NATIONAL CITY
GRANGER MUSIC HALL

RELOCATION FEASIBILITY STUDY

PREPARED FOR

CITY OF NATIONAL CITY
Development Services, Engineering Division
1243 National City Blvd
National City, California 91950

PREPARED BY

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November 7, 2017

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A. INTRODUCTION

PROJECT OVERVIEW
This report is an update to Heritage Architecture & Planning's Relocation Feasibility Study dated May 27, 2010. In addition, this study includes updated estimated construction costs for relocation versus restoring Granger Music Hall in-situ.

Granger Music Hall was designed by renowned San Diego architect Irving Gill in 1896. It was designed for Ralph Granger to house his collection of rare violins. The single room structure was originally located next to Granger's home in National City on 8th Street. In 1898 the original structure was expanded to include a large recital room. The new room featured plaster walls and ceilings with decorative painting including a ceiling mural of Euterpe, Muse of Music. The building was relocated to its present site at 1615 East 4th Street in 1972.

The building is owned by the City of National City and was rented for special events. The building is currently vacant and has not been used since 2007. The City plans to relocate the building between Pepper Park and the Pier 32 Marina in National City. The building will be used for dining and assembly.

The intent of this updated Feasibility Study is to summarize the existing building condition and provide a relocation strategy, rehabilitation recommendations, and an opinion of probable relocation and rehabilitation costs. This information will be used by the City of National City to determine the financial feasibility of the proposed relocation.

PROJECT TEAM
This study has been prepared under the direction of KTU+A Planning and Landscape Architecture by the following consultant team:

- Heritage Architecture & Planning – Architecture & Preservation
- Dodd & Associates – Structural Engineering
- John T. Hansen Enterprises – Relocation Contracting
- Weisbecker Consulting Services – Construction Cost Estimating

FIELD INVESTIGATION
Field investigation for this study was completed by Heritage Architecture & Planning (Heritage), Dodd & Associates, and John T. Hansen Enterprises on February 4, 2010 and again in May 2017. The assessments and recommendations listed in this report are based on the existing building conditions as observed by the consultant team during the field investigations. There was no exploratory demolition or testing performed. A summary of the existing building conditions is included in Section C of this study and is largely based on the 2010 survey.

COST ESTIMATE

Based on the existing conditions, the consultant team has prepared a scope of work for required improvements. Weisbecker Consulting Services will prepare a preliminary Opinion of Probable Construction costs using this summary of work. The updated construction cost estimate will be included in Section F of this study.

B. APPLICABLE CODES & GUIDELINES

FEDERAL COMPLIANCE

1. Americans with Disabilities Act:
   The Americans with Disabilities Act (ADA) was signed into law in July 1990. This civil rights statute applies to employment, as well as access to public structures and services or "public accommodations" owned or operated by private entities. In general, alterations to buildings subject to ADA must provide for access to buildings by persons with disabilities. However, there are special rules and minimum access requirements where an alteration "would threaten or destroy the historic significance" of a historic building. Historic buildings include those eligible for listing in the National Register of Historic Places or designated under State or local law. To use the minimum requirements, consultation is required with the State Historic Preservation Officer and in the case of projects subject to Section 106 of the National Historic Preservation Act, with the Advisory Council on Historic Preservation. ADA is considered to be a regulatory document.

2. Secretary of the Interior's Standards for the Treatment of Historic Properties:
   The Secretary of the Interior is responsible for establishing standards for all programs under Departmental authority and for advising Federal agencies on the preservation of historic properties listed in or eligible for listing in the National Register of Historic Places. In partial fulfillment of this responsibility, *The Secretary of the Interior's Standards for the Treatment of Historic Properties* have been developed to guide work undertaken on historic buildings. There are separate standards for acquisition, protection, stabilization, preservation, rehabilitation, restoration, and reconstruction. *The Standards for Rehabilitation* (codified in 36 CFR 67) comprise that section of the overall preservation project standards and addresses the most prevalent treatment for the Granger Music Hall following the relocation. "Rehabilitation" is defined as "the process of returning a property to a state of utility, through repair or alteration, which makes possible an efficient contemporary use while preserving those portions and features of the property which are significant to its historic, architectural, and cultural values."

   Initially developed by the Secretary of the Interior to determine the appropriateness of proposed project work on registered properties, *The Standards for Rehabilitation* (*The Standards*) have been widely used over the years as a reference for historic rehabilitation projects. In addition, *The Standards* have guided Federal agencies in carrying out their historic preservation responsibilities for properties in Federal ownership or control; the State Historic Preservation Officer (SHPO) and local officials in reviewing both Federal and non-Federal rehabilitation proposals. The intent of *The Standards* are to assist the long-term preservation of historic materials and features. *The Standards* pertain to historic buildings of all materials, construction types, sizes, and occupancy and encompass the exterior and interior of the buildings.

   As stated in the definition, the treatment "rehabilitation" assumes that at least some repair or alteration of the historic building will be needed in order to provide for an efficient contemporary use; however, these repairs and alterations must not damage or destroy materials, features or finishes that are important in defining the building's historic character. For example, certain treatments -- if improperly applied -- may cause or accelerate physical deterioration of the historic building. Similarly, exterior additions that duplicate the form, material, and detailing of the structure to the extent that would compromise the original historic character will fail to meet *The Standards*. There are no major alterations or additions proposed in this project.

The ten rehabilitation provisions of *The Standards* are to be applied to specific rehabilitation projects in a reasonable manner, taking into consideration economic and technical feasibility.

1. *A property will be used as it was historically or be given a new use that requires minimal change to its distinctive materials, features, spaces, and spatial relationships.*
2. *The historic character of a property will be retained and preserved. The removal of distinctive materials or alteration of features, spaces, and spatial relationships that characterize a property shall be avoided.*
3. *Each property will be recognized as a physical record of its time, place, and use. Changes that create a false sense of historical development, such as adding conjectural features or elements from other historic properties, will not be undertaken.*
4. *Changes to a property that have acquired historic significance in their own right will be retained and preserved.*
5. *Distinctive materials, features, finishes, and construction techniques or examples of craftsmanship that characterize a property will be preserved.*
6. *Deteriorated historic features will be repaired rather than replaced. Where the severity of deterioration requires replacement of a distinctive feature, the new feature will match the old in design, color, texture, and, where possible, materials. Replacement of missing features shall be substantiated by documentary, and physical evidence.*
7. *Chemical or physical treatments, if appropriate, will be undertaken using the gentlest means possible. Treatments that cause damage to historic materials will not be used.*
8. *Archaeological resources will be protected and preserved in place. If such resources must be disturbed, mitigation measures shall be undertaken.*
9. *New additions, exterior alterations, or related new construction will not destroy historic materials, features, and spatial relationships that characterize the property. The new work shall be differentiated from the old and will be compatible with the historic materials, features, size, scale and proportion, and massing to protect the integrity of the property and its environment.*
10. *New additions and adjacent or related new construction will be undertaken in such a manner that, if removed in the future, the essential form and integrity of the historic property and its environment would be unimpaired*

The Secretary of the Interior's Standards for the Treatment of Historic Properties and its rehabilitation provisions are considered to be advisory documents. *The Standards*, when used within the Section 106 process or the California Environmental Quality Act are considered to be regulatory documents.

3. Secretary of the Interior's Guidelines for Preserving, Rehabilitating, Restoring, and Reconstructing Historic Buildings:
   The Secretary of the Interior's Guidelines for Preserving, Rehabilitating, Restoring, and Reconstructing (Guidelines) were initially developed in 1977 to help property owners, developers, and Federal managers apply The Standards during the project planning stage by providing general design and technical recommendations. Unlike *The Standards*, the *Guidelines* are

not codified as program requirements. Together with *The Standards* they provide a model process for owners, developers, and Federal agency managers to follow. *The Guidelines* are intended to assist in applying *The Standards* to project generally; consequently, they are not meant to give case-specific advice or address exceptions or rare instances.

Some exterior and interior alterations may be needed to assure continued use, but it is most important that such alterations do not radically change, obscure, or destroy character-defining spaces, materials, features, or finishes. It is assumed that the relocation and rehabilitation of the Granger Music Hall will proceed in compliance with *The Standards*. *The Secretary of the Interior's Guidelines for Preserving, Rehabilitating, Restoring, and Reconstructing Historic Buildings*, is considered to be an advisory document for work that may be performed on the Granger Music Hall.

STATE COMPLIANCE

1. 2016 California Building Code:
   The California Building Code (CBC) incorporates, by adoption, the International Building Code of the International Code Council with California amendments.

   The CBC is published in its entirety every three years by order of the California legislature, with supplements published in intervening years. The California Legislature delegated authority to various State agencies, boards, commissions, and departments to create building regulations to implement the State's statutes. These building regulations or standards have the same force of law, and take effect 180 days after their publication unless otherwise stipulated. The California Building Standards Code applies to all occupancies in the State of California.

2. California Historical Building Code:
   The 2016 California Historical Building Code (CHBC) is intended to provide flexibility to owners of historic structures in meeting code requirements. The CHBC and regulations are performance-oriented rather than prescriptive as are most building codes. Jurisdictions must allow the use of the CHBC when dealing with qualified historical buildings, structures, sites, or resources in permitting repairs, alterations, and additions necessary for the preservation, rehabilitation, relocation, related reconstruction, change of use, or a continued use in accordance with the Health and Safety Code of the State of California.

   The California Historical Building Safety Board has adopted the following definition for a qualified historic building or property:

   > *A qualified historical building or property is any building, site, structure, object, district, or collection of structures, and their associated sites, deemed of importance to the history, architecture, or culture of an area by an appropriate local, state, or federal governmental jurisdiction. This shall include designated buildings or properties on, or determined eligible for, official national, state, or local historical registers or official inventories, such as the National Register of Historic Places, California Register of Historic Resources, State Historic*

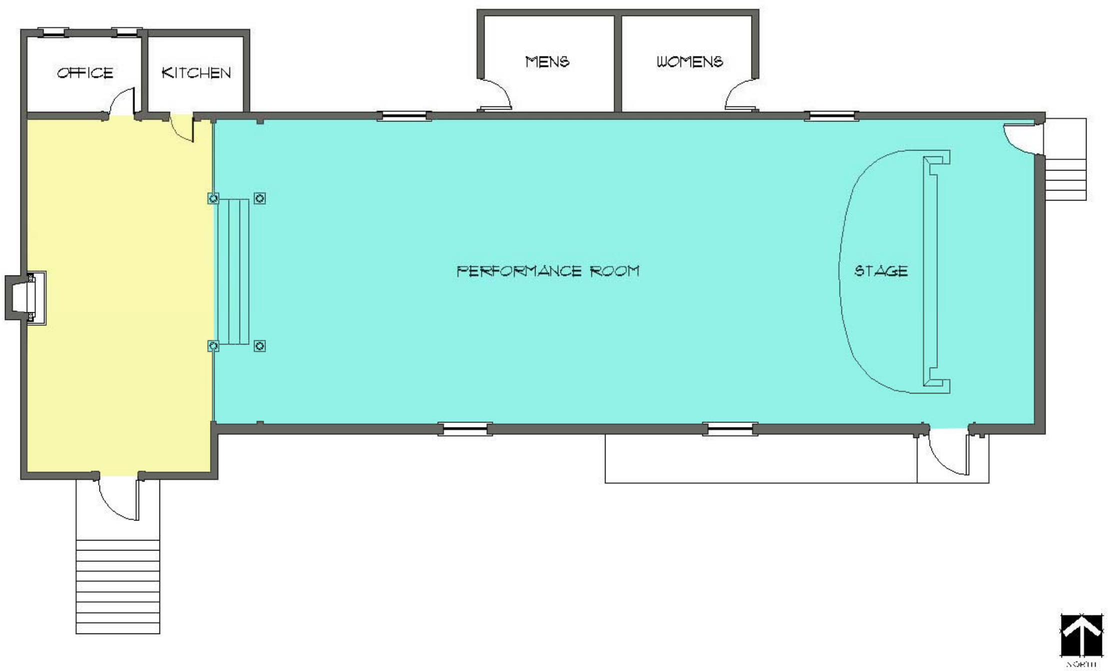
Landmarks, State Points of Historical Interest, and officially adopted city or county registers or inventories, or surveys of historical or architecturally significant sites, places, or landmarks.

Under the provisions of the CHBC, new work shall conform to prevailing code, while all the elements of the existing structure are afforded the flexibility of reasonable and sensitive alternatives. The CHBC alternative building standards and regulations are intended to facilitate the restoration so as to preserve original or restored architectural elements and features, to encourage energy conservation and a cost effective approaches to preservation, and to provide for the safety of occupants. The CHBC also has alternative provisions for compliance with Title 24, California Building Code, for accessibility issues. The California Historical Building Code is considered to be a regulatory document. The Granger Music Hall is a qualified historical building and can utilize the CHBC.

3. California Register of Historical Resources:
   In 1992, the Governor signed AB 2881 into law establishing the California Register of Historical Resources (CRHR). The CRHR is an authoritative guide in California used by state and local agencies, private groups, and citizens to identify the state's historical resources and to indicate what properties are to be protected, to the extent prudent and feasible, from substantial adverse change. The criteria for eligibility for the CRHR are based upon the National Register of Historic Places criteria. Certain resources are determined by the statute to be included in the CRHR, including California properties formally determined eligible for, or listed in, the National Register of Historic Places, State Landmarks, and State Points of Interest. The Granger Music Hall is a qualified historical building listed on the California Register and the National Register.

C. BUILDING CONDITION ASSESSMENT

GENERAL DESCRIPTION:
The historic Granger Music Hall is a one-story, wood framed building with wood shingle cladding on the exterior walls topped by a complex hipped roof that is also shingled. The overall condition of the building has been downgraded to fair due to years of deferred maintenance. Persistent roof leaks have led to the damage of historic features and finishes including interior plaster, woodwork, and decorative painting which are premiere character-defining features. Vandalism has also caused damage that will require repair.



Floor Plan: The yellow shaded area is the original 1896 Music Room. The Blue shaded area is the 1898 Performance Room addition. The existing office, kitchen, and restrooms were added later.

EXTERIOR ASSESSMENT
Site:
The existing site is non-historic. The Granger Music Hall was moved from its original location on 8th Street to its present location on 4th and Palm Street in 1972. The existing site is fenced for security (refer to Figure 1). There is a large non-historic paved courtyard with a brick fountain and a large wood Granger Music Hall sign in front of the building. In general, the site features, while pleasant, do not contribute to the historic character of the building. Adjacent to the site there is a surface parking lot and directly behind the building there is a larger lighted "Mile of Cars" sign. These features detract from the historic character of the building. There are two outbuildings of unknown age on the east side of the site (refer to Figures 10 and 11). The outbuildings are set back from public view so they do not detract from the historic character of the site.

Relocation Considerations:
There are several considerations and criteria when relocating a historic building. The National Park Service has a document which addresses moving historic structures. *National Register Bulletin 15* includes a section called "Criteria Consideration B: Moved Properties." Below are a few key excerpts from that document:

"…Significance is embodied in locations and settings as well as in the properties themselves. Moving a property destroys the relationships between the property and its surroundings and destroys associations with historic events and persons. A move also may cause the loss of historic features such as landscaping, foundations, and chimneys, as well as loss of the potential for associated archeological deposits."

"A moved property… must retain enough historic features to convey its architectural values and retain integrity of design, materials, workmanship, feeling, and association."

"…Moved properties must still have an orientation, setting, and general environment that are comparable with the property's significance."

"For a property whose design values or historical associations are directly dependent on its location, any move will cause the property to lose its integrity and prevent it from conveying its significance."

The Granger Music Hall has already been relocated once before. A second relocation would not cause additional impact to the historical integrity because the current site does not contribute to the historical setting or integrity of the building. However, it is not known if the 1972 relocation changed the building orientation or affected other aspects of the original setting. It is important that the proposed relocation plans take into account the original setting and orientation and attempt to match them if possible. Additional research is recommended to identify the original orientation.

Foundation:
The existing foundation is non-historic. It was added when the building relocated in 1972. The foundation consists of concrete block stem walls around the building perimeter with internal pier supports. A comparison between available historic photographs and the existing foundation indicates that the structure was raised approximately 30-inches when the building was moved.

Paint:
The paint is in poor condition with significant fading, chalking, flaking, and deterioration. The existing color scheme is red walls with green trim. Preliminary paint scraping revealed that the first visible paint layer is similar in color to the current paint although there appears to be a minor variation in the original hues. A detailed microscopic paint investigation should be used to determine the exact color of the original paints so the historic scheme can be replicated (refer to Photos 11 & 12).

Walls:
The exterior walls are finished with wood shingles. The shingles are 11 ½-inches long with square cut ends set with a 4 ½-inch exposure. The top four rows of shingles have rounded ends with approximately the same exposure. The general condition of the shingles is fair to poor with significant paint deterioration and many split or displaced shingles (refer to Photos 11 & 12).

Roof:
The roof is hipped with a low-to-moderate moderate slope and hipped dormer windows that provide natural light to the interior performance hall along with skylights. The roof is clad with wood shingles. A plastic tarp has been nailed to the roof to temporarily address leaks. The roofing is in poor condition and should be replaced immediately to prevent further damage to the interior finishes. Failure of the temporary roof tarp, installed in 2015, has led to water infiltration and collapse of two areas of the hand-painted ceiling in the Performance Room (refer to Photos 18 & 19). A replacement roof tarp was installed earlier this year.

The roof features flared eaves with shaped rafter tails and 1x4 V-groove tongue-and-groove sheathing. In general, the rafter tails are in fair condition. The exposed sheathing at the eaves is in fair condition (refer to Figure 5 and Photos 13 & 14). The attic space was not accessible for inspection.

Porches:
There are two historic porches on the south wall of the building. Both porches have gabled roofs with flared eaves and shaped rafter tails (refer to Figures 2 & 4 and Photos 3 & 15). The west porch roof is in fair condition with some evident of wood deterioration, deteriorated paint, and deteriorated roofing. The east porch roof is in poor condition with significant wood deterioration caused by dryrot and termites (refer to Photos 15 & 16). The front posts of both porches are non-historic. Historic photographs indicate that the porch roofs originally cantilevered without outer posts (refer to Figure H1).

The floor of the west porch, which leads to the older section of the building, is approximately 4'-8" above the exterior finish grade (refer to Figure 2 and Photo 3). The porch floor and steps are concrete. They were added in 1972 when the building was relocated to the current site. The typical rise is 5 3/8-inch. The treads are 12-inches deep. The stair includes a non-historic 1972 metal handrail which does not comply with current code.

There is a 1972 concrete ramp and landing at the east porch which leads to the Performance Room (refer to Figure 3 and Photo 1). The landing is 2'-9" above the exterior finish grade. The difference in elevation between the two porches accommodates the interior level change between the two main rooms. The 1972 porch ramp is approximately 30-feet long. It does not comply with current code due to the non-compliant slope, cross-slope, metal handrails, and landing dimensions. The door thresholds at both entry doors are not code-compliant and include a level change of approximately 1 ½-inches.

Windows:
The four circular-shaped (oval) windows located on the north and south elevations of the building are unique, primary character-defining features (refer to Figures 3 & 25 and Photos

1, 8 & 21). Historic photographs indicate that the windows originally had vertical muntins -- and possibly horizontal too (refer to Figure H1). Although the historic muntins have been removed, the existing wood frames remain in fair to good condition. The northeast circular window was broken by vandals or vagrants since 2010 and the opening has been sealed with plywood.

The building includes several dormer windows. The windows on the older section of the building feature diamond patterned divided-lite sashes (refer to Figure 6). The dormer windows above the main Performance Room are single-lite operable wood-framed hoppers (refer to Figure 20).

There are two windows on the north side of the building at the non-historic kitchen and storage room addition. These windows are wood and are in good condition. A third window in this area has been boarded-over (refer to Photo 7).

Chimney:
The existing chimney is non-historic, it was reconstructed from oversized non-historic 11 ½" x 3 ½" x 3" brick in 1972 when the building was relocated (refer to Figure 7).

INTERIOR ASSESSMENT

Original 1896 Music Room:
Originally the Granger Music Hall was built in 1896 and it included only one room (refer to Figure H2). The larger Performance Room was added to the building two years later. The original 1896 room features wood paneled walls, a coved wood paneled ceiling, wood wainscoting, a large symmetrical skylight (with one pane missing), and a fireplace with a massive marble mantel (refer to Figures 12-15 and Photos 17 & 22). Most of these original features remain intact and are in good condition. The original fireplace mantel has been replaced with a salvaged mantel from another location (refer to Figure 16). Although the mantel is not original to the building it is appropriate to the historic period of the building and it does not detract from the overall character of the space. Historic photographs (refer to Figures H2 and H4) indicate that the mantel was replaced at least once before the current mantel was installed.

The floor of the original Music Room is 1'-11" above the floor level of the adjacent (ca. 1898) Performance Room. The east wall was modified ca. 1898 when the Performance Room was added to provide a stepped connection between the two spaces (refer to Figures H4 and 18). There are four steps down to the Performance Room. The steps appear to have been modified in 1972 when the building was relocated. It is likely that the building was cut at that location to facilitate the relocation and that the original steps were removed and reconstructed. The existing steps are entirely clad in non-historic carpeting, so a detailed survey of the substrate was not possible. The original wood flooring in the Music Room has been covered with carpet which is water damaged and is in poor condition. Original photographs (refer to Figure H2) reveal that the Music Room originally had a small raised wood stage platform in the northwest corner which was probably removed from the ca. 1898 addition when the larger stage was added.

Performance Room:
The Performance Room was added ca. 1898, two years after the original construction of the Granger Music Hall. The room is a significant character-defining space (refer to Figures H3 and H4). It features a paneled wood wainscot, plastered walls, coved ceilings, decorative paint, a curved wood stage, and an elaborately carved wood organ screen (refer to Figures 20-26 and Photos 17 & 21). These features generally remain in good condition with some signs of plaster bulging, paint deterioration, and damage at the wood cornice above the organ screen caused by persistent roof leaks. As noted previously, the failure of a temporary roof tarp has resulted in rain water infiltration and the collapse of two areas of the hand-painted ceiling in this room (refer to Photos 17-20). Now that a new roof tarp has been installed, the ceiling should be inspected and stabilized to prevent further damage.

