Brick or Concrete?

by Gary Kleier
CHTKY.org

Brick or Concrete?

When someone says the word "SIDEWALK", what image comes to your mind? Is it a ribbon of gray-white concrete about four feet wide with scoring about every 4 feet along the way? For many people, that is their first and only image. However, for many of us who live in historic areas, the image is not concrete, but brick.

Until the late 1800s, concrete was unavailable. It was not until 1891, in Bellefontaine, Ohio, that the first concrete street in the United States was paved. Until that time, brick was a major paving material in many cities. As concrete became more available and the techniques for mixing and placing were refined, it became a very desirable material for paving purposes. In truth, concrete roadways have a lot of advantages over brick. They are much smoother and they are far less labor intensive to place. With the exception of longevity, it would be the rare occasion when a brick roadway had an advantage over concrete.

Unfortunately, without thinking about the consequences, many U.S. city officials accepted concrete as a superior product for all circumstances. For almost a hundred years cities have been ripping out perfectly good brick sidewalks and replacing them with concrete. In some cities, if you wanted to place a brick sidewalk, you first had to pour a concrete sidewalk and then place the brick over it. It wasn't until the last few decades of the 20th century that some cities began to stop this practice in historic areas. But as of this writing, I am unfamiliar with any city that installs brick sidewalks, over a bed of sand or gravel, anywhere but in the historic districts. If anyone does know of such a city, please let me know.

Before you write me off as a brick salesman, lets set the record straight. As an architect, I am frequently called upon to perform value engineering. That is, what is the best product for the job based upon the cost over the life of the product, not just the first cost. And therein is my argument. Based upon first cost, concrete sidewalks will usually be about 1/3 the cost of brick. However, based upon the life of the product, and the circumstances under which it is used, brick will frequently be the winner and by a large margin. Why? Life expectancy and maintenance.

Figure 1
Figure one shows one of the entrances to Central Park in Louisville, Kentucky. This historic park was completed in 1904. While the brick sidewalks work just as well today as they did 100 years ago, look at the handicapped curb ramp that was installed about 30 years ago. The severe cracking is not a recent occurrence. It has looked that way since I moved into the neighborhood in 1978. Had this ramp been installed in brick, the same brick that was removed from the sidewalk and discarded, we would not have been looking at this ugly mess for 30 years.

Figure 2
The sidewalk shown in Figure 2 was replaced about three years ago. The tree roots had cracked and displaced the sidewalk, causing a woman to trip and seriously injure herself. How long before that occurs again? The original "repair" took several days and probably cost over $1000. How soon will it need "repairing" again and at what cost? If this sidewalk were brick, the initial repair would have taken only a couple of hours at a cost of less than $100 and could be repaired again today for less than half of that.

Figure 3
Figure three shows a section of sidewalk along Oak Street in Louisville, Kentucky. Each section of concrete in this figure is approximately 4 feet square. To repair the damaged and displaced concrete surrounding the tree on the right side of this figure will require the removal of at least 7 of the concrete squares. The cost: about 20 to 30 times the cost of repairing a brick sidewalk and probably two to three days of time. That means this entire sidewalk will be closed to pedestrians for two to three days, a driving lane of the street will be blocked while the work takes place and the restaurant adjacent to the site will endure the sound of jackhammers for hours. If this were a brick sidewalk, the entire repair would require only a few hours, would not block the street, and it would make virtually no noise.

Figure 4
Figure 4 again shows a section of sidewalk along Oak Street. Notice how much area is available for rainwater to enter the ground. It is fortunate that the water table in this area of Louisville is relatively high and the sandy soil makes it easy for the tree roots to penetrate. But what about street trees that are not so fortunate? A brick sidewalk, laid over sand or gravel, allows a significant amount of rainwater to enter the ground. As an additional benefit, puddles tend to disappear in minutes rather than the hours or days they last on a concrete sidewalk.

After all of this, you probably think I believe brick to be a better sidewalk pavement than concrete. No, I don't. What I do believe is that the unthinking assumption that concrete is a superior product in all situations is wrong.

Here are the major points to consider:

- In terms of durability, brick has a slight advantage over concrete because it can accommodate small amounts of movement without cracking.
- The cost to install a brick sidewalk over a bed of gravel and sand is about 3 times the cost of concrete.
- The cost to repair a concrete sidewalk can be from ten to thirty times the cost of repairing a brick sidewalk
- The time required to repair a brick sidewalk is very little compared to concrete, it requires no heavy equipment and is relatively quiet.
- Brick is more environmentally friendly than concrete because it allows some amount of rainwater to enter the ground where concrete will not.

