

---

***Architectural Design Guide  
for Exterior Treatments of  
Unreinforced Masonry Buildings  
during Seismic Retrofit***

---

***November 1991***

***Prepared by:***

***Preservation Committee  
American Institute of Architects  
San Francisco Chapter***

***Prepared for:***

***The City of San Francisco  
Planning Department  
Landmarks Preservation Advisory Board  
and the City Planning Commission***



AMERICAN INSTITUTE OF ARCHITECTS/SAN FRANCISCO CHAPTER



---

## *Table of Contents*

<i>The Purpose of This Guide</i> . . . . .	<b>2</b>
<i>How to Use This Guide</i> . . . . .	<b>3</b>
<i>Other Considerations</i> . . . . .	<b>4</b>
<i>Other Methods Not Covered by This Guide</i> . . . . .	<b>5</b>
<i>Additional Requirements</i> . . . . .	<b>5</b>
<i>Anchor Bolts</i> . . . . .	<b>6</b>
<i>Securing Exterior Ornamentation</i> . . . . .	<b>8</b>
<i>Braced Frames</i> . . . . .	<b>10</b>
<i>Exterior Buttresses</i> . . . . .	<b>12</b>
<i>Infill Windows</i> . . . . .	<b>14</b>
<i>Where to Go for More Information</i> . . . . .	<b>16</b>

---

## ***Acknowledgements***

This booklet was written and assembled by Cassandra Mettling with assistance from Rob Cole, Mark DeBacker, Valer Mocak, Nancy Goldenberg, Michael Stern, Arnold Lerner, Douglas C. Hohbach, Elizabeth Kerman, and Scott Churchill, members of the Preservation Committee of the

American Institute of Architects, San Francisco Chapter. These individuals contributed their time and effort creating this manual to help maintain the architectural character of neighborhoods in San Francisco.

This informational guide has been printed on recycled paper to conserve resources.

---

## ***Disclaimer***

The information presented in this publication is for general information only. No representations are made as to the suitability of any of the techniques described herein for any specific

application or project. Use of this information for specific applications should be determined in each instance by the user and only upon the professional advice of competent experts.

---

## *The Purpose of This Guide*

This design guide was prepared for unreinforced masonry building owners and their contractors. It provides guidance on how to maintain the historical character of their building when conducting seismic retrofit. This guide addresses five specific procedures that could affect the exterior appearance of a building during seismic upgrades. Our goal is to reduce the impact of seismic retrofits on the exterior appearance of the building.

About 2,000 residential and commercial buildings in San Francisco are built of unreinforced masonry. Masonry is usually brick, but can also be concrete block, terra cotta, or stone. Current building methods require that new masonry buildings be reinforced with steel. However, older masonry buildings must be retrofitted in order to comply with the building code requirements.

The San Francisco Unreinforced Masonry Building Retrofit Ordinance is intended to save lives and buildings in the event of a major earthquake and will require retrofits which may impact the appearance of a building's exterior. It is possible to upgrade these buildings in a number of different ways. The method(s) of seismic upgrading will ultimately be chosen by the owner in consultation with a structural engineer. This design guide is not intended to suggest a specific structural upgrade technique, but only how to treat a structural retrofit when it impacts the exterior.

If the guidelines in this booklet are followed, the review process of the San Francisco Landmarks Preservation Advisory Board and the City Planning Commission may be greatly streamlined and costly delays may be reduced. Furthermore, by maintaining the original ornamentation and historical elements of the building, the owner can retain, and in some cases improve the resale value of the building.

---

## *How to Use This Guide*

This guide presents five different retrofit techniques that can affect the exterior appearance of the unreinforced masonry building. They are: anchor bolts, securing exterior ornamentation, braced frames, exterior buttresses, and infill windows. This guide is not intended to instruct the owner or builder how to perform the retrofit, but to serve as general guidelines of what the resulting appearance should be or not be. Undoubtedly, there are numerous techniques on how to achieve an acceptable outward appearance--too many to include in this brief guide. As a basic rule-of-thumb, when in doubt about the appearance of one of these retrofit techniques, one should try to maintain the original appearance, that is, how the building looked when first built.