The original wood flooring is covered with non-historic carpet. There are two decorative circular screens in the ceiling above the performance space visible in historic photographs (refer to Figure H3) which are currently covered with plywood. It is assumed that some repair will be required on these screens. In addition to the decorative paint, the coved ceiling features the original raised plaster trim and exposed incandescent lighting. The room is also naturally lit through the four oval windows and a band of five clerestory hopper windows on the west wall. In addition to the broken northeast oval window, vandals have destroyed a section of original wood wainscoting between the Kitchen and Performance Room.

Stage, Backstage, and Organ Loft:
The Stage has a curved front and is approximately 2'-6" above the main Performance Room floor (refer to Figure 23). The stage is wood with a paneled skirt that matches the original wood wainscot. There is a detached moveable wood stair in front of the stage. The back wall of the stage features an elaborate full-height carved wood organ screen (refer to Figures 23 and 24). The stage and screen are in good condition. The wood cornice molding on the top of the screen is split and detached from the ceiling. This damage appears to be related to a roof leak and associated plaster deterioration. The organ screen conceals two rear stage rooms and an organ loft which remain in good condition (refer to Figures 27-31). The original 2½-inch wide tongue-and-groove wood flooring in the storage rooms and loft remain intact and in good condition. Both doors to the storage rooms are non-historic and the original hardware has been replaced. The original organ has been removed.

Restrooms:
The existing restrooms are non-historic. They are located on the north side of the building in a non-historic (1972) concrete block addition that is accessed directly from the exterior (refer to Figure 8). The existing roof is a low-slope shed roof. The interior finishes include concrete floors, a 5'-8" high ceramic tile wainscot on all interior walls, floor-mounted metal toilet partitions, and painted gypsum board upper walls and ceilings. The women's restroom includes three toilet stalls and one pedestal-style lavatory (refer to Figure 33). The men's restroom includes one urinal, two toilet stalls, and one pedestal-style lavatory (refer to Figure 34). One toilet stall in each room is larger (3'-3" wide by 5'-1" deep) and equipped with side-mounted grab bars. Despite this, the existing facilities do not comply with current accessibility standards. The existing finishes and fixtures are generally in poor condition.

Kitchen:
The Kitchen is not historic. All of the interior features, fixtures, and finishes are non-historic dating to the 1972 building relocation or later. A historic photograph of the Music Room shows that there was a door in the location of the existing kitchen door, but an investigation of the foundation reveals that the floor structure is not original to the building. This would indicate that the room was added or significantly altered. The door may have originally led to a porch which could have been removed during the 1972 building relocation. The original paneled wood door and hardware have also been removed and replaced.

Storage Room:
The Storage Room was not accessible at the time of the field assessment, so this report does not include an assessment of the existing interior conditions of this space. The room is not historic. A historic photograph the original Music Room shows that there was no door in the location of the existing door (refer to Figure H2).

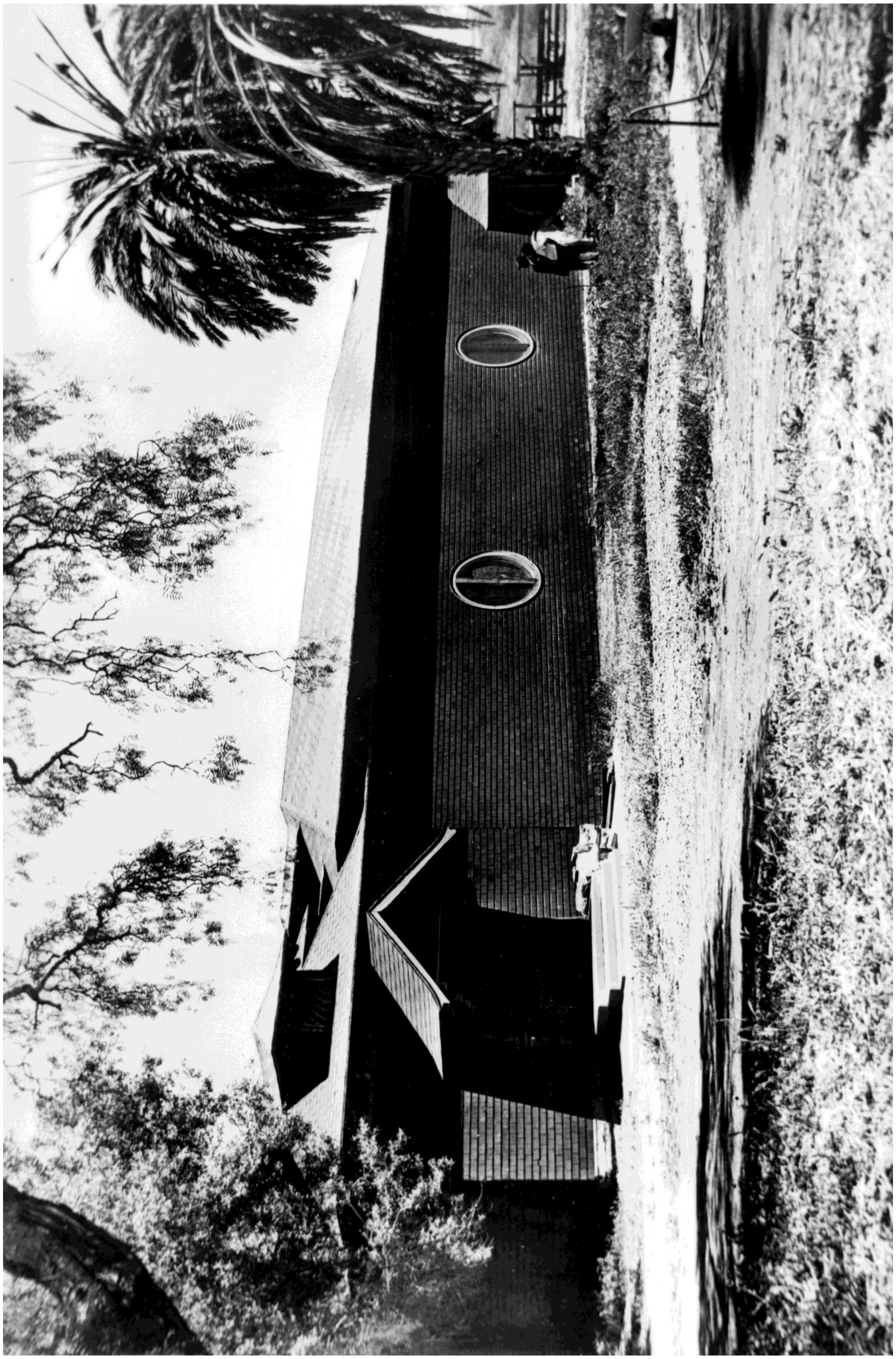


Figure H1: The Granger Hall in its original location. Note the lower height above exterior grade.

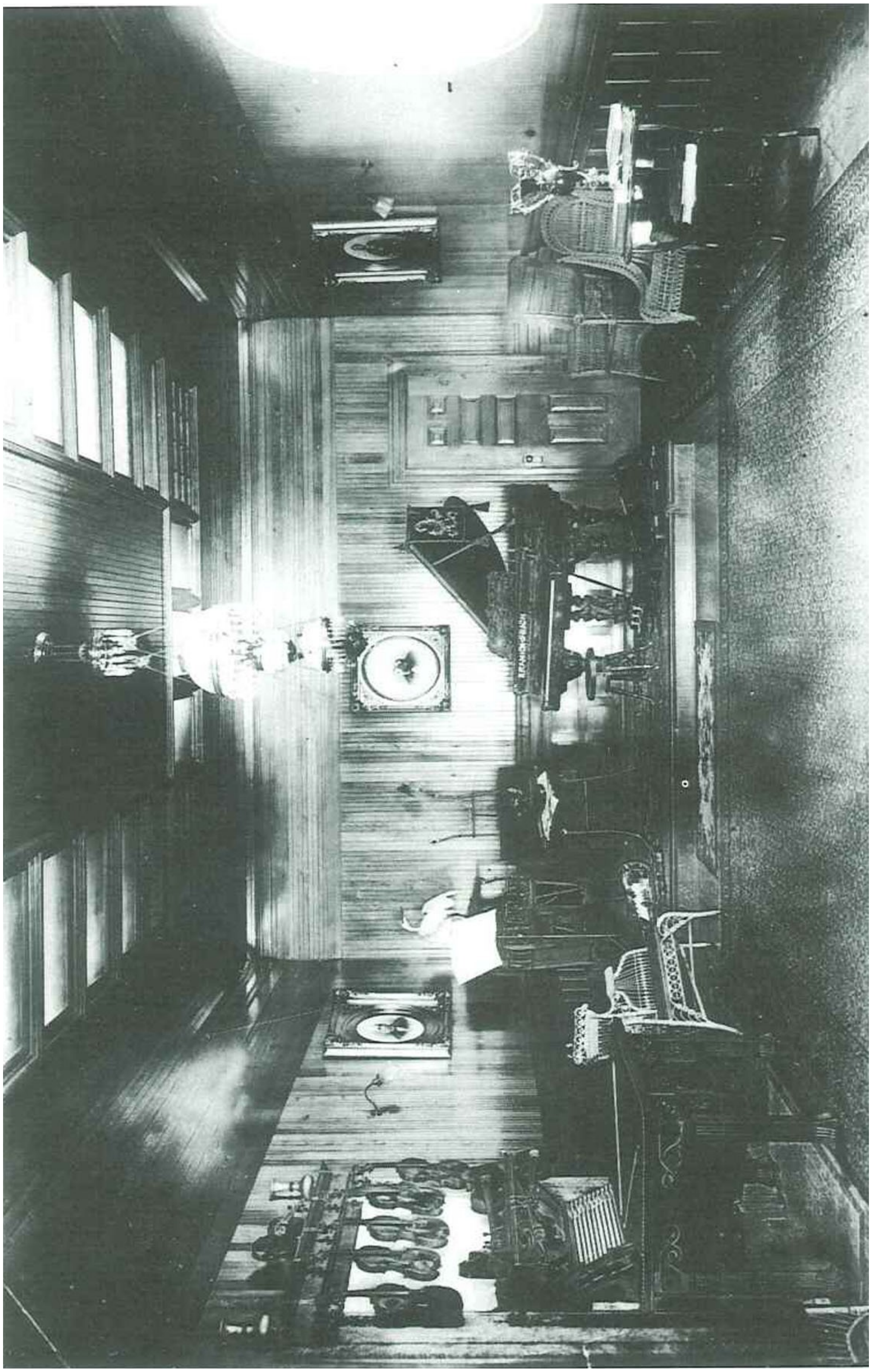


Figure H2: The Granger Music Hall Ca. 1896 prior to the 1898 expansion. Note the original stage platform, door locations, wood flooring, lighting, and fireplace mantel. These features have been modified; but the original paneled walls, wood wainscot, skylight, and coved ceiling remain intact.

Figure H3: The 1898 Performance Room showing the decorative painted murals and organ screen. These features remain mostly intact.

Figure H4: The 1898 Performance Room looking toward the 1896 portion of the building. Note the fireplace mantel has changed since the 1896 photo, but it does not match the current mantel.

Figure H5: The 1898 Performance Room looking toward the stage and organ screen.

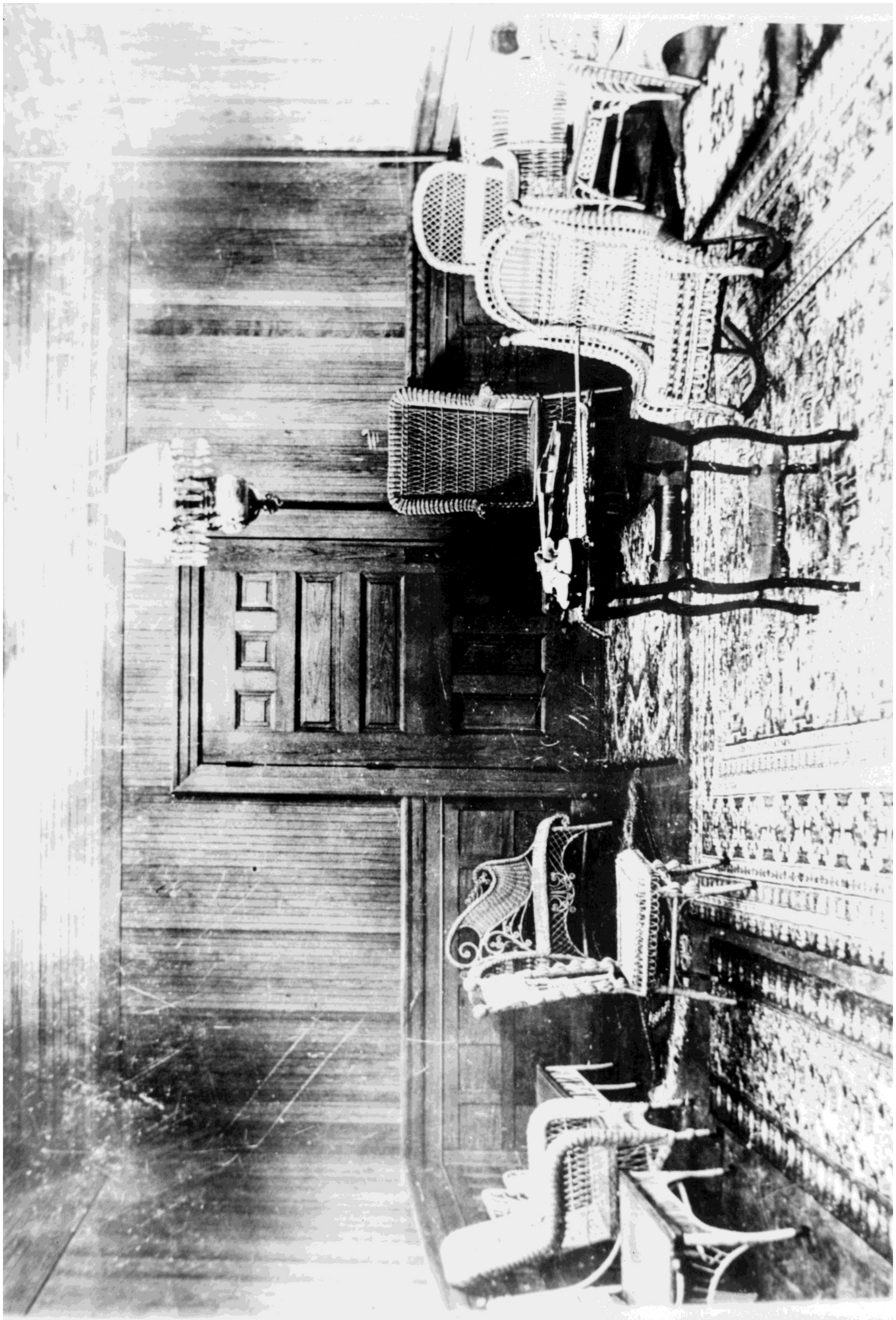


Figure H6: The 1896 Music Room looking at the front entry.

Figure H7: HABS photo (1980) looking east at the stage and organ screen. Note the decorative circular screen in the ceiling has been removed.

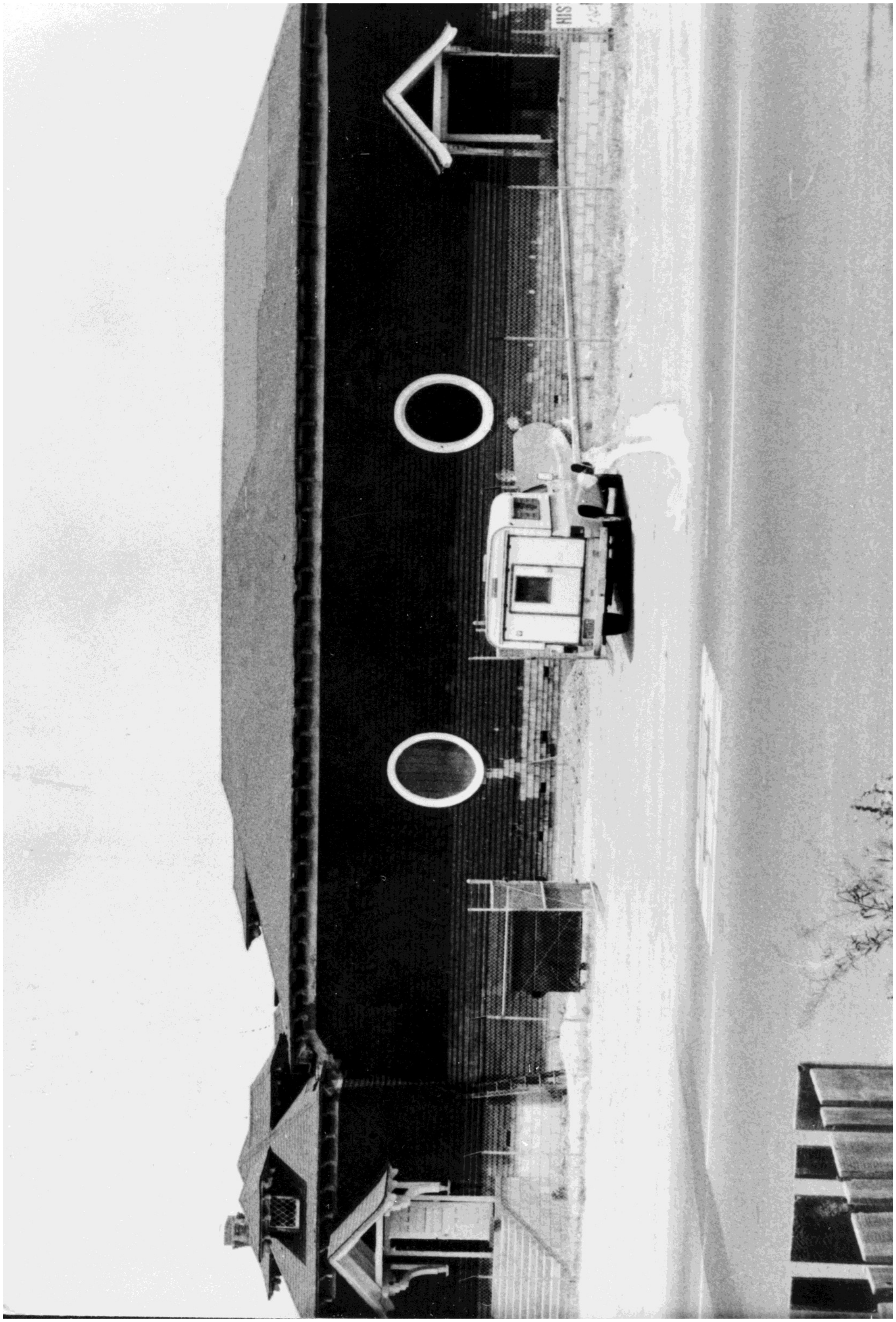


Figure H8: HABS photo ca. 1972 after the relocation

Figure H9: HABS photo ca. 1980 showing the Granger Music Hall after the relocation

2010 PHOTOGRAPHS

Figure 1: Granger Music Hall looking north, 2010.

Figure 2: Granger Hall in 2010 looking north at the main entry showing the historic porch roof, non-historic concrete steps, and non-historic metal railings. The building was raised approximately 30 inches when it was relocated in 1972.

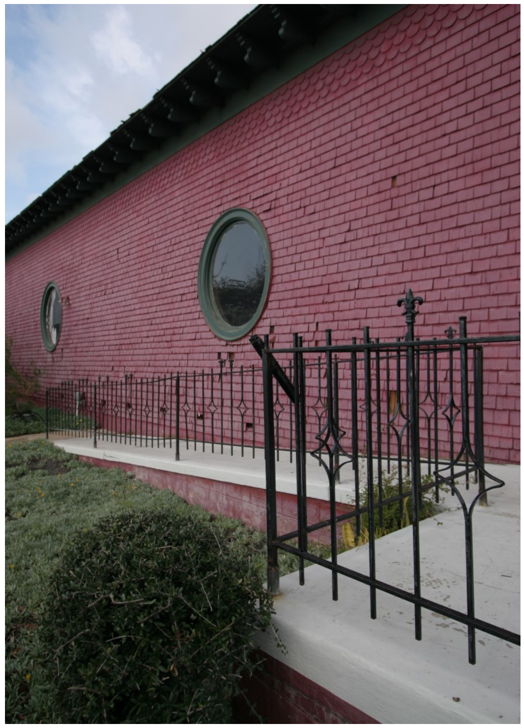


Figure 3: Granger Hall in 2010 looking northwest at the non-historic concrete ramp to the main Performance Room entry.

Figure 4: Granger Hall in 2010 looking east at one of the historic porch roofs. The front columns have been added and the porch landing and metal handrails are non-historic.

Figure 5: Typical eave condition showing the V-groove tongue-and-groove sheathing and elaborately shaped rafter tails, 2010.

Figure 6: Granger Hall in 2010 looking east at the original dormer windows which feature wood diamond pattern divided lite windows, flared eaves, and shaped rafter tails.

Figure 7: Granger Hall in 2010 looking southeast at the non-historic chimney. The location is historic, but the construction is ca. 1972 dating to the previous relocation.

Figure 8: Granger Hall in 2010 looking east at the non-historic CMU restroom addition.

Figure 9: Granger Hall in 2010 looking west at the rear entry. The concrete steps and metal handrail are non-historic.

Figure 10: A brick outbuilding at the east side of the site in 2010. The date of construction is unknown.

Figure 11: A wood shed structure at the east side of the site in 2010. The construction date is unknown.

Figure 12: The original 1896 Music Room looking north in 2010. Note the original paneled walls coved ceiling, skylight, and wainscot. The elaborate wood screens and fluted columns on the east wall were added when the building was expanded in 1898.

Figure 13: The original 1896 Music Room looking east toward the 1898 Music Room, 2010.

Figure 14: The 1896 Music Room looking south toward the main entry door, 2010.

Figure 15: The 1896 Music Room looking up at the historic skylight and ceiling, 2010.