- Brick can be recycled where concrete cannot.
- Where esthetics are a concern, brick is probably more desirable than concrete.

For the home owner there can be additional advantages:

- Brick paving is an easy do-it-yourself project.
- Compared to concrete, mistakes in brick are easy to correct.
- Bricks don't harden on you while you are eating lunch, and a sudden rain storm does no damage.
- Laying brick in sand or gravel is something anyone can do if they will take a few minutes to read the simple instructions you will find on this web site. http://www.oldlouisville.com/

You might also want to check the article on repairing brick sidewalks also on this web site.

For those of you who desire more information, I suggest you visit the web site of the Brick Institute of America (BIA). They can be found at:

http://www.bia.org/ Check technical publications 14 and 14A.

Brick Sidewalk Repair

by Gary Kleier
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One of the problems / advantages of brick sidewalks is that they can move. It is a problem because they can become a tripping hazard. It is an advantage because, unlike concrete, brick is easy to repair. Believe me, this is not rocket science. By the time you finish reading this short article, you will be ready to tackle your first repair job with confidence.

The first things are the tools. Figure 1 shows several basic things that will make life a little easier. From the left:

- A margin trowel for slipping down between the bricks and working them loose.
- A mason's hammer for chipping off small pieces of brick.
- A dead blow hammer or rubber mallet for convincing the brick to lie flat.
- Ear protectors if you need the item in figure 2.
- Not shown in the photograph, but very important if you intend to chip or cut brick, are protective glasses

If you need to cut brick, and you probably will not, you may want to purchase a masonry blade for your circular saw. These are relatively expensive and I don't recommend it unless you really think you must have it. Like I said, you will probably not need it.

Figure 1

Figure 2

Figure 3

Figure 3 shows a section of sidewalk that has been pushed up by a tree root. The bricks are displaced about 1/2" upward and present a tripping hazard. The first step is the most difficult; get that first brick out. That is where the margin trowel or something similar is very handy. Work it into the head joint (the short joint) at one end of a brick and lift up. It will not come all the way. You will have to go to the other end of the brick and repeat the process until you work it out. Then it is relatively easy to remove the remainder of the brick.

Figure 4

Figure 4

Remove enough brick to completely expose the offending root and cut it off. If your problem is that there is a depression in the walkway, remove all of the brick within the depression.

In the process of doing all of this, you have disturbed the sand or gravel bead on which the brick rest. The next thing to do is smooth out the sand (add more if you need it) and compact it tightly. Use the flat side of one of the bricks you removed and smack the sand to compact it. If you don't, the bricks will settle and you will be doing this all over again.

Figure 5

Figure 5

The next step sounds easy, but you might be surprised. Replace the bricks. Somehow, they just never want to go back the way the came out. Here are some tips:

- If the last brick in the row just will not go in, use your rubber mallet and smack the last brick on the end to tighten up the row. Sometimes this is a good idea after you have laid two or three.
- Sometimes it is necessary to tighten up the rows from side to side. Again, use the rubber mallet and tap them together. Be careful. You can knock the whole sidewalk out of alignment if you get to aggressive with this.
- These same tips work no matter what pattern you are laying.
- What if there is too much space when you get to the end of the row? Using your margin trowel (or whatever flat bladed instrument you are using) go back several bricks, insert it in the joint and wiggle it until the joint opens up. Try not to exceed 1/8" unless the rest of the brick joints are bigger than that. Do this between all the bricks in the row until you take up as much space as you need.
- How do you know if the bricks are level? Use a straight edge that is long enough to span the entire area you are repairing. If a brick is low, remove it and place some sand under it. If the brick is high, tap it with the rubber mallet until it settles into place. If it will not settle, remove some sand from under it.
- What if a brick breaks? The simple answer is "forget it". I am serious. A broken brick here or there will do no harm. If it is a matter of esthetics, use the trowel to remove it and replace it. Remember this, unless you have more brick of the type used in the sidewalk, replacing the brick will be more noticeable than a broken brick.

Figure 6

Figure 6

The last, but equally important step, is to fill the joints between the bricks with sand. If the area is relatively small, I like to begin by working the sand in by hand. This will usually get much more sand into the joints than just sweeping with a broom. Make sure you remove the loose sand from the sidewalk to keep people from slipping.