While we have addressed five types of seismic retrofitting, some methods are generally more acceptable than others. For example, it is usually better to introduce interior braced frames rather than to fill in existing windows or brace the building on the exterior. We realize, however, that in certain situations these solutions may be appropriate, so we have included guidelines on when and how these methods should be employed.

In order to illustrate the points in this guide, photographs and sketches are included as examples of what is recommended and what should be avoided. Every building is different and although the photographs may not reflect your specific situation, they are intended to serve as examples.

If you need further guidance, contact a licensed architect. A licensed structural engineer may be required to recommend the method of seismic retrofit that is the best choice for your particular building. An architect is necessary to coordinate the work between the contractor and the engineer and will assist in aesthetic issues regarding the building appearance and its architectural integrity. Contact any of the organizations listed at the end of this booklet for more information.

---

## ***Other Considerations***

Although this design guide addresses procedures that affect only the exterior, it is important to consider the impact of the added structural elements on the basic building systems. For instance, the design of a new steel frame may happen to slice through the existing toilets on successive floors causing all waste lines to be moved. Placement of a frame in front of windows might prevent access to light and air. A steel frame on an interior corridor might force the relocation of entry doors or diminish the clear width of the corridor. As a result, the cost of replacement finish materials could add up to many thousands of dollars.

Alternative schemes should be considered to address continuous occupancy of the building during construction. One scheme may be less expensive but may cause the tenants to be displaced, resulting in loss of rental revenue. An alternative scheme that initially costs more may allow continuous occupancy and be more cost effective for the building owner.

While performing seismic retrofits, it is advisable to perform other rehabilitation work such as cleaning and correcting deferred maintenance. It is often most cost effective to perform multiple repairs when rehabilitating a structure. Long-term maintenance of a building will always result in prevention of future costly repairs.

Lastly, the services of a licensed architect experienced with rehabilitation of existing structures and seismic upgrades should be engaged. An architect can analyze the existing condition of a building and, when working with a structural engineer, assist in determining the most appropriate seismic upgrade.

---

### ***Other Methods Not Covered in this Guide***

Additional methods of seismic strengthening for unreinforced masonry buildings exist which may impact architectural elements and are not covered in this guide. Core drilling, for instance, is a method where vertical cores are drilled in masonry for the installation of steel reinforcement and epoxy grout fillers. This retrofit may be preferable as it will have little effect on the building's interior and exterior. Although core drilling deserves mention, further explanation is beyond the scope of this guide. Ask your licensed architect or structural engineer about this technique.

Repointing of mortar joints is not a specific seismic retrofit but may be required as part of a retrofit procedure. Repointing involves the removal of deficient mortar and replacement with new, **compatible** mortar. Information on repointing can be obtained from a licensed architect and through the organizations listed in the back of this guide.

Additional required shear strength can also be achieved through shotcrete or gunite shear walls. Shotcrete or gunite walls are reinforced concrete material applied to a masonry surface. Use of gunite reinforcement may be appropriate in certain cases. However, it is a highly invasive procedure requiring removal of interior or exterior finishes. This can result in the loss of significant historic fabric and is also very costly.

---

### ***Additional Requirements***

The owners and their agents are responsible for complying with all codes, rules and regulations which apply. "Special Inspections" may be required for bolting existing masonry, structural steel reinforcement, welding, etc., which exceed the standard inspection process.

