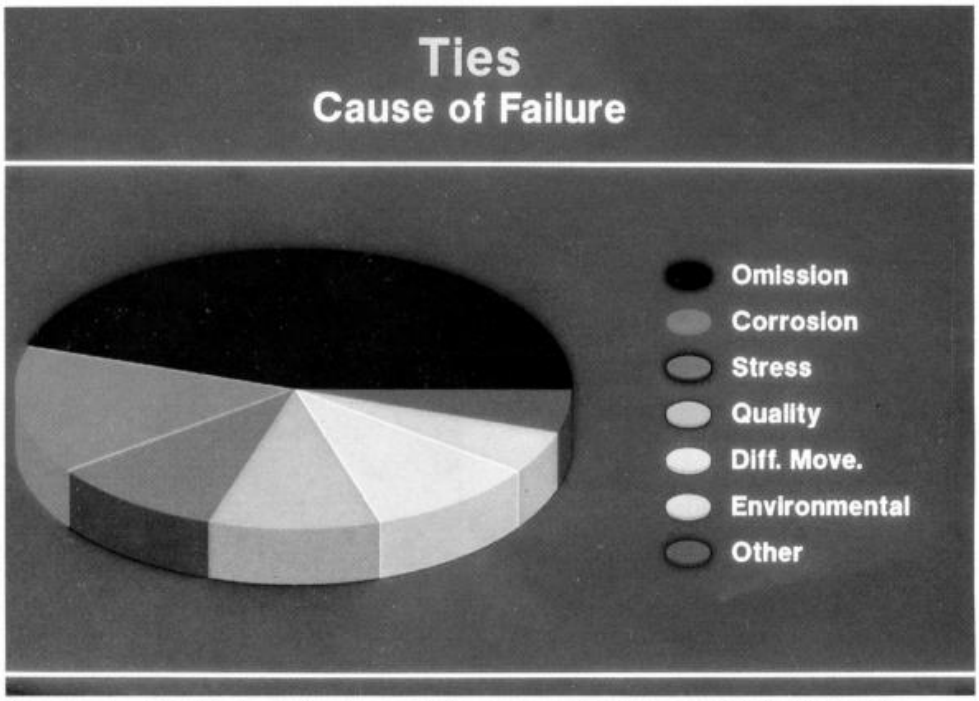
Facade Restoration: Rehabilitating Unstable Veneers

by Stephen H. Getz

The cladding on buildings throughout the United States, large and small, single story and high rise, is continually exposed to stresses and strains. In order for a building to maintain its exterior structural integrity and aesthetics, design details and recommended construction practices must be faithfully executed. Conditions that result in forces or wall movements not anticipated in the original design can create either cosmetic or catastrophic problems.

Masonry ages well. For this reason, it has been and is a desirable building material. However, masonry veneers, stone panel exteriors, cut stone facades, ornamental fascias, and many other types of exterior building materials, can be victims of instability. Although the intention of the designer was to maintain a stable connection between exterior walls to the inner structure of the building, separation of the walls can occur. Unsupported or inadequately anchored veneers will eventually fall off the building. Facade failure can destroy both property and human life, if they are in the path of the falling materials. When a facade is unstable, it is imperative that it be reattached, but before action is taken a thorough analysis, identifying the cause for the instability, must be made.



This pie chart illustrates typical case study analysis involving hundreds of facade instability problems.

Failure Causes

A common misconception about facade instability is that "old age" has caught up with the structure. That is, a building constructed over 50 years ago is typically stereotyped as the logical repair candidate. Although buildings meeting this description are being repaired, old age is not the only reason. Granted, years of neglected problems will eventually take a toll, but "age," independently, does not commonly cause the loss of facade stability. A combination of situations usually causes the problem.

Most facade instability cases occur in buildings constructed only 12 to 20 years ago. In analyzing these cases, no single cause for the problem is evident. Usually, the failure is influenced by a number of contributing elements. These include the following:

- Omission of ties or anchors when originally constructed.
- An insufficient quantity of connectors due to design miscalculations or irregular spacing.
- Ties or anchors improperly installed, such as wire reinforcement not adequately embedded in the bed joint, or poor connection to the backup.
- Improper tie or anchoring selection, such as corrugated strap in lieu of pintles, or undersized dovetails.
- Excessive differential wall movement created by thermal movement, creep, moisture, and settlement.
- Inadequate expansion and control joint type, size, and frequency, resulting in stresses exceeding the facade materials' capacity.
- Corrosion of the ties, lintels, steel studs, or screws due to moisture and inadequate plating of the tie; accelerated corrosion from chlorides; galvanic action resulting from the combination of carbon steel anchors and other materials.
- Inadequate provisions to accommodate exterior wall properties, such as warping marbles, water-absorbing travertines, and common brick moisture retention.
- Excessive water penetration into the cavity between the facade and backup.
- Freeze/thaw damage aggravated by the lack of proper wall drainage.
- Poor exterior wall maintenance habits to seal sill gaps, tuckpoint when necessary, and clear weep hole blockages.

Initially, the problem appears minor and goes unattended. Over time, other conditions aggravate the situation and a "snowballing" phenomenon begins.

A typical scenario could be that an apparently well-constructed brick facade building, having a concrete frame and block backup, has vertical expansion joints spaced too far apart. Also, the soft joints were mortar filled. Cracks begin to appear at window openings and vertical cracks at the corner of the build-

ing are evident. The cracks tend to widen and lengthen. Water starts entering the wall cavity and relief angles and ties begin to rust. Besides the excessive pressure generated at the supported angles due to an absence of a compressible soft joint, the increasing volume of rust exerts an outward pressure on the facade as the angle oxidizes. The facade starts bulging at the floor lines. Ignored, the bulging will project farther and spread, until the wall collapses.

