

Reanchoring brick

Adhesive or double expansion anchors can resecure brick facades

By Mark A. Wallace

After the Garden Apartments in Newark, Delaware, were gutted by fire in January 1990, engineers examined the building and found that the brick facades weren't tied back to the 4-inch brick backup. To reanchor the brick, the engineers, Gredell & Paul Engineering, Wilmington, Delaware, approved use of mechanical or adhesive anchors.

Hired to do the work, Victor Squillace Mason Contractors, Wilmington, decided an epoxy system would be the quickest way to install the 1,000 anchors that were needed. For each anchor, Squillace drilled one hole, installed a stainless steel screen filled with epoxy, then inserted a 3/8x6-inch stainless steel rod in the hole. Installing the anchors cost about \$4,000 (labor only) and took 12 workers about 5 days.

Last year, when engineers looked through a borescope into the hollow masonry walls of the Thomasville Furniture Warehouse in Thomasville, North Carolina, they found that 80% of the masonry headers connecting the two load-bearing brick wythes were cracked. The engineers, Sutton-Kennerly and Associates, Greensboro, also found that the exterior brick facade was bowed and cracked. In fact, a few wall sections

had bowed so much that they had collapsed a few years earlier.

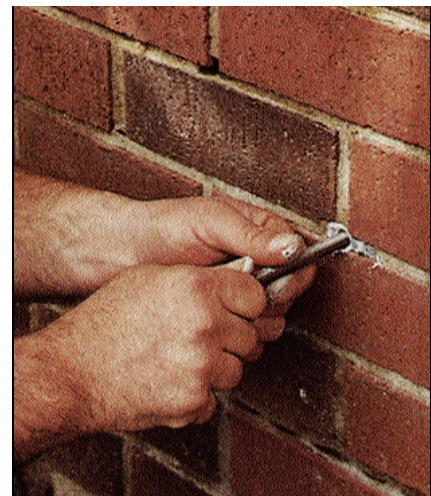
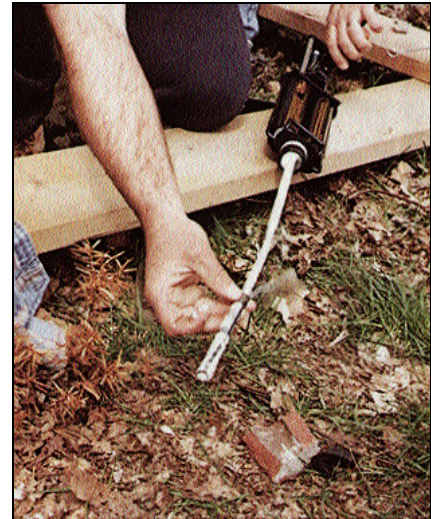
Differential movement between the inner and outer wythes had caused the problems at the Thomasville Warehouse. Unlike the inner wythe, the outer wythe was exposed to moisture and large temperature swings—yet it didn't contain any expansion joints. The result: the brick headers cracked and eventually the wall bowed.

To reanchor the four-story walls, Sutton-Kennerly decided to install 3/8-inch-diameter mechanical anchors. Because these reanchoring fasteners are smaller than most adhesive anchors, they are less rigid and should allow more differential movement between the two wythes than adhesive anchors would.

Since early this year, George W. Kane Construction Co. of Greensboro has been installing the more than 33,000 mechanical anchors required to pin the masonry on this 10-year-old, 17-acre warehouse. The masonry repair work also includes cutting vertical expansion joints in the exterior wythe, rebuilding some severely bowed wall sections, and bracing others.

Reanchoring saves money

When wall ties are missing or corroded or brick headers are broken, the exterior brick or portions of it can fall from the building. This happened at the Thomasville Furniture Warehouse. A common but expensive repair is to replace part or all of the brick. Reanchoring the brick to the backup costs much less and is just as effective if the conditions that lead to the failed wall ties are corrected too. Though the masonry repair work on the Thomasville Warehouse cost \$1.5



Adhesive anchors are installed by filling a screen tube with adhesive (top), inserting the tube in a clean, drilled hole (middle), then inserting a steel rod inside the screen (bottom). Inserting the rod pushes the adhesive through the screen into the masonry, bonding the two together.

million, this was still less expensive than closing the warehouse, demolishing the walls, and rebuilding them.

Several anchor manufacturers offer proprietary systems for reanchoring brick veneer. Most of them are similar to the adhesive and mechanical systems used on Newark's Garden Apartments and the Thomasville Warehouse.