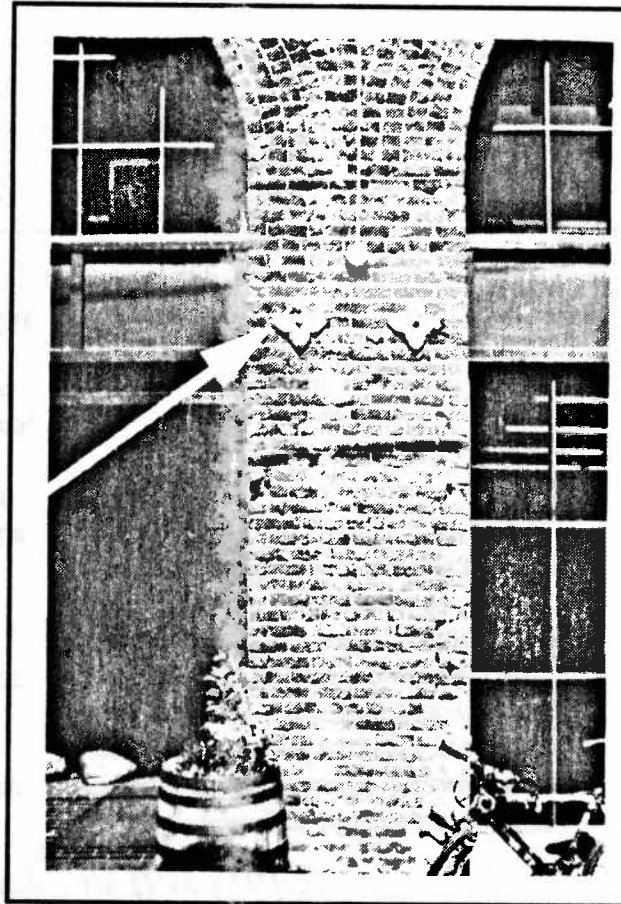
## Anchor Bolts

Anchor bolts are probably the most common retrofit procedure. Their purpose is to secure the exterior walls to horizontal elements, such as the floor or roof. This causes the building to move as a single unit during an earthquake and minimizes the probability of the facade falling away from the structure. One can see anchor bolts on many masonry buildings, usually at the parapets. They are typically 1/2" bolts with flat metal washers.

The main design issue of adding anchor bolts is to make sure that they do not damage the exterior. The bolts themselves are too small to be noticeable from the street; it is the washers that are of concern. The preferred solution would be to recess the washer below the face material, if possible. This solution is particularly applicable for stucco facades.

In circumstances where the washers are on the surface and the building is currently painted, the bolts and washers should be painted as well. Not only will the anchor bolts blend in with the facade, but they will be protected from the elements.

### RECOMMENDED:

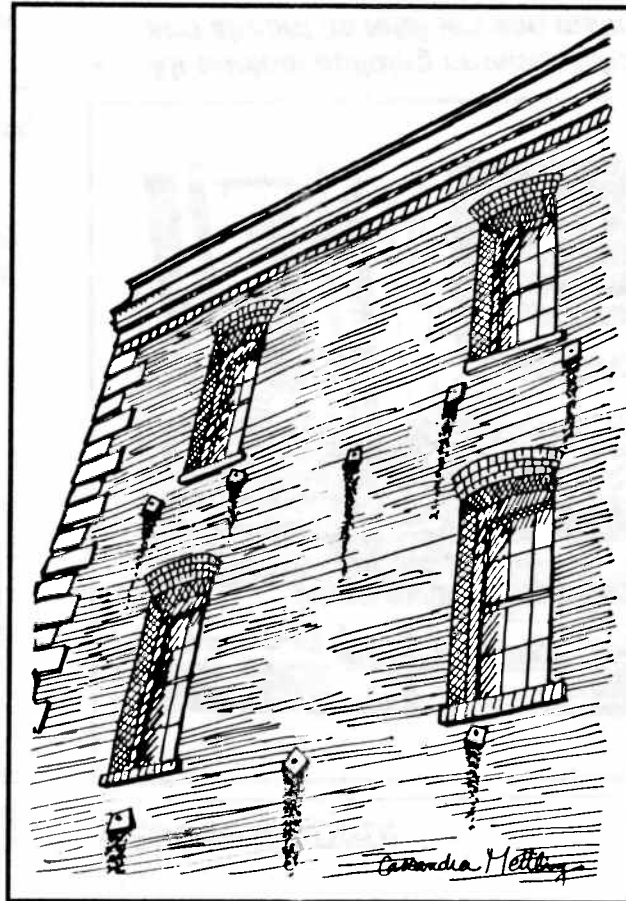


- **Use decorative washers in areas with high visibility.**
- **Align washers to create orderly appearance.**
- **Use stainless or galvanized steel and paint when appropriate, to prevent rust streaks.**
- **Attempt to conceal the bolts and washers below the exterior finish, when appropriate.**