Figure 16: The 1896 Music Room looking west at the fireplace in 2010. The mantel is historic (probably salvaged from another historic building), but it is not original to this building. It was likely installed after the 1972 relocation.

Figure 17: A detail of the elaborate wood screen on the east wall of the 1896 Music Room., 2010

Figure 18: The transition between the 1896 and 1898 sections of the building in 2010. This is the location where the building would be separated for relocation.

Figure 19: A view of the ceiling in the transition space between the 1896 and 1898 portions of the building in 2010. The paneling would be removed, cataloged, and salvaged to separate the building.

Figure 20: The Performance Room (added in 1898) looking west, 2010.

Figure 21: The Performance Room looking west., 2010.

Figure 22: The Performance Room looking east showing the historic stage, organ screen, wood wainscot, oval windows, and decorative ceiling paint, 2010.

Figure 23: The Performance Room looking east at the elaborately detailed wood organ screen and stage, 2010.

Figure 24: A detail of the carved wood organ screen, 2010.

Figure 25: One of the four oval windows in the Performance Room, 2010.

Figure 26: A detail of the ceiling mural in the Performance Room, 2010.

Figure 27: The south side of the stage looking east at the door to the backstage area, 2010.

Figure 28: The north side of the stage looking east at the rear exit, 2010.

Figure 29: The backstage area showing remnants of the historic organ in 2010. The organ has been removed.

Figure 30: The backstage area showing remnants of the historic organ, 2010.

Figure 31: The organ loft looking southwest toward the wood organ screen, 2010.

Figure 32: The non-historic kitchen, 2010.

Figure 33: The non-historic women's restroom in 2010. The existing stalls and fixtures do not comply with current accessibility standards.

Figure 34: The non-historic men's restroom looking east at the lavatory and partitions, 2010.

2017 PHOTOGRAPHS

Photo 1: May 2017 view of the east portion of the front (south) façade.

Photo 2: West end of the Performance Room on the south façade, 2017.

Photo 3: Main entry to the Music Room, looking north, 2017.

Photo 4: West side view of the Music Room entry canopy, 2017.

Photo 5: Southwest corner. Note the damaged roof tarp and the brick chimney, 2017.

Photo 6: West façade showing the Music Room and Office/Kitchen addition, 2017.

Photo 7: North wall of the Music Room, 2017. Note the boarded-up window.

Photo 8: Northwest circular window and the non-historic restroom addition, looking southeast, 2017.

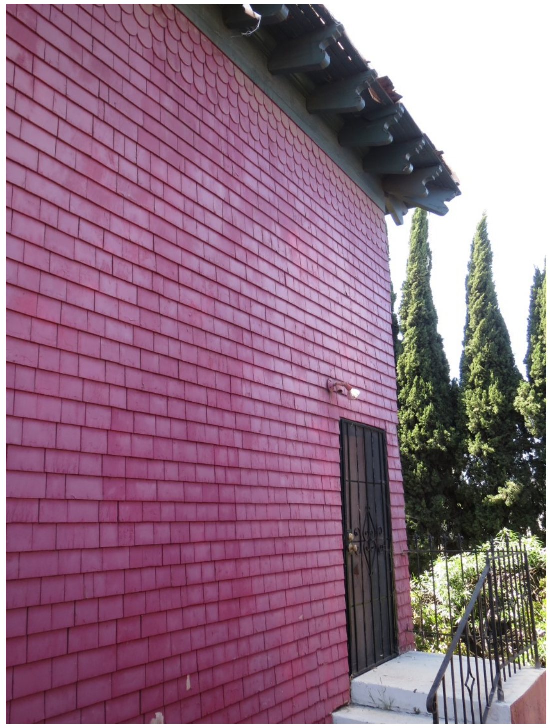


Photo 9: Partial east façade showing the side exit and stair, 2017.

Photo 10: Southeast corner, looking north, 2017.

Photo 11: Example of the damaged paint and wood shingle siding adjacent to the wheelchair ramp, 2017.

Photo 12: Close-up of damaged shingle siding on the south façade, 2017.

Photo 13: Upper south wall showing the fish scale shingles and roof eave, 2017.

Photo 14: Damaged roof eave boards and shaped rafter tails, 2017.

Photo 15: Close-up of the east entry canopy showing the peeling paint and dryrot damage, 2017.

Photo 16: Base of a wood support post at the east canopy showing termite damage, 2017.

Photo 17: The Performance Room, looking west, 2017.

Photo 18: The east end of the Performance Room ceiling showing severe water damage which has caused areas of plaster to collapse, 2017.

Photo 19: The west end of the Performance Room showing damaged ceiling plaster caused by leaking rain water, 2017.

Photo 20: A fallen section of the west ceiling fabric with damaged plaster décor, 2017.

Photo 21: The northeast circular window which was broken by vandals, 2017.

Photo 22: Skylight in the Music Room with a missing panel, 2017.

Photo 23: Proposed relocation site off of Goesno Place, east of Pepper Park, looking northeast, 2017.

Photo 24: Proposed relocation site, looking northwest, 2017.

E. RELOCATION & RESTORATION RECOMMENDATIONS

EXTERIOR RECOMMENDATION

General Recommendations:
A termite inspection and tenting is recommended. Additionally, the City should consider installing an automatic fire sprinkler system throughout Granger Music Hall, being careful not to further damage the historic decorative ceiling.

Site:
It is assumed that existing site features such as the fountain, paving, outbuildings, and fencing at the current site will be removed and the site will be left open. No future use for the existing site has been identified. A comprehensive site improvement plan will be required for the new site. Conceptual costs for development of the new site at Pepper Park are included in this study.

In the event that Granger Music Hall is restored in place and not moved, the existing fountain, paving, outbuildings, and fencing will be retained and the restroom building will be upgraded.

Foundation:
The existing foundation will be demolished following relocation of the building. A new foundation will be constructed at the new site. The new foundation will include CMU stem walls with internal pier support similar to the existing foundation. However, the new foundation will be lower to the ground to more closely match the historic foundation height.

Paint:
All painted exterior surfaces should be prepped, primed, and painted. Prep should include removal of loose and flaky paint to expose a sound substrate with feather sanding and filling to provide a smooth surface. Based on preliminary scraping of existing painted surfaces, it appears that the existing color scheme is similar to the historic colors. Samples collected can be visually inspected and matched by the architect or sent out for laboratory analysis to determine a detailed paint history and the exact historic color palette.

Walls:
The existing exterior shingles are in fair to poor condition. Moderate replacement will be required to facilitate relocation and placement on the new foundation. It is assumed for the purposes of the construction cost estimate that 50% of the existing shingles will need to be replaced.

Roof:
The existing roof is currently covered with a tarp because the roofing is in poor condition. A new fire-treated cedar shingle roof should be installed. The existing roof sheathing was not accessible for inspection, but it is assumed that some of the existing sheathing (assume 40%) will also likely require replacement. The V-groove tongue-and-groove sheathing at the eaves is in fair to poor condition. It is assumed that approximately 40% will require repair or be impacted by the relocation which will require cutting the eaves at four locations for the crane

"pick points." The rafter tails appear to be in fair to good condition, an assumed 30% replacement would likely be adequate for budgeting.

Porches:
The existing porch roofs are in fair to poor condition. The non-historic front posts (2 per porch) should be removed to match the historic appearance. It is likely that additional anchoring and structural support will be required to facilitate the original cantilever. The existing porch platforms, steps, ramp, and handrails are non-historic and will require replacement and reconfiguration for the relocation.

Windows:
The existing oval windows at the Performance Room are, overall, in fair condition. As noted previously, the northeast circular window was broken and the opening is sealed with plywood. The paint on the exterior frames is in poor condition and the wood is deteriorated. They require repair. The existing non-historic glass should be replaced with "restoration glass" to recreate the historic appearance. There is evidence in the historic photographs that there was a center mullion or exterior storm windows, but additional research is required.

The existing dormer windows were mostly covered and could not be inspected at the time of the field survey. It is assumed that some repair will be required at all windows.

Chimneys:
The chimney should be reconstructed with a clay brick that is appropriately sized. The existing brick is too large. Additional research is required to determine how the original chimney was detailed.

INTERIOR RECOMMENDATIONS

1896 Music Room:
The existing carpet and vinyl flooring should be removed and the wood floor refinished. The non-historic door to the non-historic office/storage/kitchen room should be removed and walled-over using matching wood paneling and wainscot. The existing door to the non-historic kitchen is in a historic door location so it should be retained and a new wood door matching the historic photographs should be installed. In general, all of the existing doors have non-historic hardware. Period-appropriate hardware should be provided for all doors while still providing code-required exit devices and meeting current accessibility standards. The existing ceiling and wall-mounted lighting in the Music Room is non-historic. Historic photographs should be used as a model to find appropriate reproduction light fixtures. The existing fireplace mantel is not original to the building, but it can be kept in the building as it does not detract from the historic character. The original location from which the mantel was salvaged should be researched and inscribed somewhere so it will be clear to future researchers that it is not original to the building. Seven of the original 26 glass panels in the skylight have been replaced with non-historic textured glass. The non-historic glass should be removed and replaced with matching textured art glass. There also appears to be a missing panel.

Performance Room:
Failure of the roof tarp led to the collapse of two areas of the hand-painted ceiling in the Performance Room (refer to Photos 18 & 19). Repair is required on the ceiling plaster to address this damage as well as other minor bulges. While much of the historic decorative painting is intact, new infill painting is required where damage has occurred. Historic photographs indicate that the palm leaf pattern in the four corners was repainted in reverse (with a light background and dark leaves instead of light leaves on a darker background). Compare Figures H3 and 22. This detail should be repainted to match the historic photographs. The ceiling should be inspected and stabilized to prevent further damage.

The two decorative vent screens on the ceiling, currently covered with plywood, should be repaired. The existing carpet should be removed and the original wood floor refinished. Non-historic track lights on the side walls should be removed. A vandalized section of original wood wainscoting between the Kitchen and Performance Room should be restored as well.

If the building is moved as proposed, Granger Music Hall would be cut into three sections; 1) at the connection between the Music Room and Performance Room and 2) in the middle of the Performance Room. This is so the building can traverse the move route on a flatbed truck. Once Granger Music Hall is reassembled on a new foundation, the areas where the cuts occurred need to be patched and restored to match the historic conditions.

Stage, Backstage, and Organ Loft:
Existing debris in the backstage storage rooms should be removed prior to relocating the building.

Restrooms:
If the building is moved, the existing restroom wing should be removed. Some wall repair on the historic building at the location of the addition will likely be required. A new code compliant detached public restroom structure should be constructed at the new site. For budgeting purposes it is assumed that the new restrooms will include approximately the same number of fixtures as the existing facilities. If Granger Music Hall is not moved, the existing restroom building should be gutted and remodeled with new fixtures and full disabled compliance.

Kitchen & Storage Room:
These rooms are non-historic. It is likely that the door which currently leads to the kitchen originally served as a rear exit. If the building is moved, it is recommended that the kitchen and storage room be removed and a new porch be added at the remaining door to match the porches in front. The door to the storage room should also be removed.

ACCESSIBILITY RECOMMENDATIONS

Ramps:
Since the relocated structure can be placed closer to the ground (to match its historic appearance) the ramp to the Performance Room can be significantly reduced in length. It may be possible to provide a 1:20 slope ramp which will not require handrails.

Stairs:
The stairs to the front porch should be reconstructed in wood to match the historic steps. Originally there were no handrails, but handrails will be required by current code.

STRUCTURAL ASSESSMENT & RECOMMENDATIONS SUMMARY

The overall structural condition of the Granger Music Hall is fair to good. There are no major signs of structural defects, other than water and termite damage. The foundation system was installed in 1972 when the building was relocated to the current site. In general, there appear to be adequate solid wall lengths which provide acceptable seismic shear capacity. The structural members of the roof were not accessible for survey, but there are no obvious signs of any major structural deficiencies. There are tarps and minor plaster damage, indicating persistent water leaks which over time will cause deterioration of the roof structure. The attic and roof should be inspected by a structural engineer and repaired and stabilized as required.

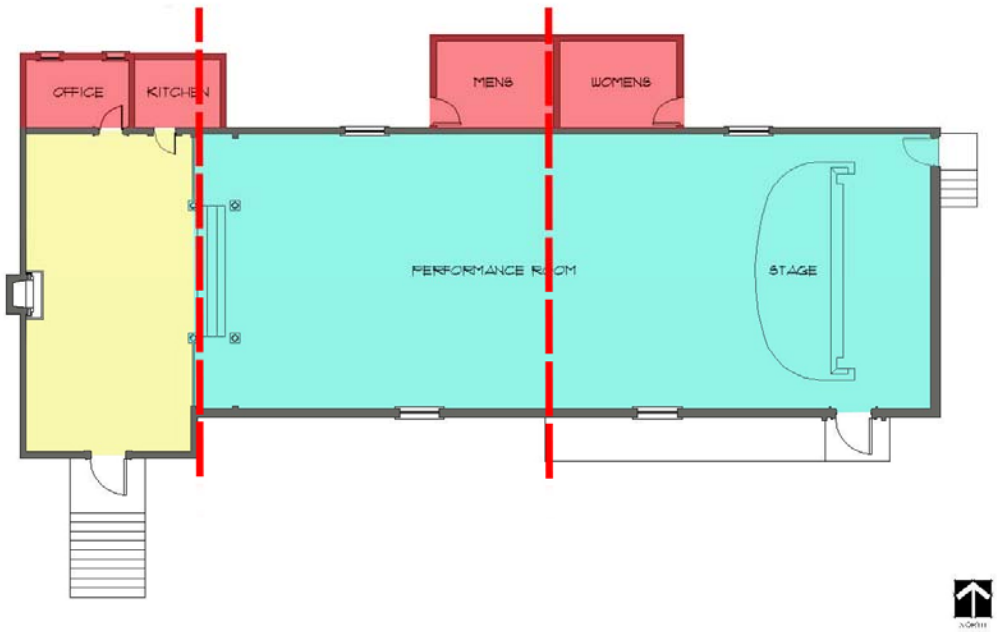
The relocation will likely not trigger a full seismic upgrade to the building because there is no proposed change in use. The relocation will require construction of a new foundation. The new foundation can be constructed in a similar manner as the existing foundation with perimeter stem walls and internal pier footings at existing support locations. The new foundation should also be built lower to the ground to match the historic condition. A minimum clearance of 18-inches below floor joists and 12-inches below beams will be required. It appears that these clearances can be accommodated with only minor excavation below the 1896 portion of the building, but the 1898 Performance Room sits lower to the ground and will require additional excavation below the floor. The moving contractor will be required to provide structural shoring for the relocation and coordinate with the architect to insure that significant architectural finishes and features are not disturbed during the relocation.

A detailed structural assessment by Dodd & Associates (from 2010) is included in the Appendix of this study.

RELOCATION SUMMARY

This study includes the scenario where Granger Music Hall is not moved, but restored in-situ. If this is the case, then the following relocation description would not apply.

The relocation of the Granger Music Hall will require cutting the building into three pieces. The building will be cut at the joint between the 1896 section and the 1898 addition and also at the center of the Performance Room. When the building was previously relocated, it is assumed that it was also cut at the joint between the 1896 and 1898 portions. The cut will require removal of the existing; wood handrail, ceiling sheathing, and wainscot (refer to Figures 18 and 19). These items should be carefully removed and cataloged so they can be reinstalled after the relocation. The existing steps appear to be non-historic (they are entirely clad in carpet). New steps should be constructed in wood to match the flooring. Additional work will include re-roofing and replacement of exterior shingles at the cut locations.



In the plan above, the dashed red lines indicate the proposed cuts for the move and the red shaded areas indicate non-historic additions to be removed.

The building transport will involve a crane, flatbed truck, and a barge towed by a tugboat. A relocation scheme has been identified by John T. Hansen Enterprises including a proposed route which will include movement on city streets to the Marine Group Boat Works at 997 G Street, Chula Vista, CA 91910 (refer to the route map in the Appendix).

John T. Hansen Enterprises would "Cut building into three, jack up, load each piece, move, setting down and shoring. Other[s] to pay for all barge and tug boats, and crane if needed. Also, other[s] to pay for all overhead wire crews, SDG&E, Cox, AT&T, and turning of signal lights and moving of trolley lines for move."

A barge on the bay is needed to avoid street routes that pass under Interstate 5, which would not provide the required vertical clearance. The exact location for the barge loading and unloading will need to be verified and coordinated with the Port District prior to the relocation. If alternate locations are required, there may be impacts to the crane and relocation costs due to available clearances which could affect the size of crane required. Additionally the exact weight of the structure is unknown. Assumed weights have been applied based on the building size for the purposes of providing an approximate cost for the relocation.

Marine Group Boat Works (MGBW) would: "Lift barge to quay wall height, stand by and adjust barge level as other[s] roll structure aboard. Other[s] to provide trench plate to facilitate bridging wall and plate. Any fencing modifications to enter the yard will be for others account.

- Granger section[s] arrive to MGBW on a flatbed as a unit.
- MGBW uses travelift to lift the barge so that top deck is flush against pavement.
- Unit drives onto the barge.
- Barge is tugged to Pepper Park."

An updated scope of work, fee, and supporting documents by John T. Hansen Enterprises and Marine Group Boat Works are included in the Appendix. The construction cost estimate is included in Section F of this study.

F. OPINION OF PROBABLE CONSTRUCTION COSTS (2017)

Weisbecker Consulting Services prepared the following preliminary Opinion of Probable Construction costs for two scenarios: 1) Relocation and Rehabilitation, and 2) In Situ Rehabilitation.

The itemized estimates are provided on the following pages. Here are the totals of the two scenarios:

Relocation and Rehabilitation:

Relocation	$1,024,249.
Rehabilitation & Site Work	$1,328,961.
TOTAL	**$2,353,210.**

In Situ Rehabilitation:

TOTAL	**$564,329.**

Description	*Quantity*	*Unit*		*Unit Price*		*Total*		*Subtotals*
Site work								
Pergola 24' x 36'	1	LS		$25,000		$25,000		
Pergola 24' x 44'	1	LS		$30,000		$30,000		
Sliding Gate - Manual	3	LS		$7,500		$22,500		
Storage Bldg with interior food prep, sink, storage and counter 12' x 24	242	SF		$400		$96,800		
Retaining Wall 36" max height	100	LF		$110		$11,000		
Driveway Aprons	120	SF		$50		$6,000		
Bollards	6	EA		$1,000		$6,000		
Wrought IronFence	360	LF		$65		$23,400		
Terrace Patio with Planters	1,000	SF		$20		$20,000		
Landscaping	3,750	SF		$8		$30,000		
Irrigation	3,750	SF		$5		$18,750		
Paving	9,500	SF		$10		$95,000		
Trees 36" Box with Grate	6	EA		$1,200		$7,200		
Trees 24" Box with Grate	2	EA		$900		$1,800	$	393,450.00
Exterior Work								
Earthwork - Site Clearing	38000	sf	$	0.35	$	13,300.00		
Demolition - Remove Existing Out Bldgs	1	ls	$	5,000.00	$	5,000.00		
Demolition - Foundation	3300	sf	$	4.00	$	13,200.00		
Demolition - Chimney	1	ls	$	2,000.00	$	2,000.00	$	33,500.00
Termite Inspection and Tenting	1	ls	$	4,500.00	$	4,500.00		
Automatic Fire Sprinkler System	3300	sf	$	7.00	$	23,100.00		
Site Electrical, Data	100	lf	$	250.00	$	25,000.00		
Site Water Line - Fire 100' max	1	ls	$	40,000.00	$	40,000.00		
Site Sewer Lateral	100	lf	$	150.00	$	15,000.00	$	107,600.00
Concrete								
Excavation @ Music Room	700	sf	$	2.00	$	1,400.00		
Excavation @ Hall	2600	sf	$	3.00	$	7,800.00		
Perimeter Footing	305	lf	$	50.00	$	15,250.00		
Spread Footings	10	CY	$	750.00	$	7,500.00	$	31,950.00
Masonry - Stem Walls	1000	sf	$	25.00	$	25,000.00		
Masonry - Clay Fire Brick Chimney	1	ls	$	7,500.00	$	7,500.00	$	32,500.00
Rough Framing								
Framing - Anchor Bolts and Straps	1	ls	$	5,000.00	$	5,000.00		
Sill Plate	305	lf	$	8.00	$	2,440.00		
New Exterior Wood Shingles - 50%	2500	sf	$	9.00	$	22,500.00		
New Roof Sheathing @ 40%	1360	sf	$	5.00	$	6,800.00		
Repair V- Groove at Eaves 40%	360	sf	$	14.00	$	5,040.00		
Replace Rafter Tails @ 30%	33	ea	$	750.00	$	24,750.00		
Cut and Repair Eaves for Crane	1	ls	$	2,500.00	$	2,500.00		
Shoring @ Porch	2	ea	$	1,500.00	$	3,000.00		
Repair Porch Roof Framing	1	ls	$	3,500.00	$	3,500.00	$	75,530.00
Roofing								
Demolition	4300	sf	$	1.25	$	5,375.00		
Demolition - sheathing @ 40%	1360	sf	$	2.00	$	2,720.00		
Fire Treated Cedar Shingles	4300	sf	$	9.00	$	38,700.00		
Fire Treated Cedar Shingles @ Porch	200	sf	$	9.00	$	1,800.00	$	48,595.00

