Historic Masonry

Restoration and Renovation

The Gerding Theater at the Armory, in Portland, Ore., the country's first LEED Platinum historic renovation and first LEED Platinum theater, involved extensive brick restoration work. Originally constructed in 1889, it now accommodates a 599-seat main-stage theater and a 200-seat black-box.

Learning Objectives

After reading this article, you should be able to:

- ✔ Discuss the basic issues affecting the restoration of historic brick structures.
- ✔ Describe the characteristics of natural stone and historic mortars that must be considered in renovation and restoration projects.
- ✔ Explain the basic details and installation techniques for proper application of manufactured cast stone.
- ✔ List three ways to prevent moisture-related defects in masonry and brick walls.
- ✔ Explain the benefits of stone and brick for sustainable building projects.

By C.C. Sullivan and Barbara Horwitz-Bennett

Historic restoration and preservation efforts are accelerating throughout the U.S., thanks in part to available tax credits, awards programs, and green building trends. While these projects entail many different building components and systems, façade restoration—as the public face of these older structures—is a key focus.

Recognizing this, seasoned architects and consultants often spend much time analyzing and evaluating an existing structure with the goal of best preserving the original façade design.

According to Andrew Wolfram, AIA, LEED AP, a senior associate in the San Francisco office of Perkins+Will, such projects often start out with a longer pre-design phase than in new construction. "At the initiation of the project, we conduct a comprehensive due diligence analysis of the building," says Wolfram. "We start with an analysis and evaluation of historic drawings and specifications, all the way through archival research."

The next step, says Wolfram, who has spent most of his 20-year career on historic preservation projects, is an overall "binocular survey" of common

A coquina stone façade on a 1797 Spanish Colonial structure in St. Augustine, Fla., is inspected prior to patching.

signs of exterior aging. For a masonry buildings—and taking into account local site conditions—this visual inspection includes the overall condition of visible stone, mortar, and grout, as well as such conditions as:

- Delamination.
- Efflorescence.
- Spalling.
- Steel lintel failure.

During this assessment, says Joseph K. Oppermann, FAIA, a Winston-Salem, N.C.-based historic preservation consultant, "We look for the patterns of deterioration as they point to weaknesses in the design or the use of materials. We also look to the patterns of maintenance and repairs, as the location and frequency of repairs tell us a lot as to the areas of the building most susceptible to problems."

One key to a successful predesign inspection, says Robert Mack, FAIA, a principal with MacDonald and Mack Architects, Minneapolis, is taking the time to do a proper evaluation. "Go slow!" he advises. "The building probably has been there for many years, and taking the time to do tests and evaluate the results won't lead to significantly more deterioration."

According to experts like David A. Vottero, AIA, senior associate and director of architectural design, and Brian E. Kiggins, AIA, senior associate, SchooleyCaldwell Associates, Columbus, Ohio, facilities personnel who have known a building for some time can be extremely helpful to Building Teams who are investigating an existing structure. For example, the project leaders can inquire about things like past repairs, the history of problems in various portions of the

Adaptive Reuse Case Study

Architecture firm Perkins+Will is turning a 1930s San Francisco Public Health Service Hospital in the city's Presidio district into a 22,000-sf apartment building. Tapping into historic tax credits and tracking for LEED Gold certification, the program for this unique adaptive-reuse project includes restoring historic brick and stone façades on the Georgian revival structure.

"We are currently working with the contractor to select appropriate infill materials at areas where historic masonry had been removed in prior renovations of the building," says Andrew Wolfram, AIA, LEED AP, a senior associate in Perkins+Will's San Francisco office. Glass-fiber-reinforced polymer panels have been selected to emulate terra cotta and limestone in larger decorative areas. The panels can easily be molded from existing details. However, for smaller areas at a historic entrance portico, "We have found that it is less expensive as an infill material to use Indiana limestone," says Wolfram. In order to boost the façade's energy efficiency, an interior stud wall with insulation has also been specified behind the brick wall.

Rendering of Public Health Service Hospital's rehabbed entry portico.