**NOT RECOMMENDED:**

- *The anchor bolts on this building were placed in a haphazard fashion. More care should be taken to align the anchor bolt washers. Also, painting the washers can reduce the unsightly rust streaks that result from weathering.*
- *Do not place anchor bolts at locations with high relief ornamentation.*



The locations of the anchor bolts are determined by the structural engineer so in some cases, they may appear to dominate the facade. In this case, a decorative washer may be used, which can enhance the building. The best local example of this is at the Cannery at Fisherman's Wharf, where each washer is a cast iron star. The anchor-bolt star has become the logo for the Cannery.

If square washers are used, care should be taken to line them up. Each washer should be placed on the diagonal or parallel to each other. Examples can be found of square washers carelessly aligned and these are far more noticeable as non-original elements than those that are carefully aligned. Of course round washers can be used to avoid this problem.

It is important that stainless steel or galvanized steel be specified as the material for the washer. If not, rusting will lead to eventual failure of the bolt as well as unsightly rust stains. Again, painting the bolts and washers (when appropriate) will help to prevent rust stains.

## ***Securing Exterior Ornamentation***

All original ornamentation should be retained in its original configuration and location. Ornament is one of the character-defining features of architecture intended to deliberately express a building's overall design and individual components.

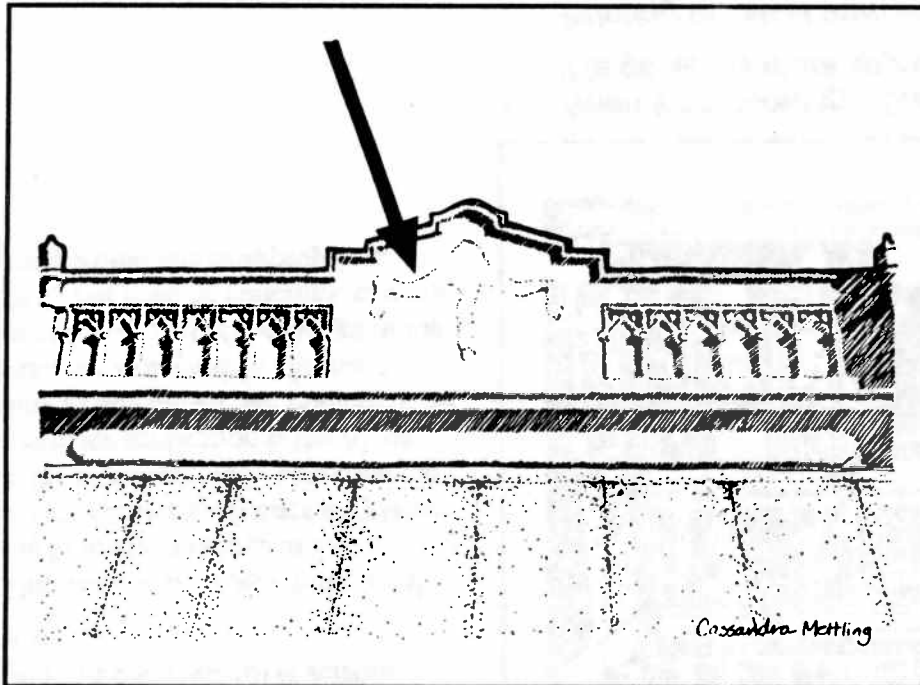
Careful forethought and analysis should always precede alterations of a building's ornamentation. Ornamentation cannot be removed or altered without compromising a building's architectural integrity.

If it is determined that ornamentation poses a potential hazard and must be secured or removed, every effort should be made to secure it. Generally, methods to secure and maintain existing ornament are relatively simple. Preferred repair techniques will minimally affect the appearance of the ornamentation and will always attempt to disguise the repair. If ornament is removed, patching and repair will be required. The repair must be carefully designed to prevent future failures such as cracking due to thermal and seismic stress, or unsightly differential

### **RECOMMENDED:**



- ***All original building ornamentation enhances the architectural value and should be retained and maintained.***

**NOT RECOMMENDED:**

- ***If it is determined that ornamentation must be secured or removed, effort should be made to secure it. The parapet of this building shows a "scar" where ornamentation was removed.***

weathering. Therefore, it is usually more cost-effective to repair and preserve the element.