Windows								
Repair Oval Windows	4	ea	$	500.00	$	2,000.00		
Replace Glazing @ Oval Windows	4	ea	$	400.00	$	1,600.00		
Repair Dormer Windows	1	ls	$	6,000.00	$	6,000.00	$	9,600.00
Painting								
Lead Abatement - Allowance	1	ls	$	5,000.00	$	5,000.00		
Prep	6500	sf	$	2.00	$	13,000.00		
Exterior - Walls and Windows	5000	sf	$	1.50	$	7,500.00		
Exterior - Soffits, Rafter Tails	1500	sf	$	1.50	$	2,250.00		
Exterior - Doors	4	ea	$	250.00	$	1,000.00	$	28,750.00
Exterior subtotal						$761,475	$	761,475.00
Exterior Contingency @ 10%					$	76,147.50		
Interior Work								
Demoltion								
Carpet	3300	sf	$	1.00	$	3,300.00		
Doors	2	ea	$	100.00	$	200.00		
Debris in Storage Rooms	1	ls	$	250.00	$	250.00		
Light Fixture	1	ea	$	150.00	$	150.00		
Track Lighting	1	ea	$	150.00	$	150.00		
Skylight - Glazing only	7	ea	$	50.00	$	350.00	$	4,400.00
Framing								
Infill Door Opening with Wainscoat	1	ls	$	2,500.00	$	2,500.00		
Refinish wood floors	3300	sf	$	5.00	$	16,500.00		
Ceiling and Paneling Repairs	1	ls	$	10,000.00	$	10,000.00	$	29,000.00
Sheet Metal								
Repair Decorative Vent Screens	2	ea	$	1,500.00	$	3,000.00	$	3,000.00
Lath and Plaster								
Ceiling Repair	1	ls	$	10,000.00	$	10,000.00	$	10,000.00
Doors Frames and Hardware								
Exterior Door to match historic photos	1	ls	$	2,500.00	$	2,500.00		
Hardware - Period Appropriate	4	ea	$	850.00	$	3,400.00		
Hardware - Closure	4	ea	$	750.00	$	3,000.00	$	8,900.00
Glazing								
Textured Art Glass to match existing	7	ea	$	250.00	$	1,750.00	$	1,750.00
Painting								
Repaint Palm Leaf Patterns	4	ea	$	2,000.00	$	8,000.00		
Decorative Paint Restoration	1	ls	$	20,000.00	$	20,000.00	$	28,000.00
Electrical								
New Fixture - Period Appropriate	1	ea	$	3,000.00	$	3,000.00	$	3,000.00
Interior subtotal					$	88,050.00	$	88,050.00

Interior Contingency@ 10%					$	8,805.00		
Restroom Bldg								
Demolition	285	sf	$	25.00	$	7,125.00		
Repair Bldg Wall @ location	1	ls	$	7,500.00	$	7,500.00		
Replace Restroom Bldg	285	sf	$	300.00	$	85,500.00	$	100,125.00
Kitchen and Storage Rooms								
Demolition	160	sf	$	25.00	$	4,000.00		
Repair Bldg Wall @ Location	1	ls	$	5,000.00	$	5,000.00		
New Porch to match existing	1	ls	$	20,000.00	$	20,000.00	$	29,000.00
Site Accessability								
ADA Ramp - Concrete @ Performance Room	100	sf	$	15.00	$	1,500.00		
Wood Framed Stairs with Handrails @ Music Room Porch	1	ls	$	12,500.00	$	12,500.00	$	14,000.00
Relocation								
John T Hansen	1	ls	$	506,359.00	$	506,359.00		
Bob's Crane	1	ls	$	15,151.20	$	15,151.20		
Marine Group	1	ls	$	16,500.00	$	16,500.00	$	538,010.20
Allowance - Overhead Wire Crews, SDGE, Trolley Lines, Signal Lights, and CHP.	1	ls	$	250,000.00	$	250,000.00	$	250,000.00
Relocation subtotal					$	931,135.20	$	931,135.20
Relocation Contingency @ 10%					$	93,113.52		
General Conditions	6	mnths	$	8,500.00	$	51,000.00		
Supervision	6	mnths	$	8,000.00	$	48,000.00		
Subtotal					$	2,057,726.22		
Overhead and Profit @ 8%					$	164,618.10		
Insurance @ 1.5%					$	30,865.89		
Subtotal					$	2,253,210.21		
Architectural and Engineering Fee's					$	100,000.00		
Total					$	2,353,210.21		

Description	*Quantity*	*Unit*	*Unit Price*	*Total*	*Subtotals*
Exterior Work					
Termite Inspection and Tenting	1	ls	$ 4,500.00	$ 4,500.00	$ 4,500.00
Automatic Fire Sprinkler System	3300	sf	$ 7.00	$ 23,100.00	$ 23,100.00
Site Water Line - Fire	1	ls	$ 40,000.00	$ 40,000.00	$ 40,000.00
Rough Framing					
New Exterior Wood Shingles - 50%	2500	sf	$ 9.00	$ 22,500.00	
New Roof Sheathing @ 40%	1360	sf	$ 5.00	$ 6,800.00	
Repair V- Groove at Eaves 40%	360	sf	$ 14.00	$ 5,040.00	
Replace Rafter Tails @ 30%	33	ea	$ 750.00	$ 24,750.00	
Cut and Repair Eaves for Crane	1	ls	$ 2,500.00	$ 2,500.00	
Shoring @ Porch	2	ea	$ 1,500.00	$ 3,000.00	
Repair Porch Roof Framing	1	ls	$ 3,500.00	$ 3,500.00	$ 68,090.00
Painting					
Lead Abatement - Allowance	1	ls	$ 5,000.00	$ 5,000.00	
Prep	6500	sf	$ 2.00	$ 13,000.00	
Exterior - Walls and Windows	5000	sf	$ 1.50	$ 7,500.00	
Exterior - Soffits, Rafter Tails	1500	sf	$ 1.50	$ 2,250.00	
Exterior - Doors	4	ea	$ 250.00	$ 1,000.00	$ 28,750.00
Roofing					
Demolition	4300	sf	$ 1.25	$ 5,375.00	
Demolition - sheathing @ 40%	1360	sf	$ 2.00	$ 2,720.00	
Fire Treated Cedar Shingles	4300	sf	$ 9.00	$ 38,700.00	
Fire Treated Cedar Shingles @ Porch	200	sf	$ 9.00	$ 1,800.00	$ 48,595.00
Windows					
Repair Oval Windows	4	ea	$ 500.00	$ 2,000.00	
Replace Glazing @ Oval Windows	4	ea	$ 400.00	$ 1,600.00	
Repair Dormer Windows	1	ls	$ 6,000.00	$ 6,000.00	$ 9,600.00
Exterior subtotal				$ 222,635.00	
Exterior Contingency@ 10%				$ 22,263.50	$ 22,263.50
Interior Work					
Demoltion					
Carpet	3300	sf	$ 1.00	$ 3,300.00	
Doors	2	ea	$ 100.00	$ 200.00	
Debris in Storage Rooms	1	ls	$ 250.00	$ 250.00	
Light Fixture	1	ea	$ 150.00	$ 150.00	
Track Lighting	1	ea	$ 150.00	$ 150.00	
Skylight - Glazing only	7	ea	$ 50.00	$ 350.00	$ 4,400.00

Framing					
Infill Door Opening with Wainscoat	1	ls	$ 2,500.00	$ 2,500.00	
Refinish wood floors	3300	sf	$ 5.00	$ 16,500.00	
Ceiling and Paneling Repairs	1	ls	$ 10,000.00	$ 10,000.00	$ 29,000.00
Sheet Metal					
Repair Decorative Vent Screens	2	ea	$ 1,500.00	$ 3,000.00	$ 3,000.00
Lath and Plaster					
Ceiling Repair	1	ls	$ 10,000.00	$ 10,000.00	$ 10,000.00
Doors Frames and Hardware					
Exterior Door to match historic photos	1	ls	$ 2,500.00	$ 2,500.00	
Hardware - Period Appropriate	4	ea	$ 850.00	$ 3,400.00	
Hardware - Closure	4	ea	$ 750.00	$ 3,000.00	$ 8,900.00
Glazing					
Textured Art Glass to match existing	7	ea	$ 250.00	$ 1,750.00	$ 1,750.00
Painting					
Repaint Palm Leaf Patterns	4	ea	$ 2,000.00	$ 8,000.00	
Decorative Paint Restoration	1	ls	$ 20,000.00	$ 20,000.00	$ 28,000.00
Electrical					
New Fixture - Period Appropriate	1	ea	$ 3,000.00	$ 3,000.00	$ 3,000.00
Upgrade Restroom Bldg	285	sf	$ 100.00	$ 28,500.00	$ 28,500.00
Upgrade Kitchen and Storage Rooms	160	sf	$ 100.00	$ 16,000.00	$ 16,000.00
Interior subtotal				$ 132,550.00	
Interior Contingency @ 10%				$ 13,255.00	$ 13,255.00
General Conditions	6	mnths	$ 7,500.00	$ 45,000.00	$ 45,000.00
Supervision	6	mnths	$ 8,000.00	$ 48,000.00	$ 48,000.00
Subtotal				$ 483,703.50	$483,703.50
Overhead and Profit @ 10%				$ 48,370.35	
Insurance @ 1.5%				$ 7,255.55	
Subtotal				$ 539,329.40	
Architectural and Engineering Fee's				$ 25,000.00	
Total				$ 564,329.40	

G. APPENDIX

Structural Assessment & Recommendations – Dodd & Associates (2010)

Scope and Cost Estimates

- John T. Hansen Enterprises
- Bob's Crane Service
- Marine Group Boat Works

Proposed Relocation Route

Conceptual Plan for the New Pepper Park Site (provided by KTU+A)

1972 Restoration Drawings

1976 HABS Drawings

Preservation Briefs

- PB4 Roofing for Historic Buildings
- PB9 Repair of Historic Wood Windows
- PB10 Exterior Paint Problems on Historic Woodwork
- PB21 Repairing Historic Flat Plaster Walls and Ceilings

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PHONE- (619)260-0057 **FAX**- (619)260-0046

February 25, 2010

Carmen M. Pauli
Principal/Architect
Heritage Architecture & Planning
625 Broadway, Suite 800
San Diego, CA 92101

Subject: Structural Assessment for the Relocation of Granger Music Hall

Dear Carmen,

As requested, we have reviewed the existing Granger Music Hall located at 1615 East Fourth Street, National City, for the purpose of the structural feasibility of relocating the structure to Sub-Area B-1 of the National City Harbor District (Bay Marina Drive and Cleveland Avenue). We understand that the current location of the structure is not its original site, but that it was moved here sometime in the past. The structure is approximately 100ft in length and mostly 32ft in width with a foyer approximately 44ft in width. The existing wood structure, including the floor framing, is to be re-attached to a new foundation at the new site location.

The existing vertical system for the building consists of a clear-span wood framed roof supported by exterior wood bearing walls which sit on top of CMU stem walls on concrete foundations. We were unable to verify roof members as there was no access available. The interior floor system consists of 6x8 wood beams spanning approximately 6ft. with 2x10 wood joists @ 16"o.c. running perpendicularly over the top of the beams. The beam lines are 6ft apart and supported by 20" square concrete isolated pad footings. It appears that the existing floor framing works for assembly loading and we see no need to replace or reinforce this floor system.

The existing lateral resisting system most likely consists of 1x diagonal planking on the roof as well as the exterior wood walls. We were unable to investigate the existing conditions but the 1x planking was typical for the period. No change in occupancy is being filed, so there are no structural/seismic upgrades required for the relocation of the building. Existing wood shearwalls and diaphragms are to remain and be replaced in kind as required due to any damage or removal required by the relocation. Not providing a full seismic upgrade of the building does not appear to be an issue due to the significant amount of existing solid wall lengths on all sides of the building and a continuous roof diaphragm as well. Even with existing openings in the roof and walls, the diaphragms appear to be sufficient to transfer lateral loads to the foundation.

New foundations and anchorage need to be designed under the 2007 CBC. The new foundation is to consist of isolated concrete pad footings and solid grouted masonry exterior stem walls on new concrete footings. The building will be re-located in two pieces and will be re-connected at the new site location with the use of steel straps and new diaphragm elements (both horizontal and vertical) as required. The existing building is to be connected to the new foundation with the voluntary use of new steel strap holdowns and anchored to a new sill plate as well. The holdown system is not required as it currently does not exist, but will provide additional anchorage for the structure. All foundation elements will be located to allow a minimum of 18" clearance from the bottom of wood floor beams/joists to soil.

Additional buildings/rooms not part of the historic building, at the East Fourth street site, are not to be relocated to the new site. The re-construction, if any, of these structures, including restrooms, will not be part of the current relocation plans.

We appreciate the opportunity to provide this structural assessment for the relocation of the Historic Granger Music Hall and look forward to our further involvement in the project.

Regards,

Dodd and Associates

Jerry Dodd

9822 ½ Hawley Road
El Cajon, CA 92021
Office (619)443-7400
Fax (619)443-7402

John T. Hansen Enterprises

June 6, 2017

RE: Granger Music Hall – Prevailing Wage Project

Heritage Architecture & Planning;

$506,359.00 - Cut building into three, jack up, load each piece, move, setting down and shoring. Other to pay for all barge and tug boats, and crane if needed. Also, other to pay for all overhead wire crews, SDG&E, Cox, AT&T, and turning of signal lights and moving of trolley lines for move. Floor plans will need to be submitted to Marine Group.

$47,500.00 - Marine Group (Barge & Tug Boat)

Route is as follows:
(West) East 4th Street
(South) Roosevelt Avenue
(East) West 16th Street
(West) East 16th Street
(South) Highland Avenue
(West) C Street
(South) Broadway
(West) F Street
(West) Lagoon
(South) Marina Pkwy
(West) G Street

Bob's Crane Service

ESTIMATE

Date: 7/21/2017
Customer: John T. Hansen Enterprises
Attention: Mr. Joe Hansen
Customer Address: 14315-B Old Hwy. 80 , El Cajon, CA 92021
Project Name: Historical Granger Music Hall
Project Address: 1615 E 4th St National City Ca 91950

Phone: (619)518-2903
Fax: (619)443-7402
Email: hansenhousemovers@cox.net
Cell: (619)518-2903

Bobs Crane Service is pleased to submit an Estimate for the above project.

Scope of work: one of two cranes to load and offload 100,000# house at two different locations.

Crane Capacity: 275
Weight of Load: 100,000
Working Radius: 50
Cap at Radius: 64,000
Boom Length & Jib: 150'
Rigging Required: Radios / to be determined

Counter Weight: FULL
Date Required:
Total Employees on site: 5
Total Trucks: 3

	ST	OT	DT
Estimated Truck Hours:	16	0	0
Estimated Crane Hours:	16	0	0

Special Instructions: two crane pick

Pricing		ST Time	OT/SAT	DT/SUN
***Crane Hourly Rate:**		$ 510.00	$ 620.00	$ 730.00
Accessory Haul:		$ 240.00		
Counter Weight / Haul in:	3	$ 360.00	$ 525.00	$ 690.00
Counter Weight / Haul out:	3	$ 360.00	$ 525.00	$ 690.00
Trucking Rate:		$ 120.00		
Qualified Rigger/Signalman:	0	$ -	$ -	$ -
Trucking Total		$ 6,000.00	$ -	$ -
7% Fuel/Inc/CA Emissions:		$ 991.20		
(to be added to Total Invoice)				

Subsistence: $120.00 if applicable
Lift Plan: NC BCS Form-GC or Base Forms $100
Site Specific Training: $120.00 P/MR + applicable charges
Crane Standby: $ 510.00 Per Hour
Long Boom Rates: Included
Permits & Licenses: Included
Traffic Control: 0 (by others)
Yard-Load/off-Load: 0

***All Projects Charged Portal-To-Portal**
(From the time Equipment/Personnel leave the yard, until Equipment/Personnel return to the yard.)

"Estimated" Cost **$ 15,151.20**

Payment Terms: Net 30

This price is an Estimate Only and is not intended to be a final contract price.
ACTUAL HOURS WORKED WILL BE INVOICED FOR.

Thank you for the opportunity to present this Estimate

Leo Zent *7/21/2017*

Date

Authorized Signature Date

Purchase Order: 0

TERMS AND CONDITION

*Estimate is valid for 30 days and equipment is subject to availability.
*Overtime Applies before 6am, after 5pm, work in excess of 8 hrs., & Saturday.
*Double Time: Applies to work in excess of 12 Hrs., and Sunday
*Hourly rates are subject to 4,6,8, hr. Minimums, in accordance with Local 12 Union Agreement
*All site required safety training, drug testing, and/or badging will be charged at published rates.
*Pricing does not include cost for delays, damages, restricted job sites, or site changes, and may be subject to additional charges.
*Employees shall have 1/2 hour meal period after 5 hours, or double time will be charged for 1/2 hour.
*Equipment held over on a job will be subject to an 8 hr. minimum the following day whether working or not.
*Customer is responsible for providing adequate access, ground bearing conditions, ingress, work space, lighting, and non-standard rigging.
*Bob's Crane Service personnel work under the direction of others and shall not be deemed as working in the capacity of supervisor or lift director.
*Customer is responsible for permits, street closures, and traffic control.
*Bob's Crane Service will not be responsible for damage to asphalt, concrete, driveways, underground utilities, or irrigation systems,and site improvements.
*Fuel/Insurance/CA emissions will be added to the invoice total.
*Rigging and unrigging of the load will be the responsibility of the customer U.N.U..

12101 HIGHWAY 67 · LAKESIDE · CA · 92040-1103 · 619-443-5887 · FAX 619-390-8279
www.bobscrane.com

Bob's Crane Service

ESTIMATE

Date:	7/21/2017
Customer:	John T. Hansen Enterprises
Attention:	Mr. Joe Hansen
Customer Address:	14315-B Old Hwy. 80 , El Cajon, CA 92021
Project Name:	Historical Granger Music Hall
Project Address:	1615 E 4th St National City Ca 91950

Phone:	(619)518-2903
Fax:	(619)443-7402
Email:	hansenhousemovers@cox.net
Cell:	(619)518-2903

Bobs Crane Service is pleased to submit an Estimate for the above project.

Scope of work: one of two cranes to load and offload 100,000# house at two different locations.

Crane Capacity:	350 as a 275
Weight of Load:	100,000
Working Radius:	50
Cap at Radius:	95k
Boom Length & Jib:	150'
Rigging Required:	Radios / to be determined

Counter Weight:	176		
Date Required:			
Total Employees on site:	6		
Total Trucks:	4		
Estimated Truck Hours:	16	0	0
Estimated Crane Hours:	16	0	0
	ST	OT	DT

Special Instructions: two crane pick

Pricing		ST Time	OT/SAT	DT/SUN
***Crane Hourly Rate:**		$ 510.00	$ 620.00	$ 730.00
Accessory Haul:		$ 240.00		
Counter Weight / Haul in:	4	$ 480.00	$ 700.00	$ 920.00
Counter Weight / Haul out:	4	$ 480.00	$ 700.00	$ 920.00
Trucking Rate:		$ 120.00		
Qualified Rigger/Signalman:	0	$ -	$ -	$ -
Trucking Total		$ 7,920.00	$ -	$ -
7% Fuel/Inc/CA Emissions: (to be added to Total Invoice)		$ 1,125.60		

Subsistence:	$120.00 if applicable
Lift Plan:	NC BCS Form-GC or Base Forms $100
Site Specific Training:	$120.00 P/MR + applicable charges
Crane Standby:	$ 510.00 Per Hour
Long Boom Rates:	Included
Permits & Licenses:	Included
Traffic Control:	0 (by others)
Yard-Load/off-Load:	0

***All Projects Charged Portal-To-Portal**
(From the time Equipment/Personnel leave the yard, until Equipment/Personnel return to the yard.)

"Estimated" Cost $ 17,205.60

Payment Terms: Net 30

This price is an Estimate Only and is not intended to be a final contract price.
ACTUAL HOURS WORKED WILL BE INVOICED FOR.

Thank you for the opportunity to present this Estimate

Leo Zent 7/21/2017

Date

Authorized Signature Date

Purchase Order: 0

TERMS AND CONDITION

*Estimate is valid for 30 days and equipment is subject to availability.
*Overtime Applies before 6am, after 5pm, work in excess of 8 hrs., & Saturday.
*Double Time: Applies to work in excess of 12 Hrs., and Sunday
*Hourly rates are subject to 4,6,8, hr. Minimums, in accordance with Local 12 Union Agreement
*All site required safety training, drug testing, and/or badging will be charged at published rates.
*Pricing does not include cost for delays, damages, restricted job sites, or site changes, and may be subject to additional charges.
*Employees shall have 1/2 hour meal period after 5 hours, or double time will be charged for 1/2 hour.
*Equipment held over on a job will be subject to an 8 hr. minimum the following day whether working or not.
*Customer is responsible for providing adequate access, ground bearing conditions, ingress, work space, lighting, and non-standard rigging.
*Bob's Crane Service personnel work under the direction of others and shall not be deemed as working in the capacity of supervisor or lift director.
*Customer is responsible for permits, street closures, and traffic control.
*Bob's Crane Service will not be responsible for damage to asphalt, concrete, driveways, underground utilities, or irrigation systems,and site improvements.
*Fuel/Insurance/CA emissions will be added to the invoice total.
*Rigging and unrigging of the load will be the responsibility of the customer U.N.U..

MARINE GROUP
BOAT WORKS
SAN DIEGO BAY | LOS CABOS

997 G Street
Chula Vista, CA 91910
Voice(619)427-6767
Fax (619)427-0324

Contract

Date	Contract No.
2/9/2010	5382
P.O. No.	

Hansen House Movers

ALL WORK CASH ON DELIVERY - LIMITED WARRANTY: 30 DAYS ON PARTS AND LABOR - MANUFACTURERS' WARRANTIES ONLY ON PARTS WITH ACCOMPANYING WARRANTIES

SEE REVERSE SIDE FOR DETAILS

Item	Description	Ordered	U/M	Rate	Total
Service - Comm...	1. Lift barge to quay wall height, stand by and adjust barge level as other roll structure aboard. Others to provide trench plate to facilitate bridging wall and plate. Quote provides for 6 hrs of yard and travel lift access. Any fencing modifications to enter the yard will be for others account.			16,500.00	16,500.00
				8.75%	0.00

3% Environmental fee will apply to total amount. Power will be charged at $0.26 per Kwh used.

WORK AUTHORIZATION AND DESIGNATION OF AGENT
I hereby authorize the above repair work to be performed. I acknowledge that I have received a copy of, and have read, understood and agree to the terms and conditions of this Contract, including those on the reverse side hereof. I hereby authorize______________________________ to act as my representative/agent with authority to contract for any additional work which may be requested or required.

