials needed, thereby reducing the energy and pollution expended, and increases the usable building space. The use of structural clay masonry can reduce the overall quantity of material required for a job as the clay masonry can serve both as a load bearing structural element as well as a finished, low maintenance, durable exterior.

Material Manufacturing
Consideration of how materials are manufactured, how raw materials are obtained, and the effects on the environment in this process is an important element in sustainable design. The efforts to evaluate the myriad of environmental effects in the manufacturing process is known as life cycle assessment, or LCA. LCA examines the effects on the environment (contamination and use of water, soil, air, raw materials, etc) for a given building product from raw material extraction.

The mortar used in clay masonry may also contain recycled materials. Most often a cement replacement, such as fly ash, is used for a portion of the Portland cement in the mortar mix. The same is true of grout.

Other aspects of manufacturing that are sustainable include the use of waste heat from kilns in other stages of manufacturing, thus avoiding the need for secondary heat sources. In some cases, waste heat is used to co generate electricity. Other sustainable practices include capture and reuse of plant run-off water in the plant or for irrigation purposes leading to a dramatic reduction in the amount of water used, and utilization of nearly all raw materials with little or no waste.

Some brick manufacturers are also investigating use of alternate fuel sources. Methane from landfills and gas made from grass clippings are just some of the possibilities.

In addition, brick is made from some of the most abundant materials on earth – clay and shale – not from a scarce resource.

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buildings occurs when moisture enters areas it should not be, and may go undetected for a long period of time. Like VOC’s, mold can cause irritation and illness for occupants.

Many building products contain cellulosic (wood or paper) components that provide food for mold. Brick masonry is not a food source for mold and cannot be “eaten away” by it.

**Pollution (Global Impact)**

Trying to assess the amount and types of pollutants and their impact on the global environment is important in evaluating the sustainability of a building product. Clay brick manufacturing has changed considerably in the last 5 to 10 years. Pollution controls have dramatically reduced discharges to the air. Efficiencies in the kilns have reduced the amount of energy needed to manufacture brick. Other examples of improved efficiencies and recycling in the manufacturing process also reduce the environmental impact.

Many clay brick manufacturers have made efforts to improve the environment by creating lakes and wetlands from reclaimed clay pits.

**Indoor Environmental Quality**

Indoor environmental quality is important because we spend nearly 80 percent of our time indoors according to estimates from the U.S. Environmental Protection Agency. Clay brick offers many benefits to the indoor environment. As pointed out earlier, brick offers superior acoustic performance with standard construction methods. Buildings built with brick have quieter interior spaces.

Air quality is also important. Brick, unlike many paints, carpets and other wall and floor coverings, does not contain any volatile organic compounds (or VOC’s) and does not require any coatings. VOC’s that are present in many wall and floor materials and coatings can cause irritation, headaches, and sickness for occupants.

Air quality can also be affected by mold. Mold in

**Transport**

Transportation associated with building products includes transport of raw materials to the location of manufacturing, transport of materials at a manufacturing site, and transport of building products to the job site. Transport by rail and ship are generally agreed to have a lesser impact on the environment than transport by truck. In some cases, such as with LEED Canada-NC, this difference is reflected in the rating system.

Clay brick manufacturers are located throughout the U.S and the manufacturing plants are usually located adjacent to or near clay mines, minimizing the transport of raw materials.

**Operations and Maintenance**

Costs associated with operating and maintaining a building usually exceed the costs of constructing the building. These costs include monetary costs, as well as energy costs and environmental costs. For this reason, sustainable designs try to minimize operation and maintenance costs.
Clay masonry is a low maintenance material, whether an interior or exterior application. Clay masonry exteriors do not require painting or cleaning on a regular basis, thus avoiding the monetary, energy and environmental costs associated with other siding materials. Glazed units are often used on building interiors in applications where easy cleaning is a priority such as in restrooms and kitchens.

Because of its durability and long life, clay masonry is unlikely to ever need replacement. Periodic maintenance of the mortar joints may be necessary, but usually not for 40 years or more.

Clay Masonry and Sustainable Design

Overall clay masonry can play a significant role in strategies used to achieve a sustainable building design. Furthermore, clay masonry buildings themselves are more likely to be reused by future generations. By taking advantage of the synergy possible with clay masonry, a truly resource-efficient building can be created.

The LEED™ Rating System

The most widely used rating system in the U.S. is currently LEED-NC for New Construction and Major Renovations. The current version, LEED 2009, is organized into seven categories. Most of the points are contained in the five environmental categories: sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality. There is also an innovation and design category to recognize exceptional performance or areas not covered in the other categories and a category for regional credits unique to a particular locale. Each category may contain mandatory prerequisites as well as voluntary credits that are worth points toward a building project’s certification. Figure 1 shows the percentage of points in each of the seven categories.

Certification

A building project must earn at least 40 points out of a possible 110 to be LEED 2009 certified. In the LEED Rating System, the more points a building project earns, the “greener” the building (or the smaller the negative impact of the building on the environment). The USGBC recognizes four levels of LEED certification.

The manufacturing process to make clay masonry is very efficient with almost no waste of materials. To reduce environmental impact, all unused clay is recycled and modern pollution controls have significantly reduced any production air discharges.

The finished product... Sustainability is a must for all green buildings and clay masonry offers performance second to none. Unlikely to ever need replacement, clay masonry can be utilized on buildings with a very long life expectancy.
Earning LEED Points

Clay masonry can make a significant contribution toward earning LEED points on a project. While no one product or material alone can earn LEED credit points*, clay masonry can be used as part of a strategy to earn points in 15 credit categories.

Sustainable Sites

Credit 2 – Development density – masonry used for urban infill development
Credit 5.2 – Reduced site disturbance – masonry used to minimize the footprint of the development
Credits 6.1 and 6.2 – Stormwater management – permeable pavements used to reduce the rate and quantity, and improve treatment of, runoff
Credit 7.1 – Non-roof Heat Island – pavers with a Solar Reflectance Index of 29 or higher help reduce the heat island effect

Energy & Atmosphere

Prerequisite 2 – Minimum energy performance – masonry can mitigate temperature swings and help achieve the required energy performance
Credit 1 – Optimize energy performance – clay masonry can be used as part of a passive solar design to further reduce the amount of energy consumed by the building

Materials & Resources

Credits 1.1, 1.2, 1.3 – Building reuse – clay masonry buildings are good candidates for reuse
Credits 2.1 and 2.2 – Construction waste management – capitalizing on the modular nature of clay masonry can nearly eliminate waste; scrap materials can be crushed and used as landscape chips
Credits 3.1 and 3.2 – Resource reuse – salvaged brick can be reused with careful consideration
Credits 4.1 and 4.2 – Recycled content – clay masonry may incorporate recycled materials as colorants, grog or aggregate; clay masonry is inert so recycled materials are safely encapsulated
Credits 5.1 and 5.2 – Local/regional materials – clay masonry is locally produced and raw materials are mined locally

Indoor Environmental Quality

Credit 4 – Low-emitting materials – clay masonry meets the intent of eliminating VOC’s from the indoor environment when exposed as interior walls or floors.

Innovation and Design

Up to 4 points: Clay masonry can help earn points for good acoustics; use of durable materials; good indoor environmental quality (no-VOC; no mold); resource efficiency (using one material to achieve multiple goals)

*Certified wood is the only product that can earn 1 point through its use under Materials & Resource Credit

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