If ornamental elements must be removed for other repairs or due to severe deterioration, reinstallation of these elements should be considered rather than their removal. Replacement in-kind is the preferred method which will simplify detailing, maintenance, and result in increased longevity. Replacement with substitute materials may be acceptable if no other options exist. However, analysis must be made for the compatibility of the new material with the existing materials to make sure that the new material will not create damage.

When repairing or removing ornament, care must be taken to prevent damage. The ornament should always be carefully protected from adjacent construction. Damage to elaborate pieces can result in costly repairs as well as future problems such as water penetration.

Regular maintenance and repair of existing ornamentation will ultimately result in simplified and less costly maintenance as well as preservation of a building's architectural integrity and value.

## Braced Frames

Steel braced frames are added to help the building resist lateral forces. Different configurations can be utilized to minimize their effect on the existing architecture. Braced frames are often required in a comprehensive seismic upgrade.

One can see examples of diagonal-bracing in many buildings in San Francisco. Generally, frames are placed inside the perimeter wall. One example of an exterior application is the Alcoa Building in downtown San Francisco. In this case, the structural "x" formation was intended as part of the design of the building. For historic buildings, exterior x-bracing would not be appropriate.

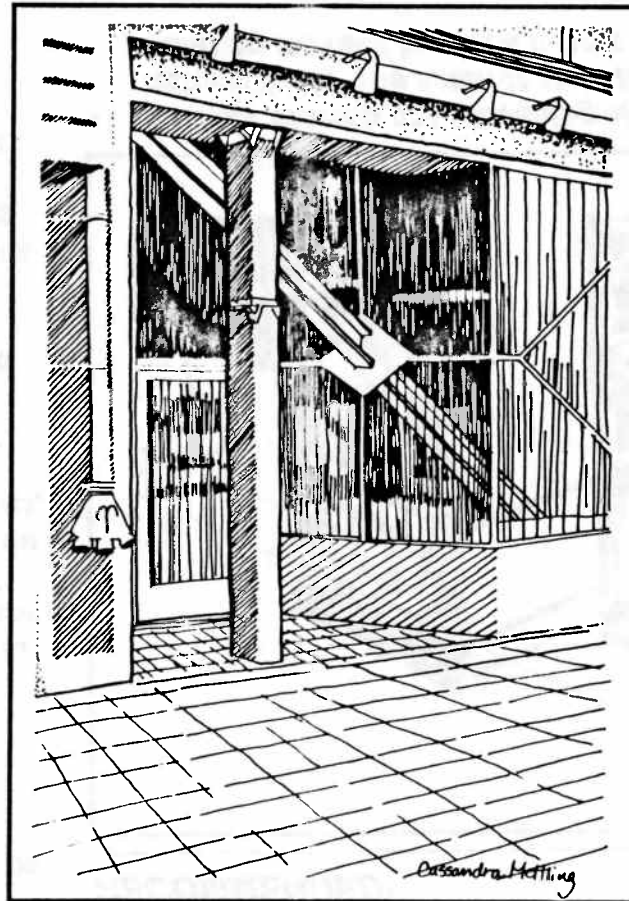
### RECOMMENDED:



- ***When incorporating a braced frame system to strengthen a building, it is generally more appropriate to build the frame on the interior.***
- ***Painting the steel framing elements can help blend them with the existing wall.***

**NOT RECOMMENDED:**

- **Penetration of the diagonal braces into a storefront should be avoided. However, location of the bracing elements is dictated by the building configuration so conflicts such as this may be unavoidable. In these instances, careful detailing is required to prevent water damage.**