OWNER____DATE_________

OWNER'S CLEAR RECEIPT
I have inspected the work performed under this Contract and find it to be satisfactory. I hereby acknowledge receipt of the within described vessel. I further acknowledge that all personal property on the vessel when originally delivered to The Marine Group, LLC has been accounted for and is in my possession. This acknowledgment is not a waiver of the limited warranty provided in paragraph 2 on the reverse side hereof.

____
Signature

Total	$16,500.00
Vessel Name	
Length	
Cf or Doc #	
Lifting weight	
Pwr or sail ?	

PROPOSED RELOCATION ROUTE

Granger Hall Relocation Concept Plan

SHEET | CITY OF NATIONAL CITY | SHEETS

APPROVED

DATE

SCALE

DRAWN BY

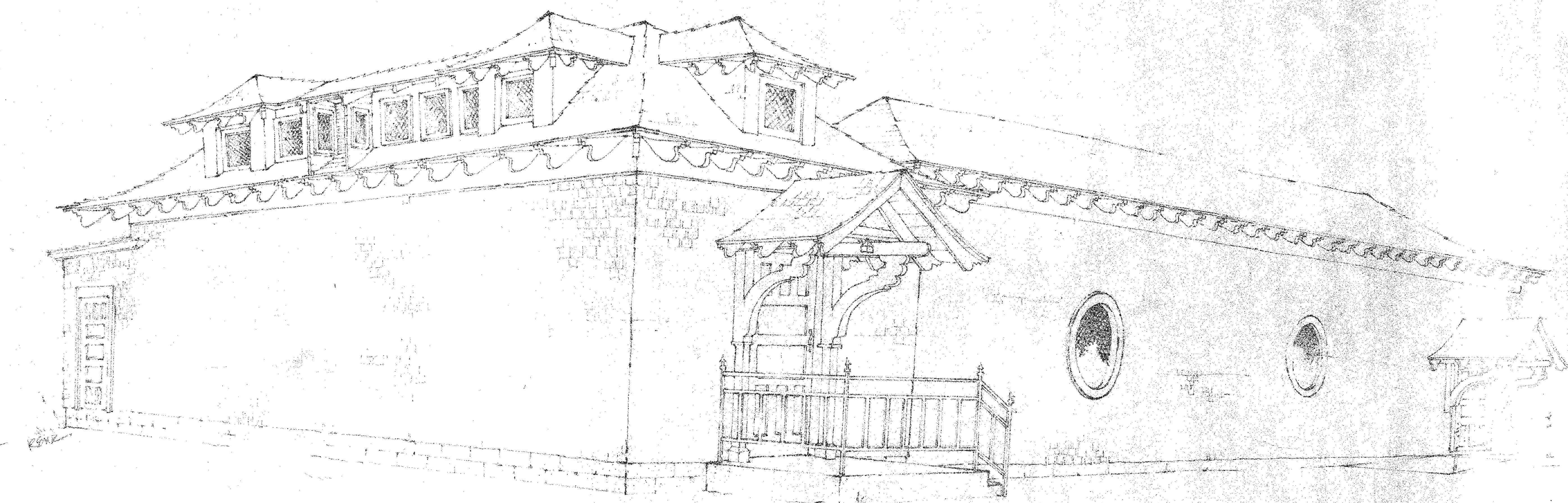
TRACED BY

CHECKED BY

FIELD BOOK

CHANGED | DATE | O.K.

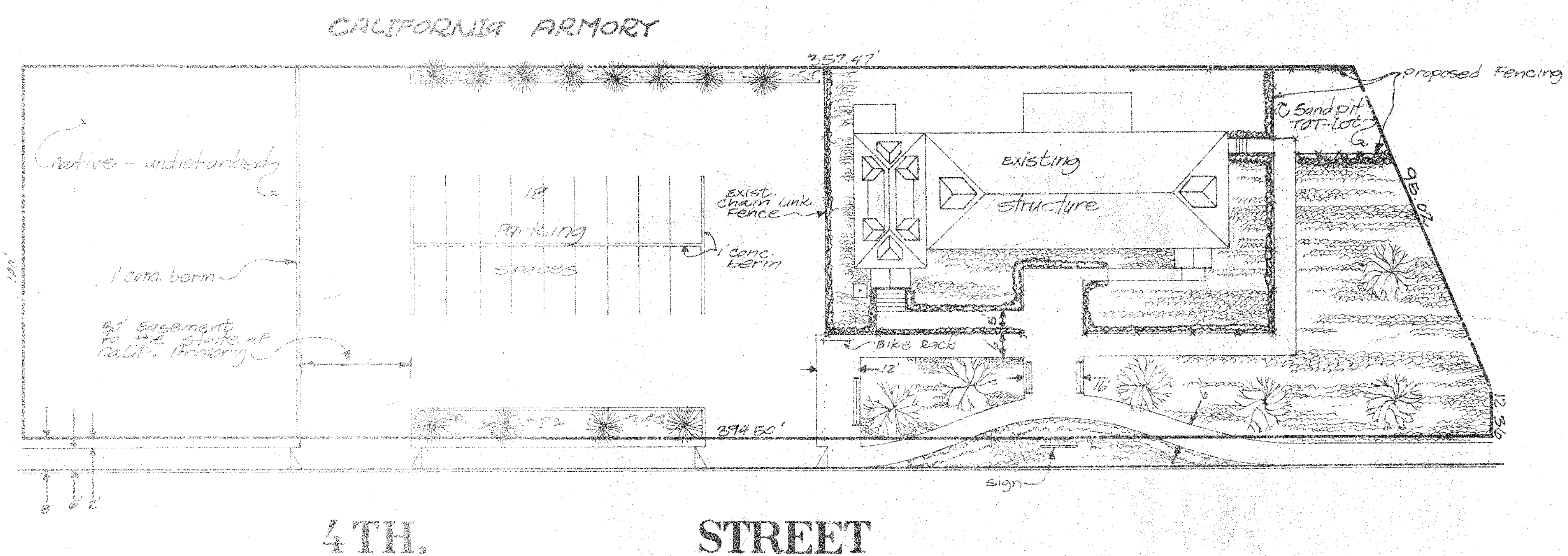
DRAWING NUMBER



"granger music hall

ENGINEERING DEPT.

SCALE: 1" = 20'-0"



LEGEND

Property Line Fence

Concrete

Grass

Ground Cover

5 gal. Bush

15 gal. Tree

20 gal. Tree

Bench

PARKING LANDSCAPE & IRRIGATION PLAN

City of National City

SHEET 1 OF 1 SHEETS

755

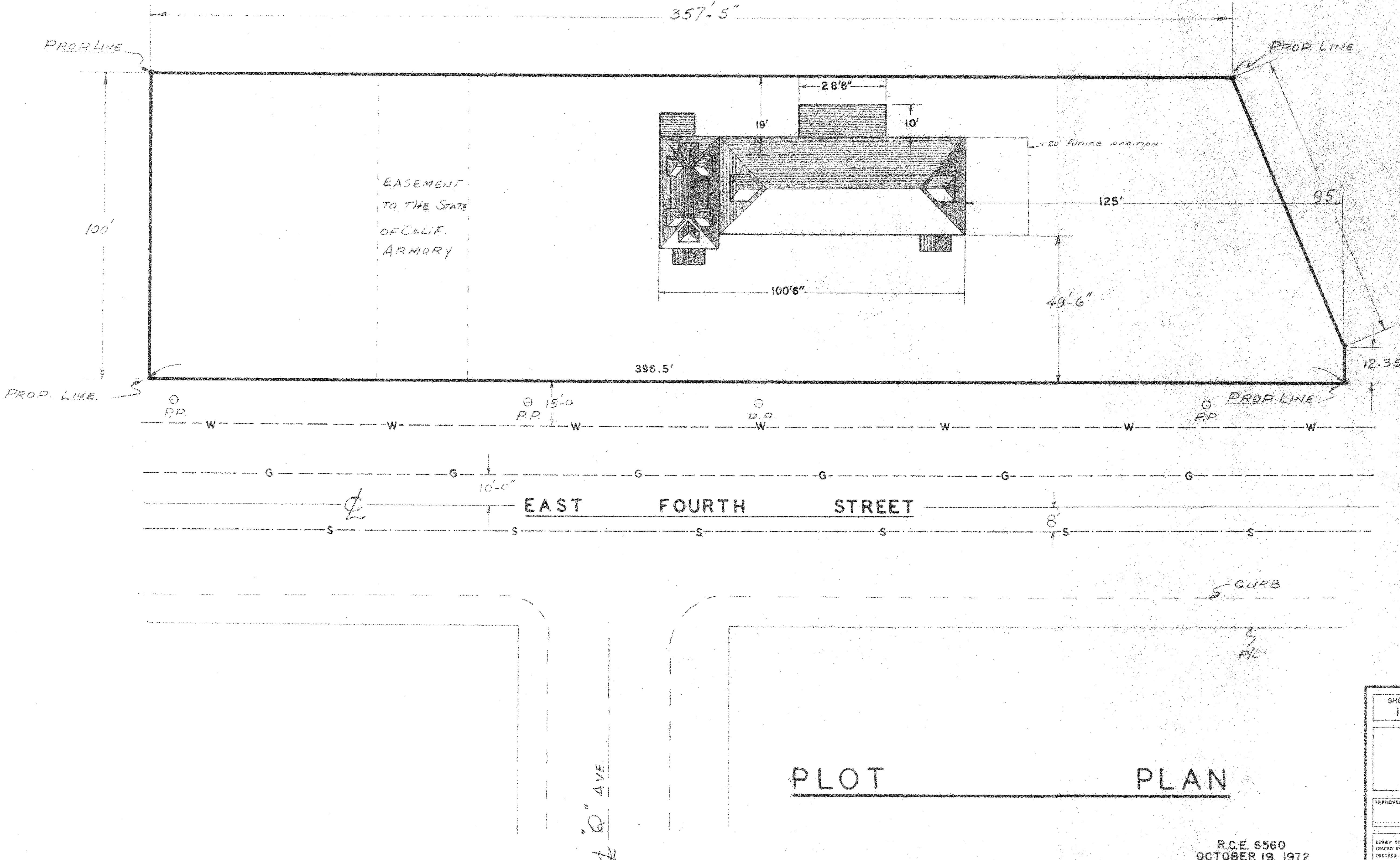
CITY ENGINEER | DATE

DESCRIPTION | BY | APPROVED | DATE

ORIGINAL

CONTRACTOR | DATE STARTED

INSPECTOR | DATE COMPLETED



PLOT PLAN

LEGAL DESCRIPTION

PORTION OF W½ OF LOT 1, QTR. SEC 130, RANCHO DE LA NACION PER MAP No. 166.

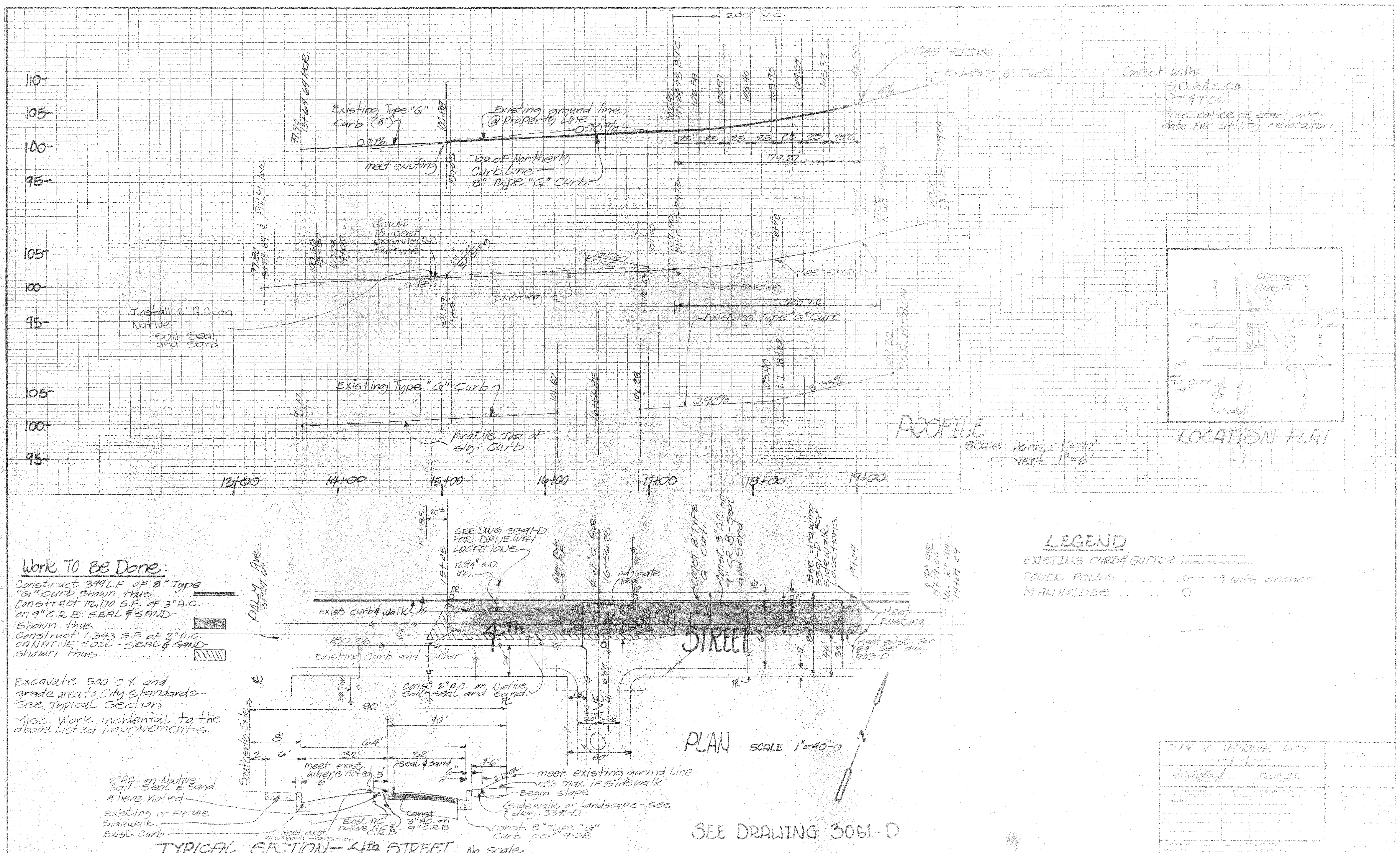
ASSESSOR PARCEL No: 554-050-8

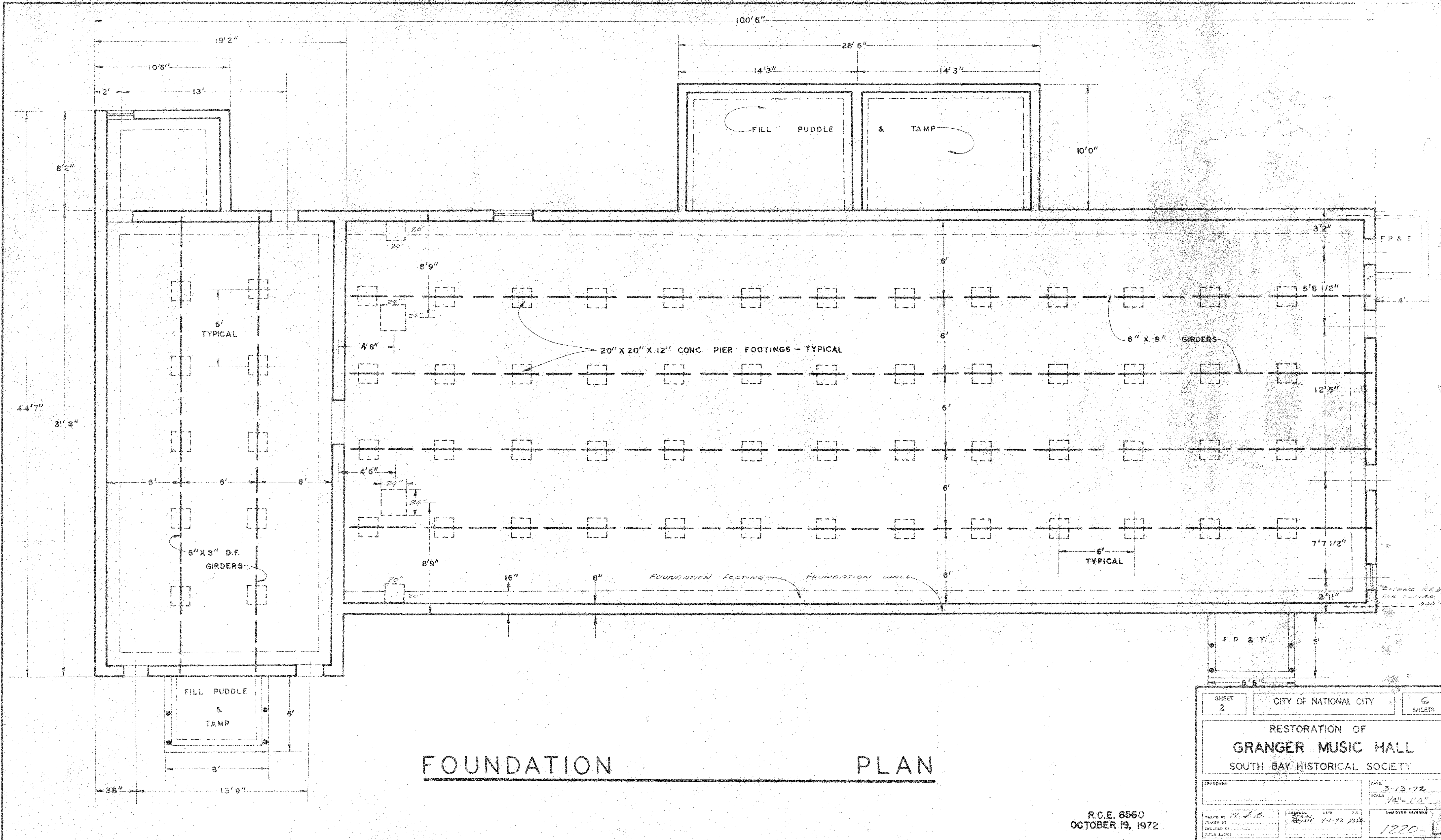
R.C.E. 6560
OCTOBER 19, 1972

SHEET 1 | CITY OF NATIONAL CITY | 6 SHEETS

RESTORATION OF
GRANGER MUSIC HALL
SOUTH BAY HISTORICAL SOCIETY

APPROVED
DATE 5/25/72
SCALE 1"=20'
DRAWN BY G. MADDAC
CHECKED BY D.J.B.
DRAWING NUMBER 1219-L

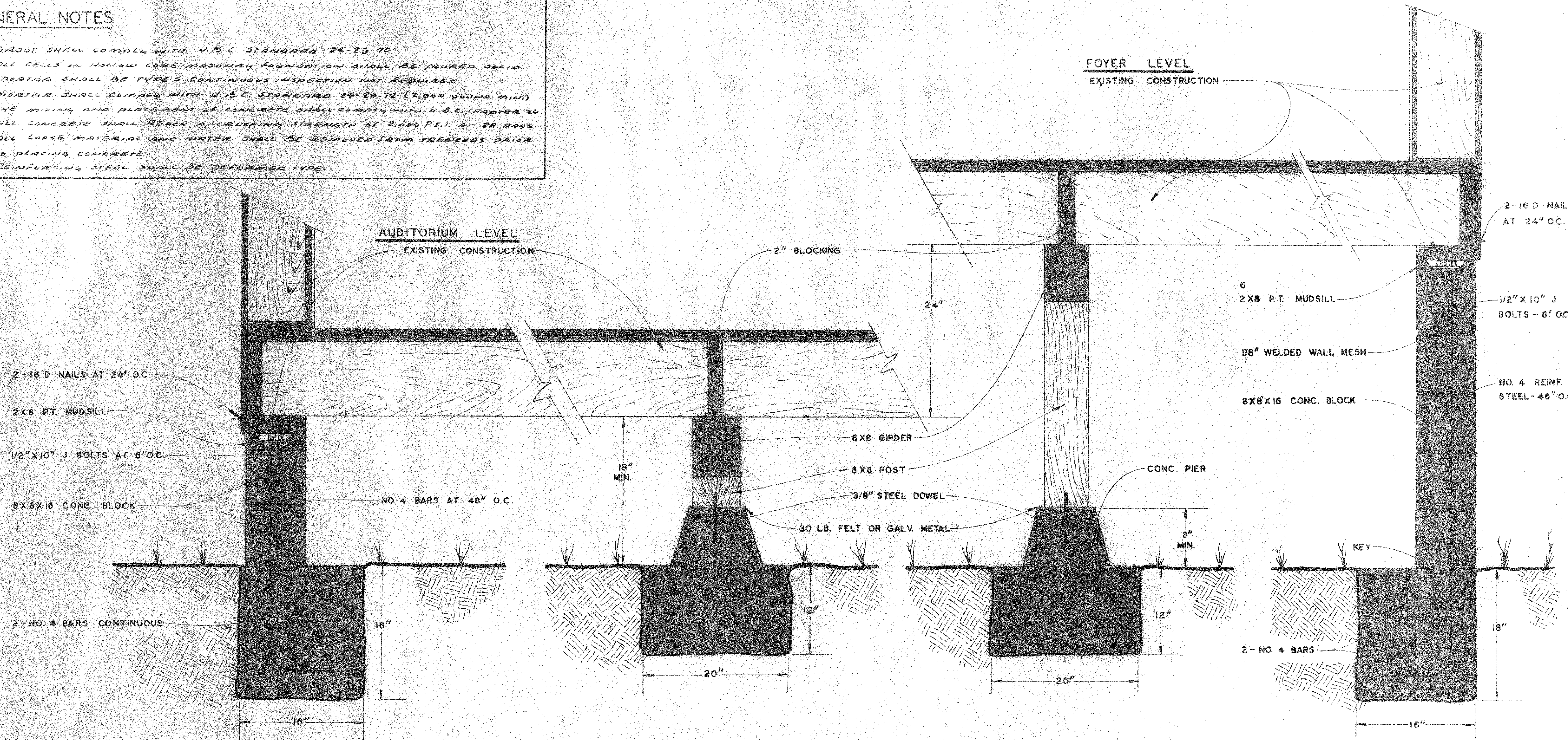

Work To Be Done:
Construct 399 L.F. of 8" Type "G" Curb shown thus
Construct 12,170 S.F. of 3" A.C. on 9" C.R.B. SEAL & SAND - shown thus
Construct 1,343 S.F. of 2" A.C. on NATIVE Soil - SEAL & SAND - shown thus
Excavate 500 C.Y. and grade area to City Standards - See Typical Section
Misc. Work incidental to the above listed improvements.
PROFILE
Scale: Horiz. 1"=40' Vert. 1"=6'
LOCATION PLAT
PROJECT AREA
LEGEND
EXISTING CURB & GUTTER
POWER POLES ... with anchor
MANHOLES ... O
Contact with: S.D.G.&E. Co., P.T.&T. Co.
Give notice of start of work date for utility relocation
Existing Type "G" Curb (8")
Existing ground line @ Property Line
meet existing
Top of Northerly Curb Line - 8" Type "G" Curb
Grade to meet existing A.C. surface
Install 2" A.C. on Native - Soil-Seal and Sand
Existing Type "G" Curb
Profile Top of S'ly Curb
Meet existing
200' V.C.
13+00
14+00
15+00
16+00
17+00
18+00
19+00
PALM AVE.
4th STREET
"Q" AVE.
SEE DWG. 3391-D FOR DRIVEWAY LOCATIONS
exist. curb & walk
Existing Curb and Gutter
Const. 2" A.C. on Native Soil, seal and sand
Const. 8" Type "G" Curb
Const. 3" A.C. on 9" C.R.B. - Seal and Sand
PLAN SCALE 1"=40'-0
TYPICAL SECTION - 4th STREET No scale.
meet existing ground line
12% max. if sidewalk
Begin slope
Sidewalk or landscape - See dwg. 3391-D
Const. 8" Type "G" Curb per 9-58
2" A.C. on Native Soil - Seal & Sand where noted
Existing or Future Sidewalk
Exist. Curb
SEE DRAWING 3061-D
CITY OF NATIONAL CITY
F.B. # D-207