The $71 million project, slated for completion this fall, will convert the space into 161 residential units, a management office, a fitness center, a private dining room and wine bar, and other tenant amenities.

Façade restoration in progress at the historic PHS Hospital. Built in the 1930s, the hospital is being converted into a 22,000-sf apartment building.

A stucco veneer at Charleston's Market Hall, original constructed in 1841, is being repaired.

building, as well as leak locations.

Another important part of the early project evaluation is materials testing. This may include positively identifying things like sand gradation and color, as well brick compressive strength and mortar strength. Even so, Mack stresses the importance of being practical: "For many buildings, for example, the bricks and mortar can be adequately evaluated using a simple hardness-classification tool rather than expensive laboratory tests."

Similarly, Oppermann, past chairman of the American Institute of Architects Historic Resources Committee and a founding member of the AIA Preservation Education Task Group, says, "With most materials and construction techniques, architects can handle much of the identification and assessment process themselves, using testing laboratories for some analyses and the manufacturers of the materials for collaboration on solutions."

However, more complex or historically significant projects do call for experts such as a historic architect or architectural conservator, whose experience and training in materials and methods of construction, code compliance, and architectural history should benefit the project. As for tracking down a credentialed professional ideal for a given project, referrals can be procured from state historic preservation offices, the American Institute for Conservation of Historic and Artistic Works, the Association for Preservation Technology, or local AIA offices, according to Mack, a professor at the University of Minnesota School of Architecture whose career spans more than four decades devoted to historic preservation.

Another useful resource is the AIA Historic Resources Committee's Guide to Historic Preservation, which gives a good overview of key players to strengthen the Building Team as well as the various stages of a typical historical preservation project.

National Conference on Preservation Technology

The Association for Preservation Technology will hold its annual conference November 2-6, 2009, in Los Angeles. In addition to workshops, symposiums, and exhibits, field sessions will feature Frank Lloyd Wright's Textile Block houses in Hollywood Hills, Pasadena's Arroyo Seco Landmarks , and Mid-century Houses by Rudolf Schindler and Richard Neutra. More information: www.apti.org.

HISTORIC RESTORATION: BRICK

Once an overall assessment is completed, it's time to analyze the extent of observable or reported damage and the potential causes of its harmful effects. For brick structures, Daniel Friedman, a Poughkeepsie, N.Y.-based consultant specializing in construction, environmental testing, and inspection, offers a brief diagnostics punch list. Highlights for historic brick subjects include:

- Bulging brick walls can be caused by bond-brick or bond-course failures, which are dangerous and require urgent attention.
- Cracks and bulges may indicate frost and earth loading, which can push a below-grade brick foundation wall inwards.
- Cracks and loose bricks are caused by frost, settlement, and expansion, often found at building corners where roof spillage is concentrated.
- Loose bricks and missing or lost mortar are common and have various causes.
- Spalling can occur when water and frost expand behind the brick's exterior surface, leading to cracks where a brick has lost its hard surface or at openings by window and door penetrations.
- Exfoliating rust damage can occur due to improper caulking that traps moisture—for example, between the brick and a steel lintel over a window or door.
- Improper repair mortar has many deleterious effects, including surface spalling, and occurs when a high-Portland-content mortar is used on soft brick in a climate subject to freezing weather conditions.
- Sandblasting bricks often results in a permanently damaged brick surface, and is considered to be poor practice in building renovation and maintenance.

Once problems are identified, possibilities for replacing and restoring the brick can be considered. Meredith Strout, AIA, LEED AP, a senior project manager in the San Francisco office of HOK, describes her firm's general approach: "Our consultants will advise us, but our goal is to preserve, not necessarily restore, what is left of the brick and match the mortar in color, softness, and strength."

As for specific options, Harry J. Hunderman, FAIA, a senior principal with Wiss, Janney, Elstner Associates, Northbrook, Ill., lists removal and reinstallation of original brick as one restoration strategy. Other options include using salvaged brick from elsewhere on the building, reclaiming salvaged brick from other buildings, or finding a matching new brick, which may require custom brick fabrication.