In a day or two the original sand will settle and it will be necessary to sweep more sand into the cracks.

By the way, Jed Johnson, my volunteer for this exercise, completed the work from beginning to end in 20 minutes.

If. After reading this article you have the desire to install your own brick paving, I suggest you read my article on that subject here on the Old Louisville Web site. You can also find great information at the Brick Institute of America web site. http://www.bia.org/

BRICK

Brick is an ancient building material, but in modern historical usage, there are three distinct brick types: 1) hand-made, “soft-mud” bricks, typical of the pre-industrial era, and usually irregular in size, varied in color, and coarse in texture; 2) pressed brick, machine made of clay pressed into molds and fired in hotter kilns, uniform in size and color, and smooth textured; and 3) modern, wire-cut brick, made of clay extruded mechanically and cut to size with wires.

By the nineteenth century, chimneys were always constructed of brick, as were most building foundations, except in areas with good indigenous building stone; brick houses are rarer, except in dense urban areas where fire codes mandated masonry construction.

A major distinction of historic and modern brick is size. Nineteenth century brick was narrower than twentieth century brick and was intended to be laid with a very narrow (1/8”) mortar joint. Modern brick is sized to conform to the dimension of a standardized “concrete masonry unit” or CMU (commonly called a concrete or “cinder” block) and to be laid with a half inch mortar joint.

Another critical distinction is the mortar used to lay up the brick. Mortar must never be harder than the brick it is used with or the mortar will crack, damage, and ultimately destroy the brick. Portland cement, a hard-fired mortar mix of ground limestone, clay, and gypsum, was developed in the 1820s in England, introduced in the United States in the 1870s, and came into standard use for masonry construction in the twentieth century. Prior to the advent of Portland cement mortars, all mortars were a mixture of ground limestone and sand. A high-lime mortar allows a brick structure to absorb movement without damage, and facilitates the transmission of moisture exiting the building.

Re-pointing historic brickwork requires skill and care as well as the right mortar mix for the type of brick. Raking, the cleaning out old mortar joints for re-pointing cannot be done reliably using an electric carbide wheel and should be done by hand if possible. Brick should NEVER by sandblasted as sandblasting removes the hard-fired outer layer of the brick called the fireskin and exposes the softer center to rapid decay.

From: Home > Preservation > Your Old or Historic Home > A-Z in Your Old House: A Primer for Homeowners historicnewengland.com

Saving Structural Brickwork

When brick walls start to peel apart due to age and short-cut construction, they can be stabilized with a combination of modern materials and traditional techniques.

By Elizabeth J. Wheeler

Though the bulk of many historic brick walls are composed of common brick that is hidden from view, what we see on the exterior is a layer of veneer brick. Here peeled off the wall. Photos courtesy Nancy Snyder

Since few trees grow in the arid plains at the base of Colorado's majestic Rocky Mountains, most of Denver's beloved old neighborhoods are built from brick. After all, clay is plentiful where mountains loom, and early Denverites learned the benefits of brick in a big way. Many of the first houses in the Queen City of the Plains were built rapidly from logs, then consumed in a deadly fire that nearly destroyed Denver City, as it was known in 1863. Shortly thereafter the mayor proclaimed that all future buildings would be constructed of fireproof materials.

In the following years, gold, ranching, railroads, and healthful air for treating consumption (tuberculosis), brought thousands of people to Colorado, and dwellings were built quickly to house them. By 1900, 206 brickyards dotted the Denver landscape. For decades, the walls appeared to be steady and strong, but after a century, some of the houses are starting to show structural failure. The outer layers of bricks are separating from the bricks behind them, a condition called delamination that can lead to their collapse. Though the causes of this condition are not unique to Denver, it's a recurring problem in the city, so they have a lot of experience that can be applied to many buildings across the country.

Degrees of Separation

Age alone is not the cause of the separation; it's also inherent in the construction. For centuries, the way to build a brick or stone building was to make the walls solid, load-bearing masonry. Finer brick or cut stone might be reserved for the finished faces, and lesser-quality brick or rubble used for infill, but each wall was still a monolithic mass, with tie-bricks or stones placed strategically across its thickness to knit the wall together. In the late 19th century, though, the solid brick wall was supplanted by the cavity wall, a European practice that was supposed to have insulating advantages (see illustrations page 64). In a cavity wall the wythes (layers) of brick are separated by an air space that runs up the wall, with header bricks laid perpendicular to the face of the wall to tie the wythes together.