A solution to the problem is possible, once a diagnostic evaluation reveals the contributing causes.

Typical Repair Techniques

If the omission of facade ties were the only problem, resupporting the walls could be easily accomplished. However, reanchoring the wall will not prevent further facade degradation if other design and construction shortcomings are not corrected.

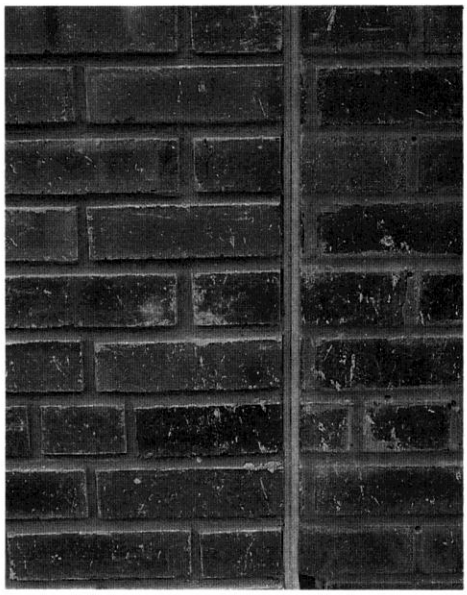
The restoration process can incorporate a number of repair techniques. Primarily, these include the following:

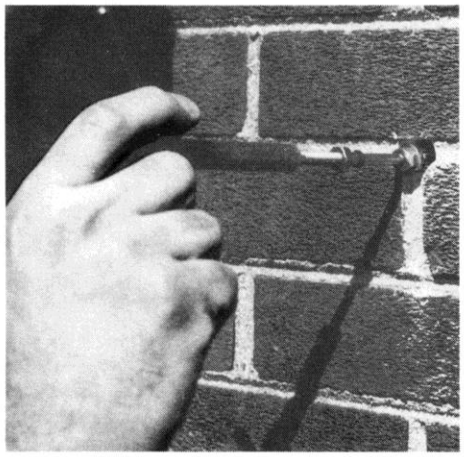
1. The restabilization of the facade by:
- Reanchoring the facade.
- Adding expansion joints, horizontal and/or vertical, to accommodate expansion and contraction.
- Removing and replacing decayed or ineffective relief angles.
- Adding relief angles to supplement vertical load support.
- Improving wall drainage.
- Enhancing the waterproofing capabilities of the facade.

2. The replacement of the facade, partially or totally, by using proper anchorage and movement control details. This is the most costly exercise; however, it is common practice for the replacement of excessive bulging and loose brick.

Facade Restabilization

Facade restabilization precedes the overall rehabilitation details necessary to correct the problems. This is done to avoid the possibility of the walls collapsing when openings in the facade are required. An essential part of any restabilization project is to refasten, or "pin," the exterior. The preferred technique is to mechanically retie the exterior wall to the inner structure.





Top, new masonry never exactly matches old masonry. Below, installation of a mechinal pin to stabilize the brick with the block.

Mechanical pinning is considered the best because of its measurable quality control during installation. Mechanical fastening is a positive acting system, and is relatively easy to install with a low installation cost. This style of refastening accommodates at least 90 percent of the facade stability situations.

Other advantages worth considering are that mechanical systems are not affected by weather conditions, either during installation or once in place, and that environmental and health risks are not prevalent as is the case with resins and epoxies. A major feature of mechanical fastening is that the system allows for in-situ, nondestructive testing of both front and backup connections. A quality assessment of anchorage and building suitability is then possible.

In the event the backup or facade material is unsuitable for mechanical pinning because the material on either side of the connection cannot sustain expansion stress without cracking (such as thin-wall terra cotta and brick), an adhesive anchorage solution is possible. With close attention to field quality control, and the proper selection of noncorrosive hardware (stainless steel, for instance), adhesive anchoring is successful. In-situ testing to ensure anchorage is a more tedious task, and is destructive when testing the backup condition. However, the final result will provide an anchorage that incorporates only those stresses developed by the working load.

Whether you use mechanical or chemical anchors, repinning can be accomplished without destroying the classic look of a mature building facade—new masonry never exactly matches old masonry.

Facade Instability Symptoms

Adequate building surveillance of the exterior can avoid major wall reconstruction. Early warning signs can include the following:

- Cracks in wall panel or shift in panel location.
- Vertical cracks in masonry at corners, window lintels and sills. Cracks usually split the brick.
- Bulging or buckling wall panels; masonry wall bulges and cracks at floor lines and parapets.
- Facade brick or stone panel shards that are found about the building's ground perimeter, set-backs, neighbor roofs, or building ledges.
- Moisture problems on interior walls.
- Loose or fallen brick or wall panels.
- New roofing. Worn roofs, especially flat types, are replaced after conceding to years of patching and water leaks. Normally, parapet flashing is in need of repair as well. The porous roof and leading parapets provide the extra moisture to accelerate corrosion of wall ties. Most new roofs provide a water-tight membrane, which can seal the moisture in the wall.

Conclusion

There are many attractive masonry and stone structures in existence, some with facades in need of rehabilitation. Regardless of age, their exterior structural integrity and appearance can be preserved indefinitely. Proper attention to preventive maintenance and repair techniques, when needed, will contribute to prolonging the building's future. □

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