In the opinion of SchooleyCaldwell's Kiggins, resorting to custom brick fabrication should be used only in rare instances. "Given the plethora of options available to designers, it is almost always possible to find an existing brick that works for a given application," he says.

In purely aesthetic terms, blending the old with the new is important, yet as Oppermann points out, "The compatibility of performance characteristics is critical to extending the life of the building." In other words, the repairs and renovations need to be consistent with the original construction technology in order to minimize future maintenance.

Addressing both aesthetics and performance, one of the most common historic preservation approaches is repointing. Because this technique requires skilled handwork, special materials, time, and money, the best approach may be to repoint only where necessary on a wall, rather than repointing an entire wall elevation, says Mack. However, if repointing is required for a good percentage of the wall, then repointing the whole wall often ends up being more cost effective.

Before repointing can begin, the first step is matching the existing mortar, as Jeff L. LaRue, AIA, senior vice president and director of quality management in the Dallas office of HKS, explains: "Repointing with mortar which matches the existing in color, shape, and texture is mandatory for a successful restoration." However, mortar matching can be one of the biggest technical obstacles facing masonry contractors, says Stephan Niewiadomski, vice president of National Restoration Systems, Rolling Meadows, Ill. Fortunately, today's choice of mortar types is more extensive than ever, making it easier to match colors.

According to Kiggins, "One aspect of mortar that should not be overlooked is the color and size of the aggregate," which can have a big impact on the overall appearance of the mortar. "Finding a source for a matching aggregate is critical in many instances because it adds to the overall appearance of the mortar."

As described in a technical paper that Mack co-authored for the National Preservation Society, the new mortar must either have greater vapor permeability and be softer (as measured in compressive strength) than the masonry units, or the new mortar must be as vapor permeable and as soft or softer than the historic mortar.

Offering some general guidelines for choosing mortar types based upon when the original façade was constructed, Mario Cantin, president of the East York, Ont.-based brick-and-mortar specialty contractor Invisible Tuckpointing, explains:

- Buildings constructed before 1872 should be repaired with a traditional lime-based mortar consisting of lime, sand, and some color pigment.
- If the building was built between 1873 and 1932, mortar made from lime, some Portland cement, sand, and color pigment should be used.
- For structures built between 1932 and 1945, a Portland, lime, and sand mix works well.

Mortar Types (measured by volume)

ASTM Designation	Cement	Hydrated lime or lime putty	Sand
Type M 2,500 psi	1	1/4	3 to 3¾
Type S 1,800 psi	1	1/2	4 to 4½
Type N 750 psi	1	1	5 to 6
Type O 350 psi	1	2	8 to 9
Type K 75 psi	1	3	10 to 12
Type "L" (lime and sand)	0	1	2¼ to 3

SOURCE: National Park Service

The ASTM designates five mortar types, each with recommended mix proportions, to aid in distinguishing between high-strength mortars and soft, flexible mortars—and to ensure the right physical properties are achieved. In decreasing order of strength, they are: Type M, S, N, O, K and a Type "L," a straight lime and sand mix.

Suggested Mortar Types for Different Exposures

Masonry Material	Exposure: Sheltered	Moderate	Severe
Very durable: granite, hard-cored brick, etc.	O	N	S
Moderately durable: limestone, durable stone, molded brick	K	O	N
Minimally durable: soft handmade brick	"L"	K	O

Source: National Park Service Preservation Brief, "Repointing Mortar Joints in Historic Masonry Buildings"

Mortars for historic preservation projects must be selected according to the type of masonry material and anticipated exposure.

The fine art of repointing arches at Market Hall in Charleston, S.C.

• For structures built after 1945, a modern cement-based mortar is most appropriate.

Once the mortar is selected, the next step is removing the old mortar, which should be done up to a minimum depth of at least two times the width of the joint, instructs Mack in the NPS brief. Although the use of hand chisels and mash hammers is the least intrusive way to remove the mortar, it is quite labor intensive. On the other hand, power saws and grinders, although commonly used, can cause extensive damage to the historic masonry, especially if operated by unskilled masons. As a compromise, Mack recommends small pneumatically powered chisels operated by skilled masons.