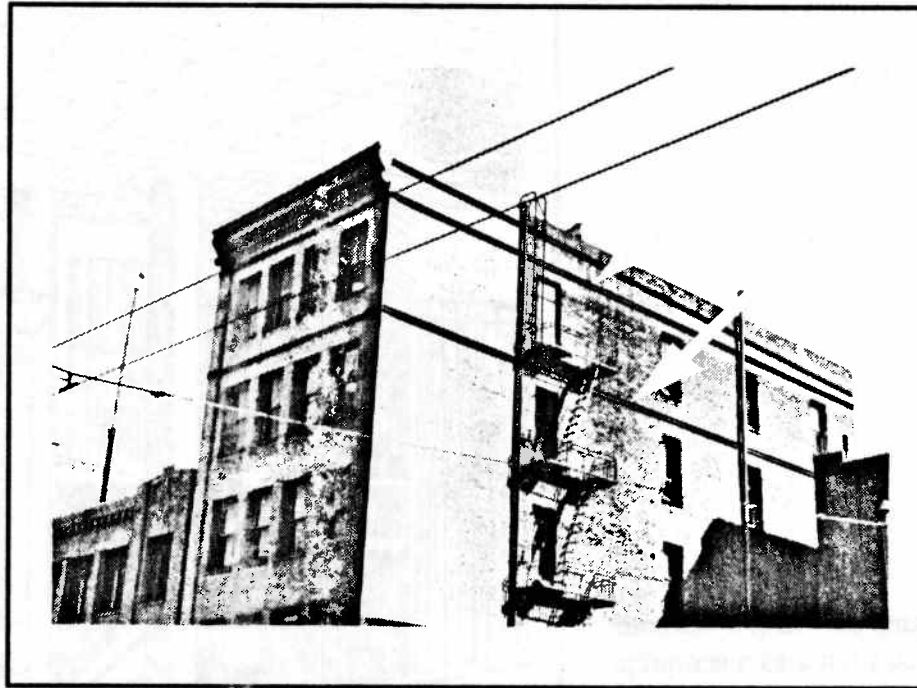


If it has been determined by the structural engineer that a braced frame is required to stabilize the structure, it should be on the inside of the perimeter walls of the building. Ideally, the frame should be placed within the exterior wall, that is, between the exterior masonry and the interior finish. If the interior of the building is historically significant, care must be taken that it is minimally disturbed during this process.