Adhesive systems

Most adhesive anchors are installed in similar ways, using an epoxy or polyester adhesive. First you drill a hole, then brush and blow out the hole to remove drilling dust (don't use steel brushes). Fill a steel screen tube with the adhesive and insert the filled screen in the hole. Then, while holding the tab attached to the end of the screen, insert a steel rod, turning it slightly to ensure a good bond.

Holding the tab prevents the screen from being pushed further into the hole when the rod is inserted. Inserting the rod pushes the adhesive through the screen into the pores of the masonry. This bonds the masonry and the rod together. In the cavity between wythes, it also creates an enlarged bulb of adhesive that keys the anchor in place.

In the last few years, injection guns have become available that ensure proper proportioning and mixing of the two components needed to make polymer adhesives. Hardener and resin come prepackaged in two-tube cartridges. You open one end of a cartridge, attach it to a nozzle, then snap the cartridge into the handgun. Next, open the valve on the nozzle and squeeze the handle to force the components out the cartridge and into the nozzle. (On some guns, pumping pressure can be adjusted to match temperature



Expansion anchors for pinning brick have two expansion sleeves, one for the backup and one for the facade. First the inside sleeve usually is installed (top) then torqued (bottom). Then the outside sleeve is installed and torqued.

conditions.) The nozzle contains a static mixer that folds the hardener and resin together many times.

For high-volume jobs, pneumatic injection guns also are available. Press the trigger and adhesive dispenses instantly. Release the trigger and the flow stops.

With traditional bulk systems, the quality of the material is determined by the person in the field who measures the two components and stirs them together in a bucket. If the proportions are off

10% to 15% or the materials aren't mixed well, the adhesive might not even harden.

Both epoxy and polyester adhesives have short pot lives. Once the adhesive is mixed in a bucket, workers must race to use it before it sets. With the new injection equipment, the material is mixed as it's injected, so only the amount needed is made. Discarding left-over material or letting material set before it's used is eliminated.

The new injection guns make installing the adhesive easier and more effective too. Pouring batch-mixed adhesive from a bucket into a horizontal hole is difficult and may leave voids. Injecting it under pressure fills holes completely.

Polyester or epoxy?

This new injection equipment has made epoxies, which are more sensitive than polyesters to improper proportioning, much more reliable for anchoring than they once were. But polyesters are still viable and widely used.

For most masonry pinning, polyester or epoxy provide enough bond strength, though epoxies can be stronger. With either material, the failure usually occurs in the masonry, not in the adhesive. Because polyesters are thinner, they may penetrate better in very porous materials. Epoxies, however, wet brick better and break through dust better. Both materials can be applied to damp holes and still obtain good bond.

Both materials set quickly too. For example, at 68°F one polyester on the market has a gel time (pot life) of 6 minutes and sets in 1 hour. A proprietary epoxy that is available cures at about the same rate. Curing time varies with individual products.

Polyesters shrink more than epoxies after curing. Most polyesters on the market are filled so

they shrink less than 5%. Epoxies shrink less than 1%. Epoxies also have a higher flash point (200° F) and longer shelf life (2 years). Polyesters have a low flash point (93° F), and the polymers in polyesters begin to break down after several months.

Both epoxies and polyesters are toxic and should be handled with care. Workers should avoid skin contact and the work area should be ventilated. Epoxy proponents say epoxies are safer than polyesters. Polyesters contain styrene, which has been classified as “possibly carcinogenic to humans” by the International Agency for Research on Cancer. One polyester anchor manufacturer admits styrene has been put on the questionable list but says there is no conclusive proof that it causes cancer.

Mechanical systems

Expansion anchors, like those used in the Thomasville Warehouse, consist of two expansion sleeves, one for the backup and one for the facade, connected by a flexible wall tie. To install an expansion anchor, you drill a hole in the mortar joint of the outer wythe, typically at the T-intersection of a head and bed joint. For hollow masonry backups, you change drill bits, align the new bit in the center of the facade hole, and drill a smaller hole in the backup wythe. After cleaning the hole with forced air, you insert the anchor. Depending on the anchor design, insert the entire anchor or just the inner expander assembly. First torque the inner expansion sleeve so it's secured to the backup. Then remove the torquing device and install the outer sleeve if it's not already assembled. Finally torque the outer sleeve to secure it to the outer wythe.