Next, the mortar should be measured and mixed carefully—first the dry ingredients followed by the water—to best achieve visual and physical uniformity, says Mack. The joints are then filled, starting with those deeper than one inch. The mortar should be applied a quarter-inch at a time, until it reaches thumb-print hardness before the next layer goes into the joint. This step-by-step process, which continues until the joint is flush with the outer surface, helps minimize shrinkage, as most mortar shrinkage occurs during hardening, according to Mack.

Once the final layer is thumb-print hard, it can be tooled to match the historic joint. Upon completion, the wall should be covered for three days and periodically watered to maximize the bond strength which develops during the drying process.

STONE MASONRY RESTORATION

Although the beauty and longevity of stone has made it a great veneer choice, in recent years a number of factors have been chipping away at its durability. For example, building owners are sometimes quick to take advantage of newer material and style options by choosing stone imported from outside the local climate and building vernacular. Second, the reduced thickness of modern-day veneers leaves less room for error. Third, the availability of skilled designers and masons has not kept pace with the growth in stone façade work.

Yet another common cause of deterioration is incompatible materials. For example, the varying properties of stone types that absorb heat and water—and expand at different rates—may not be compatible with the original mortar, according to Robert Young, owner of Gothic Stone Restoration, New Haven, Conn. Consequently, Young stresses the importance of specifying similar materials and details with a track record of compatibility with the project site's climate.

When initially approaching historic stone masonry structures, Wiss, Janney, Elstener's Hunderman, an AIA Historic Resources Committee Advisory Group member and past Association for Preservation Technology president, explains that an evaluation requires "a holistic understanding of the structural and cladding systems, and knowledge of the stone's physical characteristics, fabrication methods, and installation techniques."

It's also important to take the time to understand the porosity, hardness, and other characteristics of the specific stone type in use, be it granite, limestone, marble, or sandstone. In his experience, Perkins+Will's Wolfram—who has served on numerous preservation groups, such as the California Preservation Foundation—has seen a lot of structural problems with stone veneers: "Often the stone anchorage system of the original design provides inadequate support, or the support system is in poor condition, and rehabilitation or replacement of the anchorage is required."

In addition, the evaluation process may include research, review of test data from the quarries, laboratory materials, and physical testing of selected samples. Taking it a step further, SchooleyCaldwell's Vottero has worked on projects where quarrying new stone from original quarries was actually required.

As for restoration options, possibilities include repairing or treating existing stone, replacement in kind, dismantlement and reconstruction, anchorage repairs, and repointing, says

Hunderman.

Offering a couple of practical techniques for preserving stone facades, the Standards for Preservation and Guidelines for Preserving Historic Buildings, a National Park Service resource, delineates the following:

• A defective area of masonry can be cut out and repaired using restoration mortar. The area of repair is dampened and where necessary nonferrous reinforcements are fixed into the host area where the repair is required. This area is then restored forward with mortar to its original line and profile.

• Areas of unstable or loose stonework can be consolidated using grouting or pinning techniques. Grout is pumped into the unstable structure to bind the masonry together while producing what is in effect an invisible repair. Pinning can be used to fix loose pieces of masonry to the main structure and improve the stability of the substrate.

In some cases, it's possible that a simple cleaning may be all that's required. As the consultant Oppermann says, "Often a brick or stone building will take on a completely new appearance when given a gentle cleaning."

However, care must be taken not to damage the surface with sandblasting or high-powered pressure spraying, says Young. Acidic cleaners also can eat away at the stone and compromise the color. Instead, water cleaning is considered the gentlest and safest way to remove dirt from the façade. For additional information on cleaning masonry facades, refer to "Assessing Cleaning and Water-Repellent Treatments for Historic Masonry Buildings," another excellent NPS Preservation Brief co-authored by Mack

TURNING TO MANUFACTURED STONE?

Although a departure from historical building materials, manufactured stone is becoming a more popular alternative. Giving the appearance of natural stone, manufactured veneer is much lighter, possibly obviating the need for wall ties and footings. The product is usually available at between one-third and one-half the cost of natural stone.