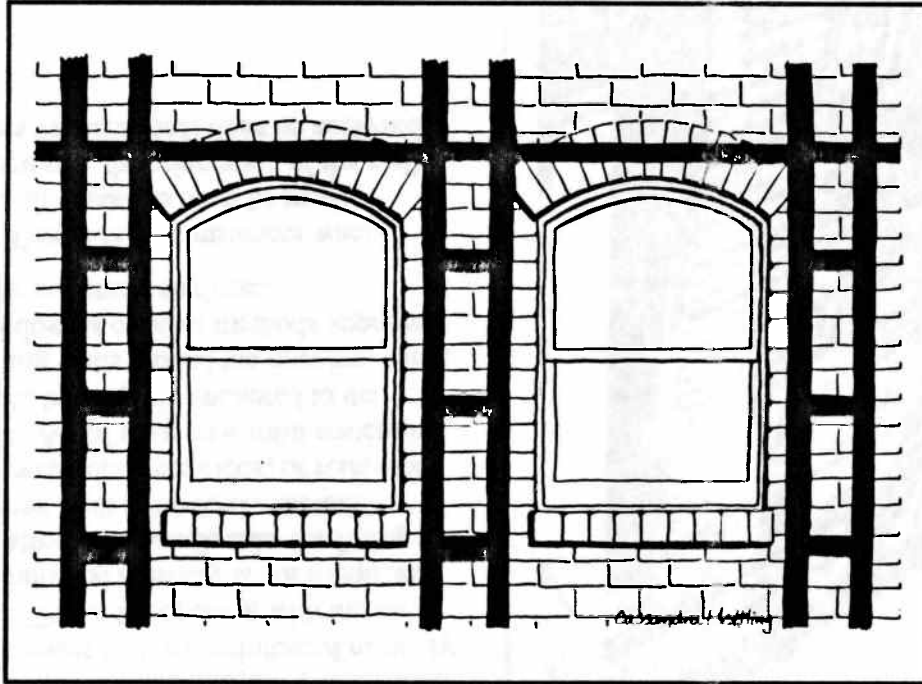
## Exterior Buttresses

Historically, the flying buttresses on Gothic cathedrals exemplify exterior buttresses. These buttresses are an integral part of the design of these cathedrals and help define their character. In retrofitting an existing building, however, it is usually better to use an in-wall or interior bracing system than a visible exterior one. In most cases, exterior buttresses will destroy the character of the building. In worst cases, buttresses can require the removal of existing decorative elements. Even if elements can be saved, exterior buttresses could visually obscure them. Another problem is physically integrating the buttresses with the existing structural system. The building skin would be punctured, necessitating the loss of building fabric and, if not properly detailed, making the building more vulnerable to water damage.

### RECOMMENDED:



- ***Exterior bracing or buttressing should incorporate the building's natural lines. The exterior steel bracing appears to be an original building element because it runs parallel to the cornice line.***

**NOT RECOMMENDED:**

- ***The exterior bracing on this building dominates its appearance. Care should be taken to design exterior bracing to blend with or enhance the building's natural lines.***

In a few cases, especially where the interior building fabric is highly significant, exterior buttresses may be preferred. Care should be taken to remove, damage or obscure existing exterior building fabric as little as possible, and to incorporate the buttresses in such a way that the building's overall character is not lost.

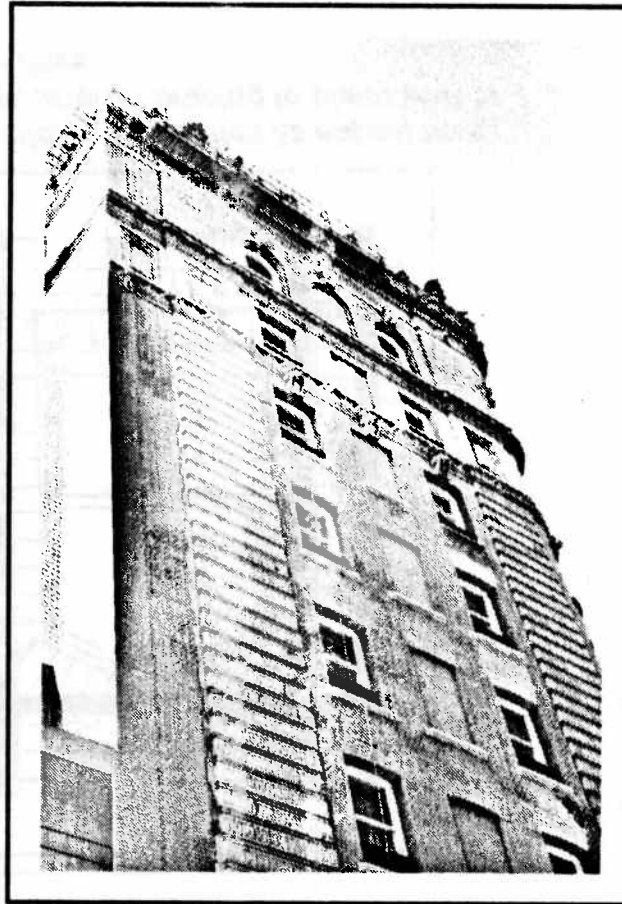
## ***Infill Windows***

From an architectural standpoint, infill of openings is not a desirable remedy and should be used only as a last resort.

The purpose of filling the opening is to increase the shear capacity and reduce the stresses on the unreinforced masonry wall. To fill the opening with the same unreinforced masonry is not adequate. The structural criteria calls for filling the opening with reinforced concrete, reinforced concrete block, or reinforced brick. All of these new infill materials should be properly anchored to the existing walls around the opening, using steel dowels or other methods approved by the structural engineer.

There are circumstances when difficult decisions must be made. Sometimes, the orientation of the wall (street vs. backyard) must be analyzed.