Though the bulk of many historic brick walls are composed of common brick that is hidden from view, what we see on the exterior is a layer of veneer brick. Here peeled off the wall.

Unfortunately, during the hasty years of Denver's construction boom, shortcuts were common. Some bricklayers did not take the time to always install a header course of brick when tying the multiple wythes together. Some embedded twisted wire or metal ties (common products at the time) in the horizontal mortar joints to tie the outer bricks to the inner ones. Others masons would angle a partial brick, called a queen closure, across the cavity, hiding it behind the outer wythe of bricks. In some cases, the masons altogether eliminated header courses—bricks laid perpendicular to the wall face in a horizontal stripe—because the homeowner or builder wanted a smooth, uniform look.

Environment took its toll too. "Denver's sunny days and cold nights are the real culprits," notes Diane Travis, technical advisor of the Rocky Mountain Masonry Institute, a nonprofit organization whose mission is to increase understanding and use of masonry. "When it rains or snows, brick becomes saturated," she explains, "Then the water expands 9% when it freezes. The constant freezing and thawing, called freeze-thaw cycles, can fracture even tough materials like brick, block, or stone. Once the outer wythe of brick starts tearing away from the inner wythes, it creates a vertical crack between the layers of the wall. "Broken brick accumulates in these fractures," adds Travis, "and this debris forces the crack to get wider and wider." Houses in climates where there are significant temperature swings might also be subject to this damage.

What to do About Wythes

The first step in addressing the problem is determining where the wythes are delaminating. The simplest method is to sight down the face of the wall with one eye, studying the surface for bulges. Another approach is to look inside the wall cavity with a borescope, an inspection device consisting of long rigid or flexible tube with a lens at the end. After boring a small hole in a mortar joint, an engineer can insert the borescope and look behind the veneer bricks to examine the cavity and the condition of tie bricks or metal ties.

Historically, the fix for bulging and out-of-plane walls was to install steel through-wall ties to hold the separating wythes together. These installations are not hard to identify because the masons typically used steel bars or S-shaped plates on the wall face to spread out the load and keep the tie from pulling through the brick veneer. If the delamination is severe, the traditional way to repair the brick veneer bulge has been to tear the unstable bricks off the wall and reinstall them with proper masonry ties, a costly and time

consuming method.

Today there are stainless steel masonry anchors on the market that can be inserted in the wall, not to pull the bulges back into place, but to tie the wythes together and keep them from continuing to peel apart. The ties can be installed by working on either the exterior of the wall (which avoids disrupting household activities), or the interior, say while remodeling the living space. Diane Travis recommends installing the ties from the interior face of the wall. This way the ties are totally invisible and they are not exposed to weather at all.

Though each manufacturer has their own version, these ties are basically thin spirals that can be countersunk into the wall so they are almost invisible. They are also flexible so they allow the wall to move and dissipate forces without cracking the masonry or causing other damage. Michael Schuller, PE, a Colorado-based consulting engineer specializing in the repair of masonry buildings recommends these anchors because of their adaptability and effectiveness. "We have used these ties on projects throughout the United States to tie historic facades back to the structure," says Schuller.

Ties in Practice
John Voelker, a mason who has specialized in preservation of historic masonry for 25 years and helps teach the historic preservation certification class at Rocky Mountain Masonry Institute, is another advocate. To demonstrate the technique during a certification class, Voelker begins by boring a small pilot hole into a brick wall. Voelker explains that ties are driven into mortar joints, not the bricks or other masonry units, at intervals of 16" horizontally and vertically. Next he loads the tie into the power driver attachment fitted to a hammer drill. He then drives the tie into the wall until the outer end is fully recessed below the face of the brick. Finally, he grouts the tiny hole with a small amount of mortar of the same color and composition of the original masonry. The ties come in several different lengths to accommodate the various layers, wythes, or courses, of brick used on a house. The process is the same for an interior application except the small hole is covered with plaster or drywall.

The total time it takes to repair brick walls with this system depends on the size and condition of the home. It is not uncommon for the whole process to be completed in a few hours or a few days. Voelker has used this system in his restoration projects for over a decade. "It is a great solution for unstable veneers on historic properties," notes Voelker. "When it's done correctly," he adds, "no one will know that I saved a client's brick wall from collapsing."

Elizabeth Wheeler *writes regularly about historic preservation topics from Denver.*