As a growing market sector, top industry players recently formed the Masonry Veneer Manufacturing Association. Out of concern that manufactured stone was being improperly specified, detailed, and installed—typically in ways associated with brick and natural stone walls—MVMA's member companies came together to begin developing their own set of standards to maximize the performance and longevity of manufactured veneer. Although this process is still under way, the current lack of industry standards makes it important for designers to look to manufacturers for guidance in selection and detailing, says Wiss, Janney's Hunderman. "Interface details and anchorages are important to their serviceability, and are highly design-dependent," he adds.

While many of these products are relatively new, their basic performance characteristics are well understood. For example, while cast stone can add to the load-bearing capacity of a masonry wall, this is not the case with adhered veneer, which is simply applied to a structural wall with an adhesive. Moreover, veneer generally should not be adhered directly to building sheathing, such as plywood or oriented strand board, because it can trap moisture or inhibit drying within the wall.

Also crucial is the choice of mortar, which makes up about 20% of the wall's visible surface. For instance, by matching mortar color to local stone or earth, the building design can go a long way toward lending a natural look to the manufactured veneer and better enabling it to blend into the surrounding environment, according to Michael Chusid, RA, FCSI, a principal with Chusid Associates, Tarzana, Calif.

Lastly, construction crews should be well-versed in system installation. For example, one particular problem in assembling manufactured-stone walls can be dealing with very hot or very cold weather conditions. With hot weather—defined as above 90ºF—the biggest concern is the evaporation of water, which will compromise the bond created between the stone and mortar during the setting process.

According to the Lebanon, Pa.-based Cast Stone Institute, there are two measures that can be taken to address this issue: 1) ensure that the mortar contains sufficient water when the units are laid, and 2) store cast stone units and sand in the shade. In addition, prior to mixing, sand piles

Fly-ash Brick: Next Big Thing?

One interesting new product, fly-ash brick, will soon be available for use in construction, says Michael Chusid, RA, FCSI, a principal with Chusid Associates, Tarzana, Calif. He says the product will have about 10% of the carbon footprint of clay brick. "Fly ash is a smokestack waste product, normally disposed of in landfills or retention ponds, so by reusing it as a cementitious material and incorporating it into building products, this stabilizes it and takes pressure off the landfills," he says.

Sustainable bricks manufactured with fly ash have a lower carbon footprint than conventional bricks and come in a variety of colors.

should be kept damp. In cold weather conditions, below 40ºF, the mixing water and sand must be heated to prevent mortar expansion and cracking when the weather warms up.

While SchooleyCaldwell's Vottero acknowledges that manufactured stone has come a long way in recent years, he cautions against overusing it. "The installations in which manufactured stone has worked the best for us are ones where it is a supporting member of the cast, not the star of the show," he contends. "Because the material is relatively affordable, it often gets overused, but a little bit goes a long way."

MASONRY AND MOISTURE CONTROL

Another serious concern with manufactured veneer, as with traditional assemblies like brick and stone, is moisture control. According to Construction Specifications Institute (CSI) founder and past president Bill Russell, a cavity/drainage wall is the most effective way to protect cast stone from moisture. Made up of five basic elements, the wall includes 1) an exterior wythe of masonry, 2) a clear cavity or air space of at least one inch, 3) an interior wythe of masonry or other backing material, 4) flashing at all interruptions in the drainage cavity, and 5) weep holes at all flashing locations.

Another important moisture-combating component is the water-resistive barrier, which needs to be integrated well with flashing, says John Woestman, the Masonry Veneer Manufacturing Association's director of codes and standards.