### **RECOMMENDED:**

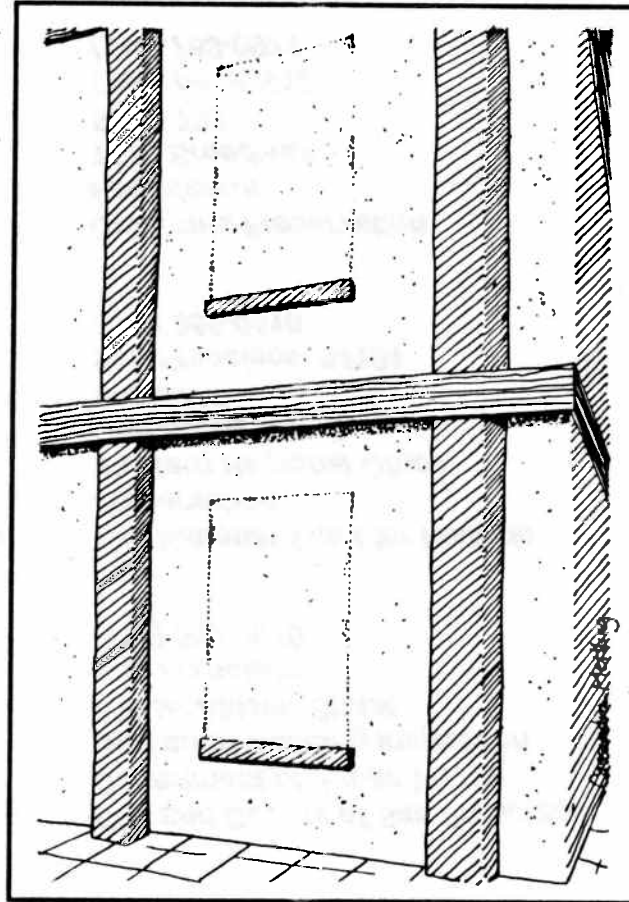


- ***Infill of windows should be avoided in all cases. Where absolutely required, however, the appearance of a window opening should be retained to suggest the original visual rhythm of the facade.***



**NOT RECOMMENDED:**

- *Infill techniques such as this are not encouraged. Suggestion of a former window opening should have been emphasized by slightly recessing the former opening.*



Buildings officially rated as landmarks pursuant to Articles 10 and 11 of the City Planning Code are often excluded from infill of openings. The facade of each building, which expresses its architectural character, can be compromised by extensive infills. This applies especially to landmark buildings. As for all historic buildings, compliance with the California State Historical Building Code must be met.

Structural bracing from the interior of the unreinforced masonry wall may be preferred to infill, although it may be more expensive. If, however, the infill of openings appears to be the only realistic method to seismically upgrade the building, the design solution should be sensitive. The recess in the filled opening should suggest the location of the former window to soften the impact of the loss of glazed area. Effort should be made to either match the infill material with the surrounding material, or create a deliberate contrast through the use of color or texture.

---

## *Where to Go for More Information*

**Foundation for  
San Francisco's  
Architectural Heritage**  
2007 Franklin Street  
San Francisco  
(415) 441-3000

**American Institute of Architects  
San Francisco Chapter**  
130 Sutter Street  
6th Floor  
San Francisco  
(415) 362-7397

**Landmarks Preservation  
Advisory Board**  
Department of City Planning  
450 McAllister Street  
4th Floor  
San Francisco  
(415) 558-6345  
(415) 558-6320

**City and County of San Francisco  
Department of Public Works  
Bureau of Building Inspection**  
450 McAllister Street  
San Francisco  
(415) 558-6070

**The National Trust for Historic  
Preservation**  
Western Regional Office  
One Sutter Street  
Suite 707  
San Francisco 94104  
(415) 956-0610

**California Preservation  
Foundation**  
1615 Broadway  
Suite 705  
Oakland 94612  
(510) 763-0972

**City and County of San Francisco  
Zoning Planning**  
450 McAllister Street  
San Francisco  
(415) 558-6377

**National Park Service  
Western Region  
Preservation Assistance Branch**  
600 Harrison Street  
Suite 600  
San Francisco 94107  
(415) 744-3988