100'6"
19'2"
10'6"
2'
13'
28'6"
14'3"
14'3"
10'0"
8'2"
44'7"
31'8"
FILL PUDDLE & TAMP
20" X 20" X 12" CONC. PIER FOOTINGS – TYPICAL
6" X 8" GIRDERS
6' TYPICAL
6"X 8" D.F. GIRDERS
8'9"
4'6"
16"
8"
FOUNDATION FOOTING
FOUNDATION WALL
3'2"
5'8 1/2"
12'5"
7'7 1/2"
2'11"
F P & T
5'
5'6"
6'
8'
38"
13'9"
FOUNDATION PLAN
R.C.E. 6560
OCTOBER 19, 1972
SHEET 2
CITY OF NATIONAL CITY
6 SHEETS
RESTORATION OF
GRANGER MUSIC HALL
SOUTH BAY HISTORICAL SOCIETY
DATE 3-13-72
SCALE 1/4" = 1'0"
DRAWING NUMBER 1220-L

GENERAL NOTES

1. GROUT SHALL COMPLY WITH U.B.C. STANDARD 24-23-70
2. ALL CELLS IN HOLLOW CORE MASONRY FOUNDATION SHALL BE POURED SOLID
3. MORTAR SHALL BE TYPE S. CONTINUOUS INSPECTION NOT REQUIRED.
4. MORTAR SHALL COMPLY WITH U.B.C. STANDARD 24-20-72 (2,000 POUND MIN.)
5. THE MIXING AND PLACEMENT OF CONCRETE SHALL COMPLY WITH U.B.C. CHAPTER 26.
6. ALL CONCRETE SHALL REACH A CRUSHING STRENGTH OF 2,000 P.S.I. AT 28 DAYS.
7. ALL LOOSE MATERIAL AND WATER SHALL BE REMOVED FROM TRENCHES PRIOR TO PLACING CONCRETE.
8. REINFORCING STEEL SHALL BE DEFORMED TYPE.



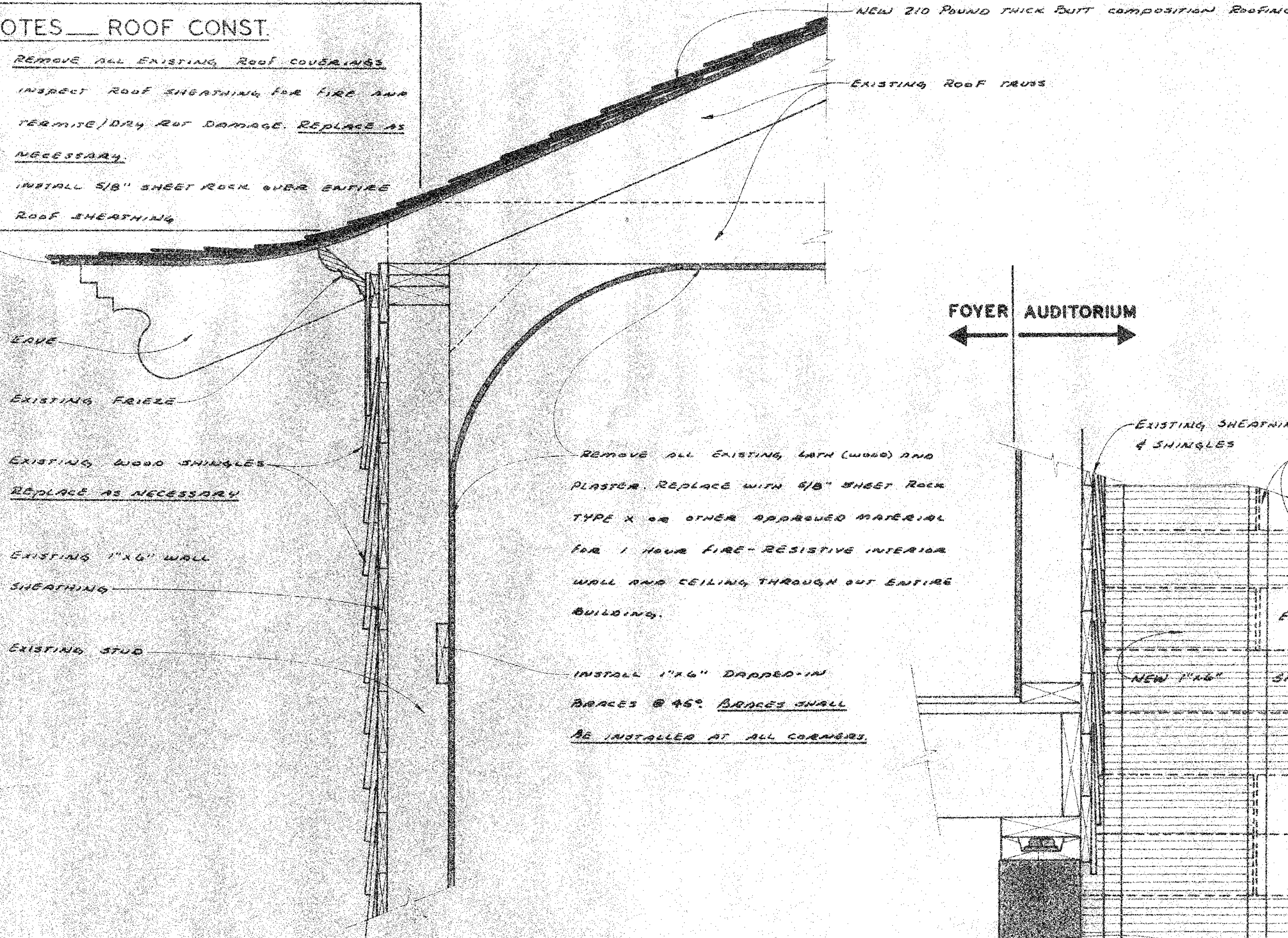
FOUNDATION & FOOTING DETAILS

R.C.E. 6560
OCTOBER 19, 1972

SHEET 6	CITY OF NATIONAL CITY	6 SHEETS
RESTORATION OF GRANGER MUSIC HALL SOUTH BAY HISTORICAL SOCIETY		
APPROVED	DATE 3-17-72	SCALE 1 1/2"=1'0"
DRAWN BY / TRACED BY / CHECKED BY / FIELD BOOK	CHECKED DATE	DRAWING NUMBER 1225-L

NOTES — ROOF CONST.

- REMOVE ALL EXISTING ROOF COVERINGS
- INSPECT ROOF SHEATHING FOR FIRE AND TERMITE/DRY ROT DAMAGE. REPLACE AS NECESSARY.
- INSTALL 5/8" SHEET ROCK OVER ENTIRE ROOF SHEATHING



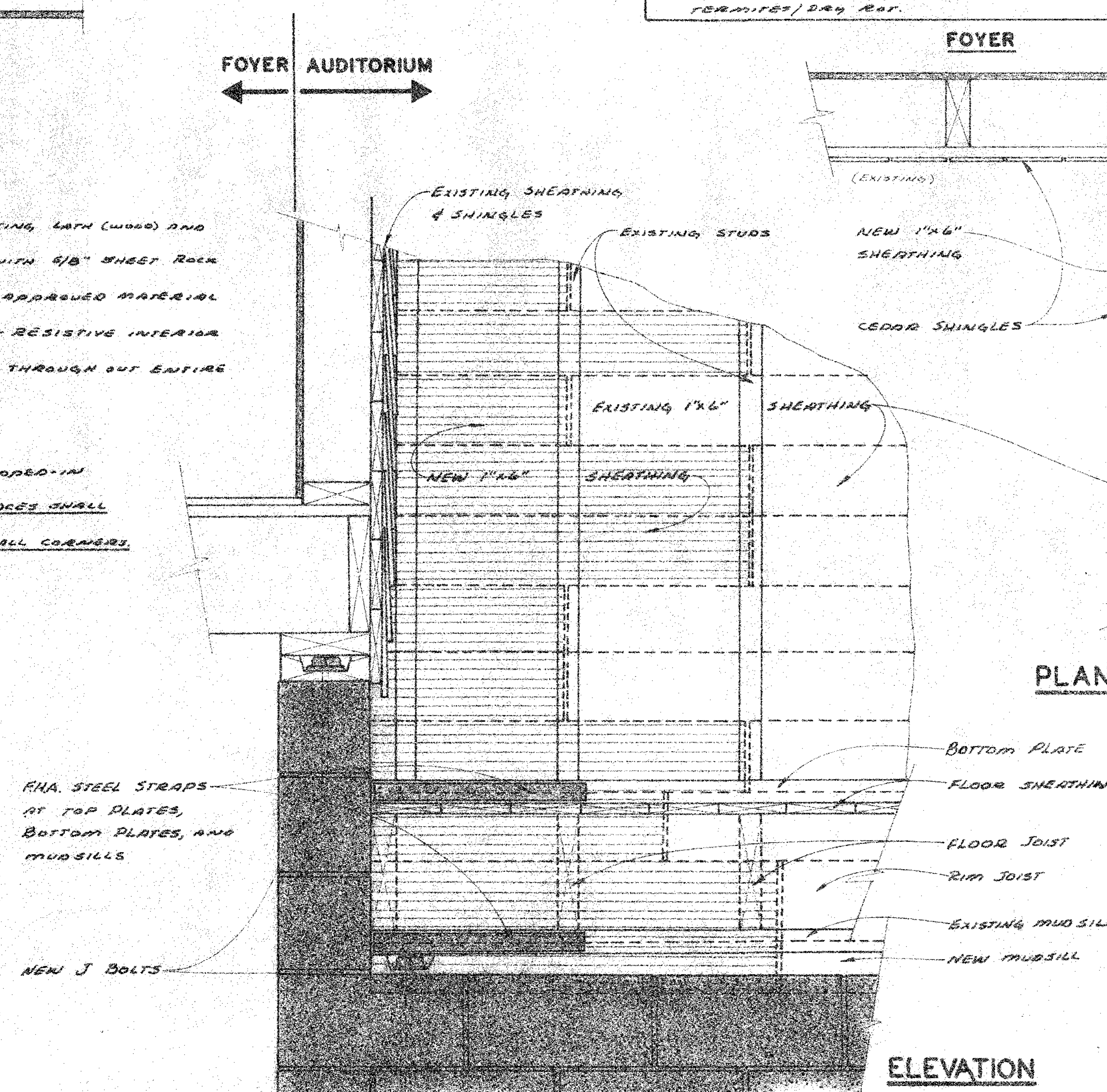
TYPICAL SECTION

NOTES — CONST. MATERIAL

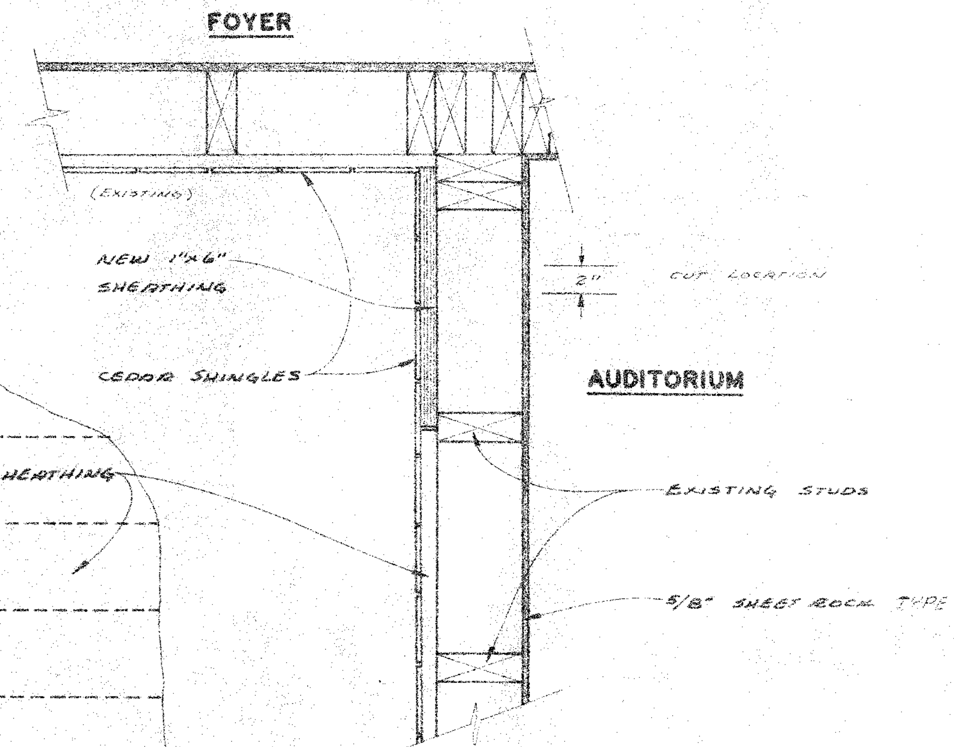
1. NEW LUMBER SHALL BE GRADE STAMPED IN ACCORDANCE WITH THE LATEST LUMBER GRADING RULES AS PUBLISHED BY W.C.L.I.B.
2. PLYWOOD SHALL BE APPROVED FOR THE LOCATION USED.
3. USED LUMBER SHALL BE APPROVED BY THE DIRECTOR OF BUILDING AND HOUSING PRIOR TO USE.
4. STRUCTURAL MEMBERS DAMAGED BY FIRE-CHAR SHALL NOT EXCEED 1/4" PER SIDE OR 1/2" ON ONE SIDE ON 2" MEMBERS, OR 1/8" TOTAL FOR 1" MEMBERS

GENERAL CONSTRUCTION NOTES

1. ALL WORK SHALL BE PERFORMED IN A WORKMAN LIKE MANNER.
2. ALL WORK SHALL COMPLY WITH THE UNIFORM BUILDING CODE AND ORDINANCE NO. 1259 OF THE CITY OF NATIONAL CITY.
3. IN AREAS NOT COVERED BY DETAIL IN THESE PLANS, OR IN AREAS OF QUESTION, CONTACT THE ENGINEER OR THE BLDG. INSPECTOR PRIOR TO PROCEEDING WITH THE WORK.
4. REPLACE ALL STRUCTURAL MEMBERS DAMAGED BY FIRE OR TERMITES/DRY ROT.



ELEVATION



PLAN VIEW

BUILDING SPLICE DETAIL

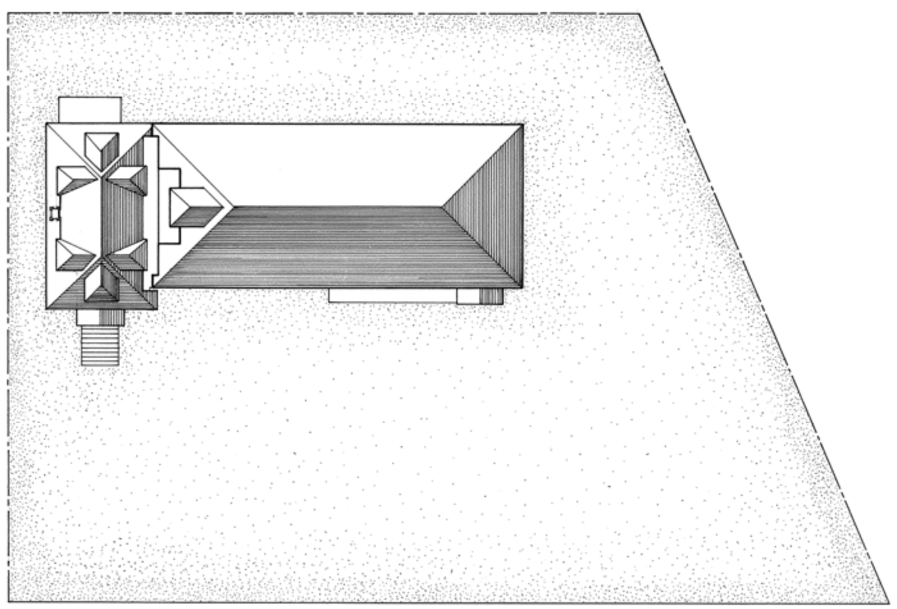
SHEET 5	CITY OF NATIONAL CITY	6 SHEETS
RESTORATION OF GRANGER MUSIC HALL SOUTH BAY HISTORICAL SOCIETY		
APPROVED	DATE 6-10-72	SCALE NO SCALE
DRAWN BY R.I.B. TRACED BY CHECKED BY FIELD BOOKS	CHANGES DATE	DRAWING NUMBER 1224-L

R.C.E. 6560
OCTOBER 19, 1972

TRIM LINE

IN 1896, SAN DIEGO MILLIONAIRE RALPH GRANGER COMMISSIONED CALIFORNIA ARCHITECT IRVING JOHN GILL TO DESIGN A DETACHED "MUSIC ROOM" FOR THE SILVER BARON'S PARADISE VALLEY ESTATE. THE ARCHITECT, WHO HAD APPRENTICED UNDER THE CHICAGO FIRM OF ADLER AND SULLIVAN —A FIRM HIGHLY RESPECTED FOR THEIR ACOUSTICAL DESIGN EXCELLENCE— PROVIDED A SMALL THOUGH GRAND SETTING FOR THE MUSIC WHICH WAS GRANGER'S PASSION. TWO YEARS AFTER THE MUSIC ROOM WAS COMPLETED, IT BECAME THE VESTIBULE FOR A TWO HUNDRED-SEAT AUDITORIUM ADDITION. SPECIAL CARE WAS LAVISHED ON THE SOUNDPROOFED WALLS AND ELABORATE INTERIOR DECORATION, WHICH INCLUDED A SEVENTY-FIVE-FOOT ALLEGORICAL CEILING PAINTING. THE HALL, WHICH HOUSED A 1060-PIPE ORGAN AND AN EXTENSIVE COLLECTION OF VIOLINS, WAS USED FOR NUMEROUS PERFORMANCES BY MAJOR ARTISTS. AFTER FIRE DESTROYED THE ESTATE HOUSE IN 1906, THE MUSIC HALL WAS CLOSED AND EVENTUALLY DAMAGED BY FIRES AND VANDALISM. IN 1969, THE HALL WAS MOVED TO ITS PRESENT SITE AND RESTORATION WAS BEGUN.

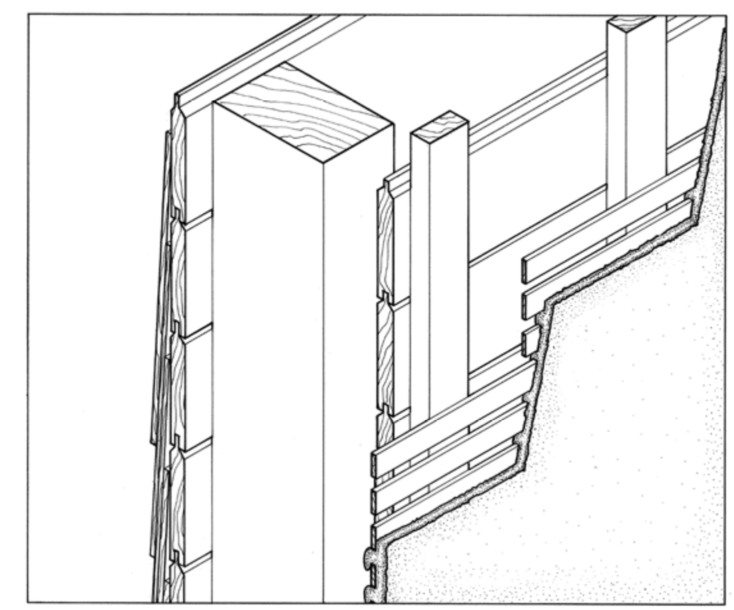
GRANGER MUSIC HALL



SITE PLAN SCALE 1"=20' 1:240 0 5 10 20 30 40 50 FEET 0 5 10 15 20 METERS

TAKEN FROM USGS "NATIONAL CITY" QUADRANGLE, 1967. UTM: 11, 491600. 3616110

LOCATION MAP SCALE 1"=2000' 1:24000 0 2000 4000 6000 FEET 0 2 KILOMETERS



CUTAWAY ISOMETRIC DETAIL OF WALL SCALE 3"=1'-0" 1:4 0 1 FOOT 0 10 20 30 CENTIMETERS

THIS PROJECT WAS UNDERTAKEN BY THE HISTORIC AMERICAN BUILDINGS SURVEY IN COOPERATION WITH THE CITY OF SAN DIEGO AND THE COUNTY OF SAN DIEGO. MEASURED AND DRAWN SUMMER 1975, UNDER THE DIRECTION OF JOHN POPPELIERS, CHIEF OF HABS, BY KIM SPURGEON (KANSAS STATE UNIVERSITY), PROJECT SUPERVISOR, AND ROBERT BRUEGMANN (UNIVERSITY OF PENNSYLVANIA), PROJECT HISTORIAN, WITH STUDENT ARCHITECTS JOHN CLAGETT (UNIVERSITY OF HOUSTON), WILLIAM LEE (ARIZONA STATE UNIVERSITY), JOHN LIVENGOOD (SYRACUSE UNIVERSITY), JOHN REDDICK (YALE UNIVERSITY), AT THE ST. FRANCIS OF ASSISI CHAPEL, MUSEUM OF MAN, BALBOA PARK.