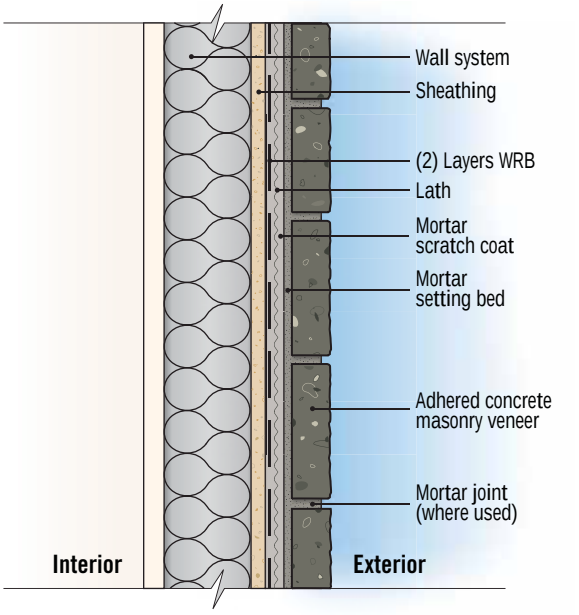
When dealing with natural stone, proper detailing of key elements—namely coping stone widths, projection pitches, and drip profiles—are effective in helping maximize the wall's ability to shed water. With flashing and weeps installed at key points within the masonry to better manage water flow, Young recommends observing a newly constructed stone façade to make sure it's shedding water as intended. If something is misaligned, flashing or masonry details can often be adjusted to compensate.

According to HKS's LaRue, particular attention should be paid to the mortared areas of the walls, as this is where the majority of air and moisture migration will occur.

For a comprehensive guide to moisture management with brickwork, consult the Brick Industry Association Technical Note, "Water Penetration Resistance – Materials." Important moisture-combating points listed in the note include:

- The use of quality construction and compatible materials in brickwork.
- Selection of a mortar or grout to create the most complete bond with the specified masonry units.
- Inclusion of a water-resistant barrier in exterior walls when brick veneer is anchored to wood or steel framing.
- Proper detailing and installation of flashing materials that are waterproof, durable, and resist puncture and cracking—during and after construction.
- Including drainage materials and mortar diverters when there is a high probability of mortar falling into the air space within the cavity wall; otherwise the mortar could bridge the air space or block weeps.
- Employing effective sealants to prevent water penetration around openings in masonry walls.

Typical Masonry Veneer Wall Section



Source: Masonry Veneer Manufacturer's Association Installation Guidelines for Adhered Concrete Masonry Veneer, p. 17 http://www.masonryveneer.org/pdf/mvma030909.pdf

Adhered concrete masonry veneers are often installed with mortar and lath directly on sheathing, although some experts recommend using a drainage layer as well.

SUSTAINABILITY AND MASONRY

When all these details and construction techniques are integrated into a renovation project or new building, the result is a long-lasting, healthy envelope. Not surprisingly, when brick and stone are sized up in terms of sustainability, they score relatively well. "Brick, stone, and manufactured stone have a very long life cycle, and if maintained, are extremely durable materials," says Perkins+Will's Wolfram. Wiss, Janney's Hunderman adds, "Cast stone, a refined form of precast concrete, can also have a very long service life if properly fabricated, installed, and maintained."

Another selling point for brick is that it's made from abundant natural resources, often in manufacturing plants that are located close to mines. Brick and stone also serve multiple building functions, including structural support, energy efficiency, acoustic buffering, indoor air quality, and fire and impact resistance. As Michael Chusid notes, "The thermal

Recommended Flashing Materials

Material	Minimum thickness	Advantages	Disadvantages
Stainless steel	0.01 in. (0.25 mm)	Extremely durable, nonstaining	Difficult to solder and form
Cold-rolled copper	10 ounces/sf (3100 g/sm)	Durable, easily formed, easily joined	Stains adjacent masonry
EPDM	30 mils (0.8 mm)	Flexible, easy to form, easy to join, nonstaining	Metal drip edge required, more easily torn
Rubberized asphalt	30 mils (0.8 mm)	Self-healing, flexible, easy to form, easy to join	Dimensional instability, incompatibility with joint sealant, metal drip edge required
Copper laminates	5 ounces/sf (1500 g/sm)	Easy to form, easy to join, nonstaining	Metal drip edge required, more easily torn

Source: Brick Industry Association Engineering & Research Digest, "Through-Wall Flashing."