For solid backups, such as con-

crete, the same hole size is drilled in both the facade and the backup. For hollow masonry backups, two different sized holes are required, one in the facade and a smaller one in the backup. However, special carbide drill bits are available that can drill both holes in one step, without having to change drill bits. To refasten brick to wood studs, metal studs, or structural steel, the inside expansion assembly can be replaced with other hardware, such as a threaded end, nut and washer, or toggles.

Combination system

One proprietary pinning system introduced in the United States this year after about 5 years of use in Europe is part adhesive and part mechanical. Neither a screen nor an expansion bolt is used. Instead you drill a hole in the brick or mortar joint of the facade masonry, then change bits and drill a pilot hole in the backup. Next, insert one of the stainless steel ties in a special support tool and slip it through the hole in the facade. Hammer the tool until the helical, self-tapping tie is anchored in the backup. Then remove the tool and use it to push a plastic sleeve into the hole until the sleeve is flush with the cavity. The sleeve cleans out the dust and seals the hole at the cavity, so you're ready for the final step: injecting the adhesive into the hole.

This system anchors the tie mechanically to the backup and adhesively to the facade. Because the tie doesn't rely on expansion, it can be used close to edges. It also provides lateral flexibility for accommodating normal building movements.

Adhesive or mechanical?

Which system is better to use? An engineer who has examined the symptoms and causes of the

building's problems should decide. Adhesive anchors generally are stronger than mechanical anchors. To obtain good bond, though, adhesive anchors must be installed in well-cleaned holes. Adhesives don't bond well through dust.

Most mechanical anchors work by expanding a metal sleeve until the sleeve grips the inside of the drilled hole. In hollow masonry backups, the expanded sleeve grips the back of the hole. Some materials, such as thin-wall terracotta, are too fragile and can't withstand this expansive stress. Because of this, mechanical anchors also can't be applied as close to an edge or as close to one another as adhesive anchors can. Adhesive anchors strengthen the surrounding material instead of stressing it. Thus they can be installed where high setting stresses are harmful, such as in cracked brick.

Mechanical anchors tend to be more flexible than adhesive anchors, allowing more differential movement between masonry wythes. Adhesive anchors are more rigid. A 3/8-inch-diameter rod creates a 1/2-inch-diameter, composite, rigid tie once the adhesive is pushed out the screen.

Because mechanical anchors don't have to cure, they can be loaded immediately. They also provide better quality assurance during installation. Because the anchor is secured to each wythe independently, the anchorage to each wythe can be tested independently at any time. This is one reason mechanical anchors were chosen for the Thomasville Warehouse. Workers secured the anchor to the backup, then the next day they torqued it again and checked its fixity. Next they secured the anchor to the outside wythe and checked its fixity.

Though rarely done, adhesive anchors can be tested if long rods that project from the wall are used. With the combination anchor described earlier, the backup anchorage can be tested before the facade connection is made. After the tie is adhered to the facade, both connections can be tested together.

Some contractors prefer mechanical anchors because they can feel the anchors become secured as the anchors are tightened. They can't feel adhesives set. Mechanical anchors also aren't toxic to the skin or lungs (of workers or building tenants) and don't require any special disposal measures. They can be installed in cold weather (whereas adhesives set much more slowly) and their performance isn't affected by high temperatures (some adhesives lose strength above 125°F, which masonry can easily reach in direct sunlight).


Brick pinning trends

According to one anchor manufacturer, in 1980 about 1% of all anchors, including those for masonry pinning, were adhesive anchors. In 1987, 15% were adhesive anchors. By 1995, he predicts 35% of all anchors will be adhesive. Though this company once made mechanical anchors for masonry pinning, it now makes only adhesive anchors for this use.

Other anchor manufacturers also have decided to concentrate on adhesive anchors for masonry pinning. One company that makes both mechanical and adhesive anchors claims mechanical anchors are more appropriate for reanchoring masonry but admits that the competition is forcing him more into adhesive anchors.

This manufacturer says for a brick and block wall with a 2-inch cavity, mechanical anchors cost \$10

to \$20 installed and adhesive anchors cost \$13 to \$28 installed. One epoxy anchor manufacturer says epoxy anchors cost \$8 to \$14 each, not including installation labor.

As older buildings and landmark structures need fortifying and unreinforced masonry buildings need strengthening against earthquakes, the need for masonry pinning—and retrofit anchors—is bound to grow. Though expensive, reanchoring a brick facade usually costs much less than removing and rebuilding it. Anchors can be installed from the inside or outside and leave only small holes that are easily filled with mortar or caulk. 

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