DRAWN BY: K. SPURGEON 1975; REDRAWN, J. FINE 1976

SAN DIEGO SURVEY 1975

OFFICE OF ARCHEOLOGY AND HISTORIC PRESERVATION UNDER DIRECTION OF THE NATIONAL PARK SERVICE, UNITED STATES DEPARTMENT OF THE INTERIOR

NAME AND LOCATION OF STRUCTURE

GRANGER MUSIC HALL

1700 EAST FOURTH STREET NATIONAL CITY SAN DIEGO COUNTY CALIFORNIA

SURVEY NO. CAL. 1998

HISTORIC AMERICAN BUILDINGS SURVEY SHEET 1 OF 3 SHEETS

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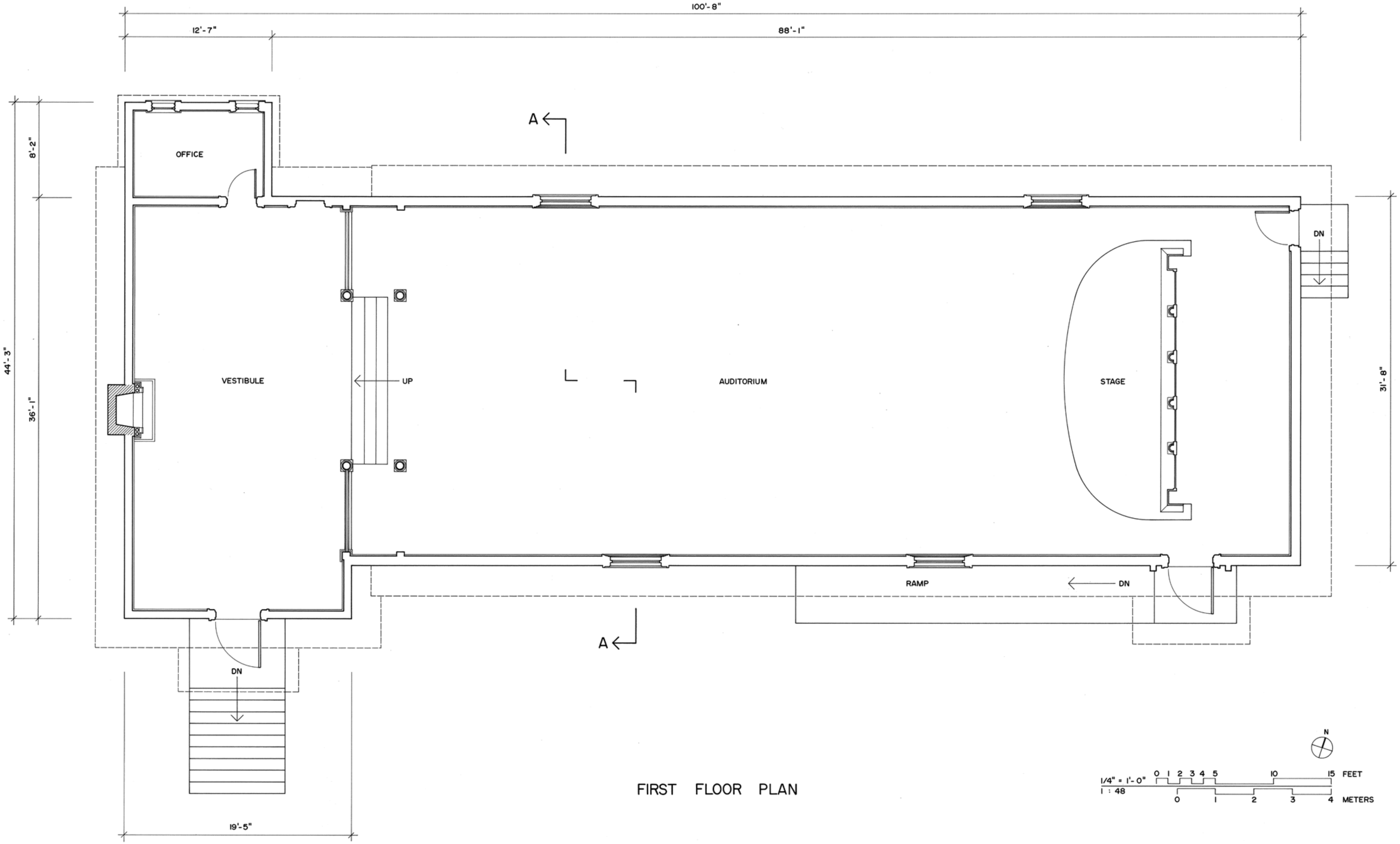
TRIM LINE



FIRST FLOOR PLAN

HISTORIC AMERICAN BUILDINGS SURVEY
SHEET 2 OF 3 SHEETS

SURVEY NO. CAL. 1998

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GRANGER MUSIC HALL
NATIONAL CITY SAN DIEGO COUNTY CALIFORNIA
1700 EAST FOURTH STREET

DRAWN BY: J. REDDICK 1975, REDRAWN 1976

SAN DIEGO SURVEY 1975
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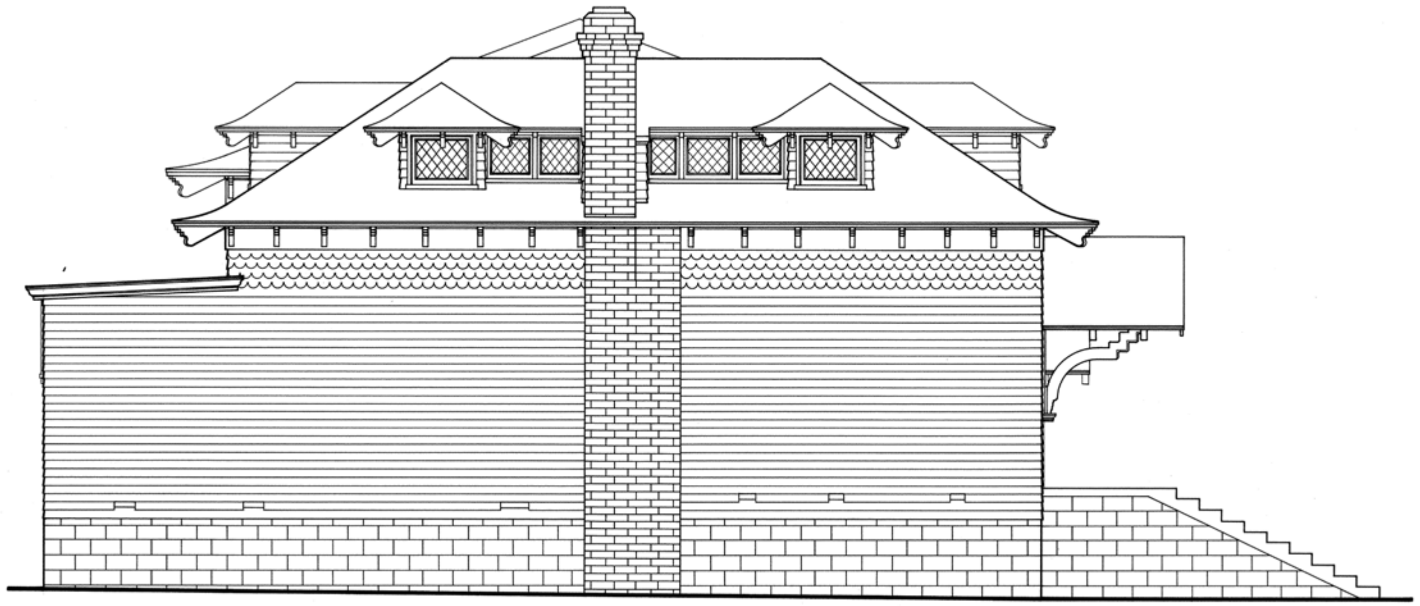
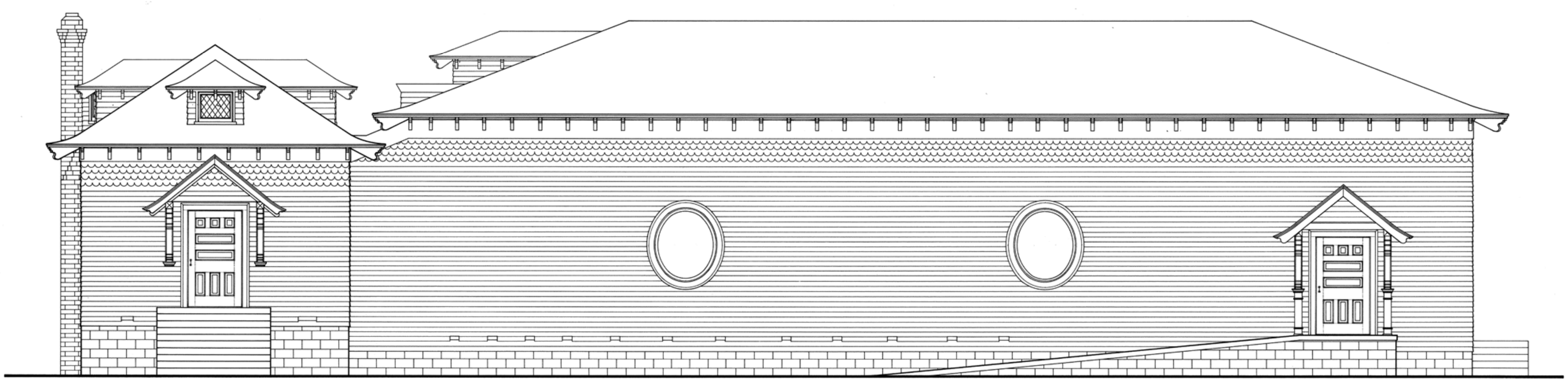
UNITED STATES DEPARTMENT OF THE INTERIOR



WEST ELEVATION

SECTION A-A



SOUTH ELEVATION

1/4" = 1'-0" 0 1 2 3 4 5 10 15 FEET
1 : 48 0 1 2 3 4 METERS

DRAWN BY: W. LEE 1975, REDRAWN 1976

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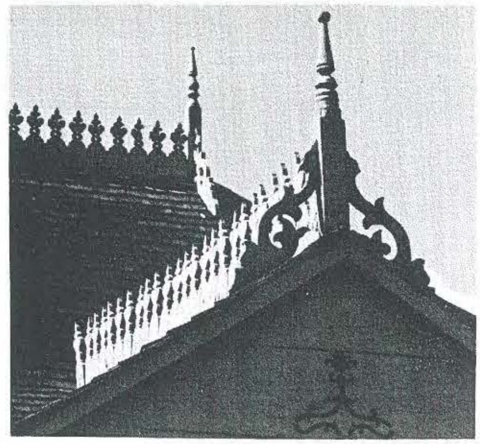
SHEET 3 OF 3 SHEETS

4 PRESERVATION BRIEFS


HABS

Roofing for Historic Buildings

Sarah M. Sweetser

U.S. Department of the Interior National Park Service
Preservation Assistance Division Technical Preservation Services

Significance of the Roof

A weather-tight roof is basic in the preservation of a structure, regardless of its age, size, or design. In the system that allows a building to work as a shelter, the roof sheds the rain, shades from the sun, and buffers the weather.

During some periods in the history of architecture, the roof imparts much of the architectural character. It defines the style and contributes to the building's aesthetics. The hipped roofs of Georgian architecture, the turrets of Queen Anne, the Mansard roofs, and the graceful slopes of the Shingle Style and Bungalow designs are examples of the use of roofing as a major design feature.

But no matter how decorative the patterning or how compelling the form, the roof is a highly vulnerable element of a shelter that will inevitable fail. A poor roof will permit the accelerated deterioration of historic building materials—masonry, wood, plaster, paint—and will cause general disintegration of the basic structure. Furthermore, there is an urgency involved in repairing a leaky roof since such repair costs will quickly become prohibitive. Although such action is desirable as soon as a failure is discovered, temporary patching methods should be carefully chosen to prevent inadvertent damage to sound or historic roofing materials and related features. Before any repair work is performed, the historic value of the materials used on the roof should be understood. Then a complete internal and external inspection of the roof should be planned to determine all the causes of failure and to identify the alternatives for repair or replacement of the roofing.

Historic Roofing Materials in America

Clay Tile: European settlers used clay tile for roofing as early as the mid-17th century; many pantiles (S-curved tiles), as well as flat roofing tiles, were used in Jamestown, Virginia. In some cities such as New York and Boston, clay was popularly used as a precaution against such fire as those that engulfed London in 1666 and scorched Boston in 1679.

Tiles roofs found in the mid-18th century Moravian settlements in Pennsylvania closely resembled those found in Germany. Typically, the tiles were 14–15" long, 6–7" wide with a curved butt. A lug on the back allowed the tiles to hang on the lathing without nails or pegs. The tile surface was usually scored with finger marks to promote drainage. In the Southwest, the tile roofs of the Spanish missionaries (mission tiles) were first manufactured (ca. 1780) at the Mission San Antonio de Padua in California. These semicircular tiles were


Repairs on this pantile roof were made with new tiles held in place with metal hangers. (Main Building, Ellis Island, New York)

made by molding clay over sections of logs, and they were generally 22" long and tapered in width.

The plain or flat rectangular tiles most commonly used from the 17th through the beginning of the 19th century measured about 10" by 6" by ½", and had two holes at one end for a nail or peg fastener. Sometimes mortar was applied between the courses to secure the tiles in a heavy wind.

In the mid-19th century, tile roofs were often replaced by sheet-metal roofs, which were lighter and easier to install and maintain. However, by the turn of the century, the Romanesque Revival and Mission style buildings created a new demand and popularity for this picturesque roofing material.

Slate: Another practice settlers brought to the New World was slate roofing. Evidence of roofing slates have been found also among the ruins of mid-17th-century Jamestown. But because of the cost and the time required to obtain the material, which was mostly imported from Wales, the use of slate was initially limited. Even in Philadelphia (the second largest city in the English-speaking world at the time of the Revolution) slates were so rare that "The Slate Roof House" distinctly referred to William Penn's home built late in the 1600s. Sources of native slate were known to exist along the eastern seaboard from Maine to Virginia, but difficulties in inland transportation limited its availability to the cities, and contributed to its expense. Welsh slate continued to be imported until the development of canals and railroads in the mid-19th century made American slate more accessible and economical.

Slate was popular for its durability, fireproof qualities, and

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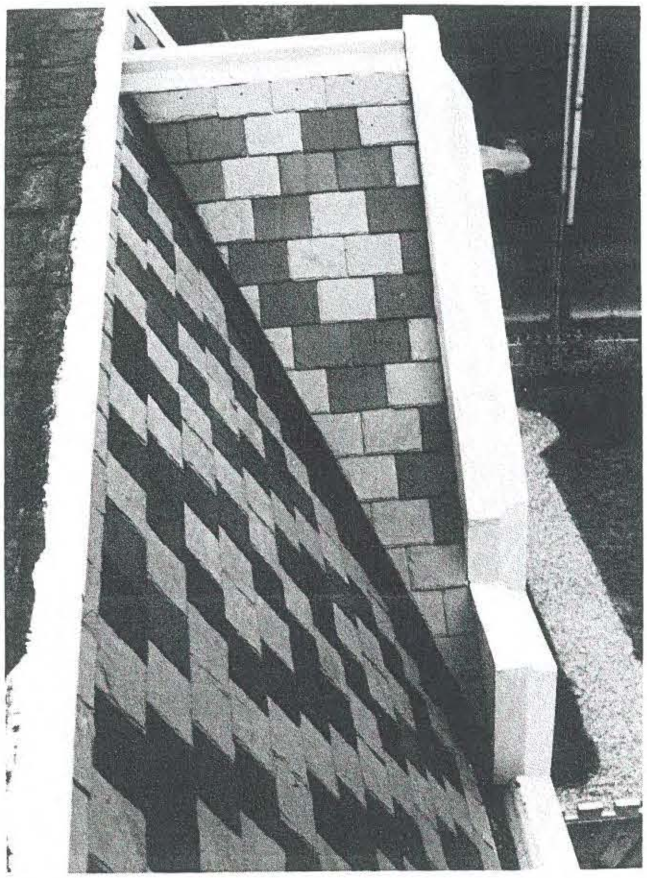
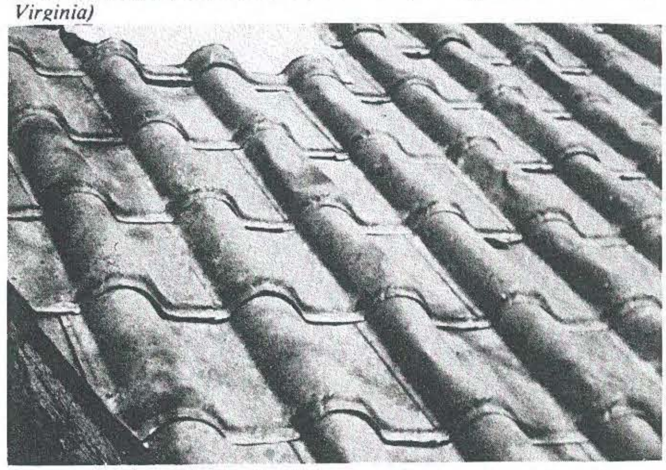


The Victorians loved to used different colored slates to create decorative patterns on their roofs, an effect which cannot be easily duplicated by substitute materials. Before any repair work on a roof such as this, the slate sizes, colors, and position of the patterning should be carefully recorded to assure proper replacement. (Ebenezer Maxwell Mansion, Philadelphia, Pennsylvania, photo courtesy of William D. Hershey)

Replacement of particular historic details is important to the individual historic character of a roof, such as the treatment at the eaves of this rounded butt wood shingle roof. Also note that the surface of the roof was carefully sloped to drain water away from the side of the dormer. In the restoration, this function was augmented with the addition of carefully concealed modern metal flashing. (Mount Vernon, Virginia)



Galvanized sheet-metal shingles imitating the appearance of pantiles remained popular from the second half of the 19th century into the 20th century. (Episcopal Church, now the Jerome Historical Society Building, Jerome, Arizona, 1927)

aesthetic potential. Because slate was available in different colors (red, green, purple, and blue-gray), it was an effective material for decorative patterns on many 19th-century roofs (Gothic and Mansard styles). Slate continued to be used well into the 20th century, notably on many Tudor revival style buildings of the 1920s.

Shingles: Wood shingles were popular throughout the country in all periods of building history. The size and shape of the shingles as well as the detailing of the shingle roof differed according to regional craft practices. People within particular regions developed preferences for the local species of wood that most suited their purposes. In New England and the Delaware Valley, white pine was frequently used: in the South, cypress and oak; in the far west, red cedar or redwood. Sometimes a protective coating was applied to increase the durability of the shingle such as a mixture of brick dust and fish oil, or a paint made of red iron oxide and linseed oil.

Commonly in urban areas, wooden roofs were replaced with more fire resistant materials, but in rural areas this was not a major concern. On many Victorian country houses, the practice of wood shingling survived the technological advances of metal roofing in the 19th century, and near the turn of the century enjoyed a full revival in its namesake, the Shingle Style. Colonial revival and the Bungalow styles in the 20th century assured wood shingles a place as one of the most fashionable, domestic roofing materials.

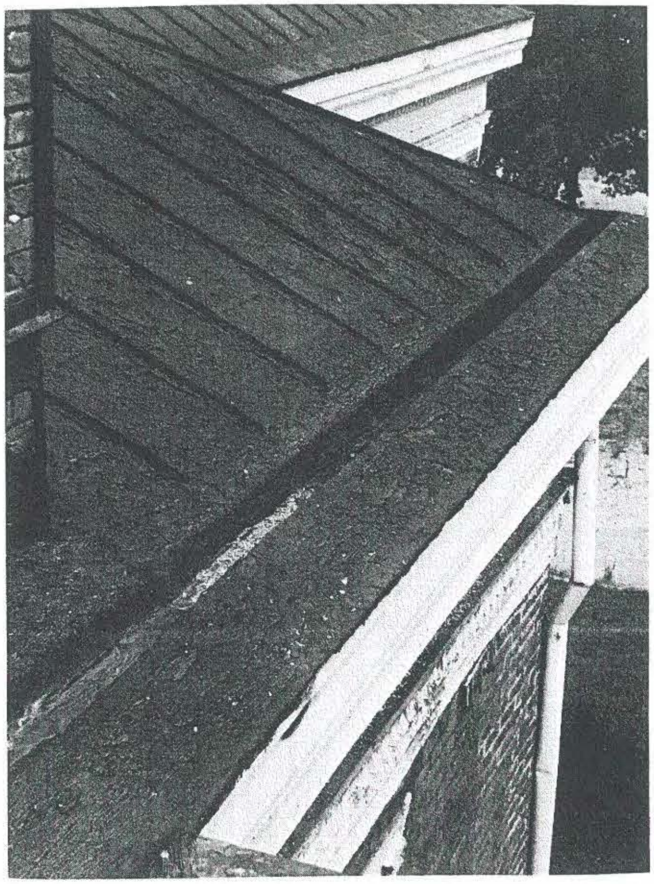
Metal: Metal roofing in America is principally a 19th-century phenomenon. Before then the only metals commonly used were lead and copper. For example, a lead roof covered "Rosewell," one of the grandest mansions in 18th-century Virginia. But more often, lead was used for protective flashing. Lead, as well as copper, covered roof surfaces where wood, tile, or slate shingles were inappropriate because of the roof's pitch or shape.