A number of flashing materials can be suitable for use on historic and new structures. The key to proper selection is to choose a material with the right properties in proper thicknesses that is compatible with all other products in the façade assemblies.

mass effect helps lower the impact of day-night changes in the exterior ambient temperature." By absorbing and storing heat, both brick and stone veneers help moderate indoor temperature swings, reduce peak heating and cooling loads, and potentially reduce HVAC system size. These benefits are even more pronounced when brick masonry is exposed on the building's interior.

Furthermore, when masonry buildings are renovated or restored, tons of material are kept out of landfills, and these structures keep serving useful social and economic functions.

Another point related to sustainability is that bricks are both recyclable and can be manufactured from recycled materials. For example, salvaged brick is often considered for adaptive reuse projects due to its durability and historic value, although it sometimes comes with a price tag (see "How Viable is Salvaged Brick?," at right) It can be made into brick chips and used for landscaping, or crushed for use as a sub-base material for pavements or as aggregate for concrete. Recycled materials such as sawdust, metallic oxides, and fly ash can be used in the manufacture of new bricks, according to the Brick Industry Association (BIA) Technical Note, "Sustainability and Brick."

With regard to embodied energy, a standard U.S. brick in the 1970s required 14,000 Btu to mine, manufacture, and transport. Today, that figure is about 4,300 Btu, according to BIA figures. Diane Travis, technical director of the Rocky Mountain Masonry Institute, Denver, notes that this number is relatively small when compared to the embodied energy required for steel, aluminum, and glass production.

As for stone, there is reliable sustainability information on quarrying and fabrication for some sources, but not for all of them—in fact, some experts concede that only a fraction of producers provide useful green building data. To begin filling in the gap, the National Stone Council Committee on Sustainability and the University of Tennessee's Center for Clean Products and Clean Technologies are working on a "Natural Stone Industry Environmental Benchmarking Study" to analyze the life cycle of stone. Some initial results rank sandstone as requiring the fewest Btu to manufacture, followed by limestone and granite.

All stone has benefits, ranging from thermal mass to aesthetic and biophilic appeal—and no volatile organic compounds are directly emitted from the production of many stone types, according to Genuine Stone. Best of all, the

How Viable is Salvaged Brick?

Even though salvaged brick is a boon to brick's sustainability and can lend character to restoration and adaptive reuse projects, salvaged materials can be rather pricey. In fact, according to Jeffrey Frake, vice president of Masonry Preservation Group, Merchantville, N.J., the time and labor involved to clean old brick and remove its water content is significant.

If the brick is not be adequately cleaned, which is sometimes that case, there may be inadequacies in the mortar bond as the old mortar does not bond well with the new, according to a Brick Industry Association Technical Note, "Salvaged Brick."

Another potential problem is that hard-burned and soft-burned brick can get mixed up in demolition, creating a single pile of two very different grades of materials. In addition, says the BIA, maintenance costs can add up when disintegrated units need to be cut out and replaced, mortar joints require tuckpointing to reduce leaks and repair cracks, and other waterproofing repairs need to be made.

In spite of these concerns, salvaged brick is being used, not just for preservation and sustainability, but to save on initial building costs, notes Harry J. Hunderman FAIA, senior principal, Wiss, Janney, Elstner Associates, Northbrook, Ill. Ultimately, individual building owners need to weigh the pros and cons in order to decide on salvaged brick vs. new brick for a particular project.

end-product lasts a very long time; practically all stones are commonly reused in landscaping, retaining walls, walkways, and concrete mixtures.

Whether it's due to masonry's longevity, durability, sustainability, or sheer beauty, its popularity continues to grow, as evidenced by the enactment of masonry ordinances in a number of cities across the U.S. For example, Overland Park, Kan., requires 40% brick or stone veneer on all new multifamily and commercial developments. New façades in Aurora, Colo., must be at least 50% masonry—brick, stone, manufactured stone, or cementitious stucco. And in Orland Park, Ill., officials demand that all commercial buildings bear 100% masonry façades.

Looking to boost the value, longevity, and visual appearance of the built environment, communities are opting for masonry, either through ordinances or by investing in historic preservation projects, which restore classic brick and stone veneer. In either case, proper detailing and material choice will ensure they get the most out of their investments. BD+C