Copper with standing seams covered some of the more notable early American roofs including that of Christ Church (1727–1744) in Philadelphia. Flat-seamed copper was used on many domes and cupolas. The copper sheets were imported from England until the end of the 18th century when facilities for rolling sheet metal were developed in America.

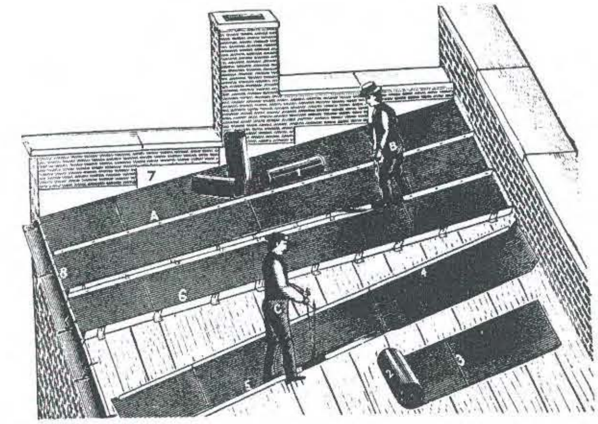
Sheet iron was first known to have been manufactured here by the Revolutionary War financier, Robert Morris, who had a rolling mill near Trenton, New Jersey. At his mill Morris produced the roof of his own Philadelphia mansion, which he started in 1794. The architect Benjamin H. Latrobe used sheet iron to replace the roof on Princeton's "Nassau Hall," which had been gutted by fire in 1802.

The method for corrugating iron was originally patented in England in 1829. Corrugating stiffened the sheets, and allowed greater span over a lighter framework, as well as reduced installation time and labor. In 1834 the American architect William Strickland proposed corrugated iron to cover his design for the market place in Philadelphia.

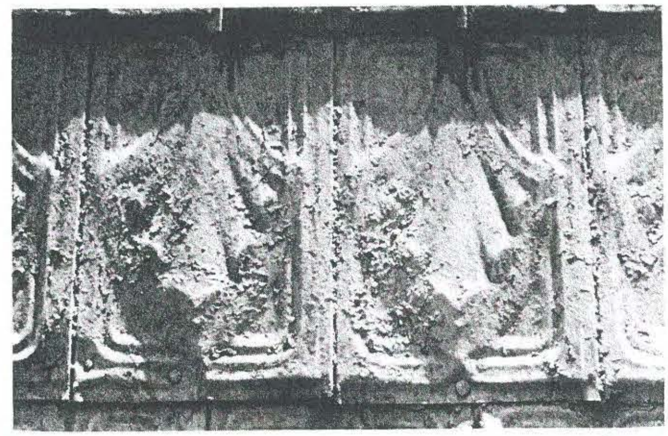
Galvanizing with zinc to protect the base metal from rust was developed in France in 1837. By the 1850s the material was used on post offices and customhouses, as well as on train sheds and factories. In 1857 one of the first metal roofs in the



Repeated repair with asphalt, which cracks as it hardens, has created a blistered surface on this sheet-metal roof and built-in gutter, which will retain water. Repairs could be made by carefully heating and scraping the surface clean, repairing the holes in the metal with a flexible mastic compound or a metal patch, and coating the surface with a fibre paint. (Roane County Courthouse, Kingston, Tennessee, photo courtesy of Building Conservation Technology, Inc.)



A Chicago firm's catalog dated 1896 illustrates a method of unrolling, turning the edges, and finishing the standing seam on a metal roof.



Tin shingles, commonly embossed to imitate wood or tile, or with a decorative design, were popular as an inexpensive, textured roofing material. These shingles $8^3/_8$ inch by $12^1/_2$ inch on the exposed surface) were designed with interlocking edges, but they have been repaired by surface nailing, which may cause future leakage. (Ballard House, Yorktown, Virgina, photo by Gordie Whittington, National Park Service)

South was installed on the U.S. Mint in New Orleans. The Mint was thereby "fireproofed" with a 20-gauge galvanized, corrugated iron roof on iron trusses.

Tin-plate iron, commonly called "tin roofing," was used extensively in Canada in the 18th century, but it was not as common in the United States until later. Thomas Jefferson was an early advocate of tin roofing, and he installed a standing-seam tin roof on "Monticello" (ca. 1770–1802). The Arch Street Meetinghouse (1804) in Philadelphia had tin shingles laid in a herringbone pattern on a "piazza" roof.

However, once rolling mills were established in this country, the low cost, light weight, and low maintenance of tin plate made it the most common roofing material. Embossed tin shingles, whose surfaces created interesting patterns, were popular throughout the country in the late 19th century. Tin roofs were kept well-painted, usually red; or, as the architect A. J. Davis suggested, in a color to imitate the green patina of copper.

Terne plate differed from tin plate in that the iron was dipped in an alloy of lead and tin, giving it a duller finish. Historic, as well as modern, documentation often confuses the two, so much that it is difficult to determine how often actual "terne" was used.

Zinc came into use in the 1820s, at the same time tin plate was becoming popular. Although a less expensive substitute for lead, its advantages were controversial, and it was never widely used in this country.

Other Materials: Asphalt shingles and roll roofing were used in the 1890s. Many roofs of asbestos, aluminum, stainless steel, galvinized steel, and lead-coated copper may soon have historic values as well. Awareness of these and other traditions of roofing materials and their detailing will contribute to more sensitive preservation treatments.

Locating the Problem

Failures of Surface Materials

When trouble occurs, it is important to contact a professional, either an architect, a reputable roofing contractor, or a craftsman familiar with the inherent characteristics of the particular historic roofing system involved. These professionals may be able to advise on immediate patching procedures and help plan more permanent repairs. A thorough examination of the roof should start with an appraisal of the existing condition and quality of the roofing material itself. Particular attention should be given to any southern slope because year-round exposure to direct sun may cause it to break down first.

Wood: Some historic roofing materials have limited life expectancies because of normal organic decay and "wear." For example, the flat surfaces of wood shingles erode from exposure to rain and ultraviolet rays. Some species are more hardy than others, and heartwood, for example, is stronger and more durable than sapwood.

Ideally, shingles are split with the grain perpendicular to the surface. This is because if shingles are sawn across the grain, moisture may enter the grain and cause the wood to deteriorate. Prolonged moisture on or in the wood allows moss or fungi to grow, which will further hold the moisture and cause rot.

Metal: Of the inorganic roofing materials used on historic buildings, the most common are perhaps the sheet metals: lead, copper, zinc, tin plate, terne plate, and galvanized iron. In varying degrees each of these sheet metals are likely to deteriorate from chemical action by pitting or streaking. This can be caused by airborn pollutants; acid rainwater; acids from lichen or moss; alkalis found in lime mortars or portland cement, which might be on adjoining features and washes down on the roof surface; or tannic acids from adjacent wood sheathings or shingles made of red cedar or oak.

Corrosion from "galvanic action" occurs when dissimilar metals, such as copper and iron, are used in direct contact. Corrosion may also occur even though the metals are physically separated; one of the metals will react chemically against the other in the presence of an electrolyte such as rainwater. In roofing, this situation might occur when either a copper roof is decorated with iron cresting, or when steel nails are used in copper sheets. In some instances the corrosion can be prevented by inserting a plastic insulator between the dissimilar materials. Ideally, the fasteners should be a metal sympathetic to those involved.

Iron rusts unless it is well-painted or plated. Historically this problem was avoided by use of tin plating or galvinizing. But this method is durable only as long as the coating remains intact. Once the plating is worn or damaged, the exposed iron will rust. Therefore, any iron-based roofing material needs to be undercoated, and its surface needs to be kept well-painted to prevent corrosion.

One cause of sheet metal deterioration is fatigue. Depending upon the size and the gauge of the metal sheets, wear and metal failure can occur at the joints or at any protrusions in the sheathing as a result from the metal's alternating movement to thermal changes. Lead will tear because of "creep," or the gravitational stress that causes the material to move down the roof slope.

Slate: Perhaps the most durable roofing materials are slate and tile. Seemingly indestructable, both vary in quality. Some slates are hard and tough without being brittle. Soft slates are more subject to erosion and to attack by airborne and rainwater chemicals, which cause the slates to wear at nail holes, to delaminate, or to break. In winter, slate is very susceptible to breakage by ice, or ice dams.

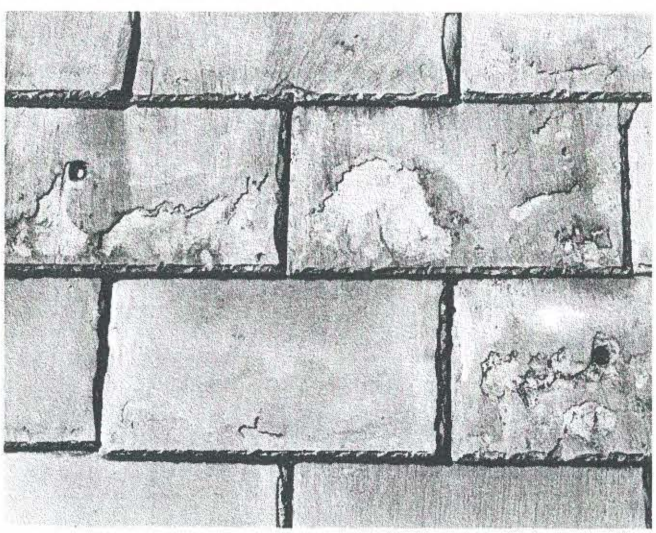
Tile: Tiles will weather well, but tend to crack or break if hit, as by tree branches, or if they are walked on improperly. Like slates, tiles cannot support much weight. Low quality tiles that have been insufficiently fired during manufacture, will craze and spall under the effects of freeze and thaw cycles on their porous surfaces.

Failures of Support Systems

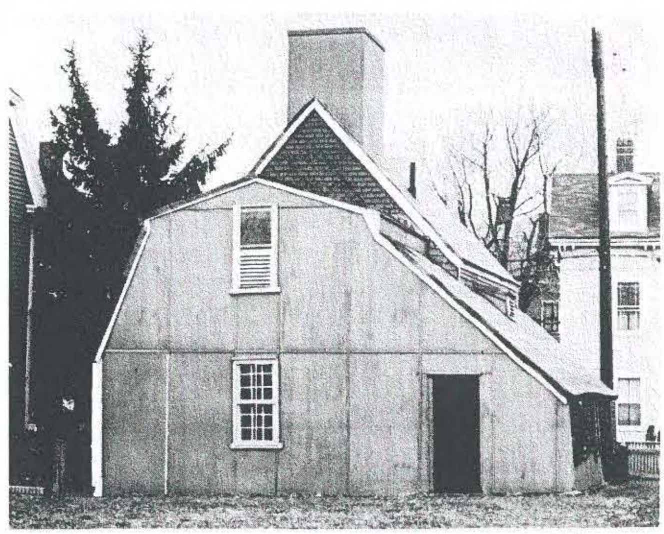
Once the condition of the roofing material has been determined, the related features and support systems should be examined on the exterior and on the interior of the roof. The gutters and downspouts need periodic cleaning and maintenance since a variety of debris fill them, causing water to back up and seep under roofing units. Water will eventually cause fasteners, sheathing, and roofing structure to deteriorate. During winter, the daily freeze-thaw cycles can cause ice floes to develop under the roof surface. The pressure from these ice floes will dislodge the roofing material, especially slates, shingles, or tiles. Moreover, the buildup of ice dams above the gutters can trap enough moisture to rot the sheathing or the structural members.

Many large public buildings have built-in gutters set within the perimeter of the roof. The downspouts for these gutters may run within the walls of the building, or drainage may be through the roof surface or through a parapet to exterior downspouts. These systems can be effective if properly maintained; however, if the roof slope is inadequate for good runoff, or if the traps are allowed to clog, rainwater will form pools on the roof surface. Interior downspouts can collect debris and thus back up, perhaps leaking water into the surrounding walls. Exterior downspouts may fill with water, which in cold weather may freeze and crack the pipes. Conduits from the built-in gutter to the exterior downspout may also leak water into the surrounding roof structure or walls.

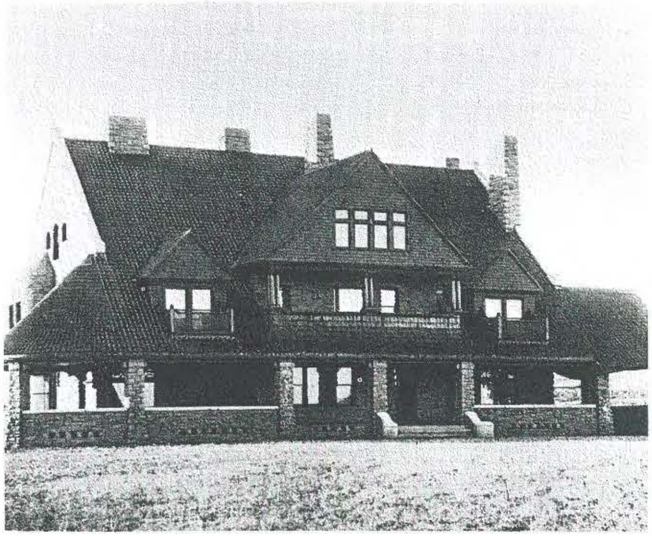
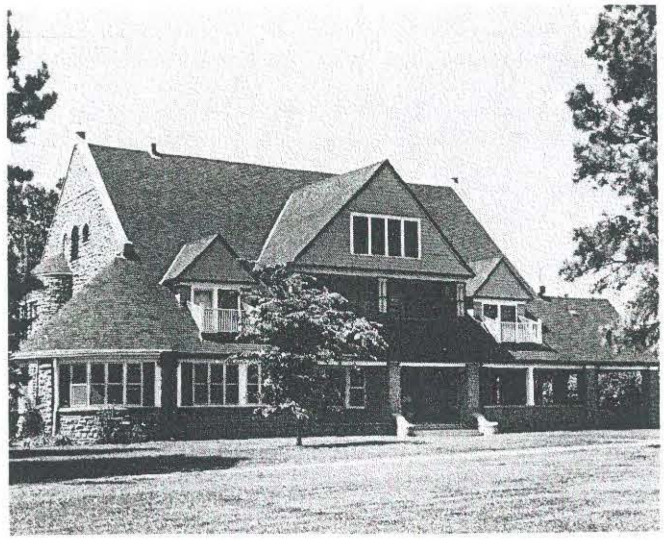
Failure of the flashing system is usually a major cause of roof deterioration. Flashing should be carefully inspected for failure caused by either poor workmanship, thermal stress, or metal deterioration (both of flashing material itself and of the fasteners). With many roofing materials, the replacement of flashing on an existing roof is a major operation, which may require taking up large sections of the roof surface. Therefore, the installation of top quality flashing material on



This detail shows slate delamination caused by a combination of weathering and pollution. In addition, the slates have eroded around the repair nails, incorrectly placed in the exposed surface of the slates. (Lower Pontalba Building, New Orleans, photo courtesy of Building Conservation Technology, Inc.)



Temporary stabilization or "mothballing" with materials such as plywood and building paper can protect the roof of a project until it can be properly repaired or replaced. (Narbonne House, Salem, Massachusetts)

These two views of the same house demonstrate how the use of a substitute material can drastically affect the overall character of a structure. The textural interest of the original tile roof was lost with the use of asphalt shingles. Recent preservation efforts are replacing the tile roof. (Frank House, Kearney, Nebraska, photo courtesy of the Nebraska State Historical Society, Lincoln, Nebraska)

a new or replaced roof should be a primary consideration. *Remember, some roofing and flashing materials are not compatible.*

Roof fasteners and clips should also be made of a material compatible with all other materials used, or coated to prevent rust. For example, the tannic acid in oak will corrode iron nails. Some roofs such as slate and sheet metals may fail if nailed too rigidly.

If the roof structure appears sound and nothing indicates recent movement, the area to be examined most closely is the roof substrate—the sheathing or the battens. The danger spots would be near the roof plates, under any exterior patches, at the intersections of the roof planes, or at vertical surfaces such as dormers. Water penetration, indicating a breach in the roofing surface or flashing, should be readily apparent, usually as a damp spot or stain. Probing with a small pen knife may reveal any rot which may indicate previously undetected damage to the roofing membrane. Insect infestation evident by small exit holes and frass (a sawdust-like debris) should also be noted. Condensation on the underside of the roofing is undesirable and indicates improper ventilation. Moisture will have an adverse effect on any roofing material; a good roof stays dry inside and out.

Repair or Replace

Understanding potential weaknesses of roofing material also requires knowledge of repair difficulties. Individual slates can be replaced normally without major disruption to the rest of the roof, but replacing flashing on a slate roof can require substantial removal of surrounding slates. If it is the substrate or a support material that has deteriorated, many surface materials such as slate or tile can be reused if handled carefully during the repair. Such problems should be evaluated at the outset of any project to determine if the roof can be effectively patched, or if it should be completely replaced.

Will the repairs be effective? Maintenance costs tend to multiply once trouble starts. As the cost of labor escalates, repeated repairs could soon equal the cost of a new roof.

The more durable the surface is initially, the easier it will be to maintain. Some roofing materials such as slate are expensive to install, but if top quality slate and flashing are used, it will last 40-60 years with minimal maintenance. Although the installation cost of the roof will be high, low maintenance needs will make the lifetime cost of the roof less expensive.

Historical Research

In a restoration project, research of documents and physical investigation of the building usually will establish the roof's history. Documentary research should include any original plans or building specifications, early insurance surveys, newspaper descriptions, or the personal papers and files of people who owned or were involved in the history of the building. Old photographs of the building might provide evidence of missing details.

Along with a thorough understanding of any written history of the building, a physical investigation of the roofing and its structure may reveal information about the roof's construction history. Starting with an overall impression of the structure, are there any changes in the roof slope, its configuration, or roofing materials? Perhaps there are obvious patches or changes in patterning of exterior brickwork where a gable roof was changed to a gambrel, or where a whole upper story was added. Perhaps there are obvious stylistic changes in the roof line, dormers, or ornamentation. These observations could help one understand any important alteration, and could help establish the direction of further investigation.

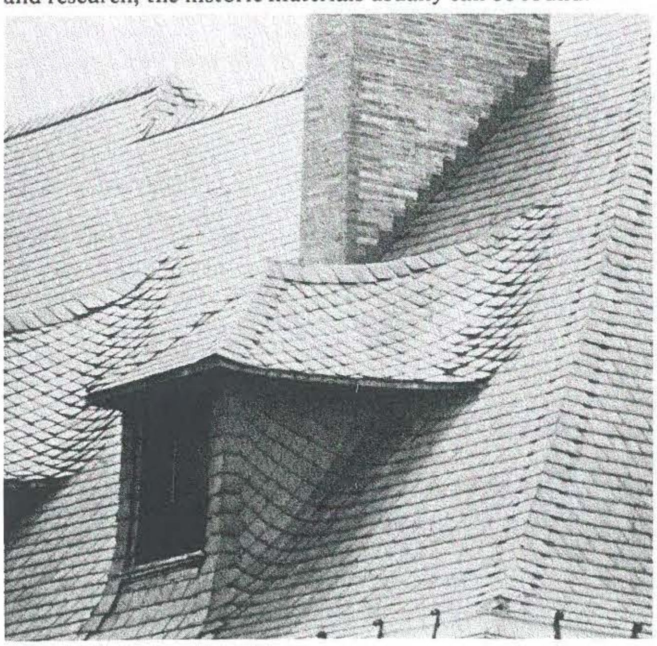
Because most roofs are physically out of the range of careful scrutiny, the "principle of least effort" has probably limited the extent and quality of previous patching or replacing, and usually considerable evidence of an earlier roof surface remains. Sometimes the older roof will be found as an underlayment of the current exposed roof. Original roofing may still be intact in awkward places under later features on a roof. Often if there is any unfinished attic space, remnants of roofing may have been dropped and left when the roof was being built or repaired. If the configuration of the roof has been changed, some of the original material might still be in place under the existing roof. Sometimes whole sections of the roof and roof framing will have been left intact under the higher roof. The profile and/or flashing of the earlier roof may be apparent on the interior of the walls at the level of the alteration. If the sheathing or lathing appears to have survived changes in the roofing surface, they may contain evidence of the roofing systems. These may appear either as dirt marks, which provide "shadows" of a roofing material, or as nails broken or driven down into the wood, rather than pulled out during previous alterations or repairs. Wooden headers in the roof framing may indicate that earlier chimneys or skylights have been removed. Any metal ornamentation that might have existed may be indicated by anchors or unusual markings along the ridge or at other edges of the roof. This primary evidence is essential for a full understanding of the roof's history.

Caution should be taken in dating early "fabric" on the evidence of a single item, as recycling of materials is not a mid-20th-century innovation. Carpenters have been reusing materials, sheathing, and framing members in the interest of economy for centuries. Therefore, any analysis of the materials found, such as nails or sawmarks on the wood, requires an accurate knowledge of the history of local building practices before any final conclusion can be accurately reached. It is helpful to establish a sequence of construction history for the roof and roofing materials; any historic fabric or pertinent evidence in the roof should be photographed, measured, and recorded for future reference.

During the repair work, useful evidence might unexpectedly appear. It is essential that records be kept of any type of work on a historic building, before, during, and after the project. Photographs are generally the easiest and fastest method, and should include overall views and details at the gutters, flashing, dormers, chimneys, valleys, ridges, and eaves. All photographs should be immediately labeled to insure accurate identification at a later date. Any patterning or design on the roofing deserves particular attention. For example, slate roofs are often decorative and have subtle changes in size, color, and texture, such as a gradually decreasing coursing length from the eave to the peak. If not carefully noted before a project begins, there may be problems in replacing the surface. The standard reference for this phase of the work is *Recording Historic Buildings,* compiled by Harley J. McKee for the Historic American Buildings Survey, National Park Service, Washington, D.C., 1970.

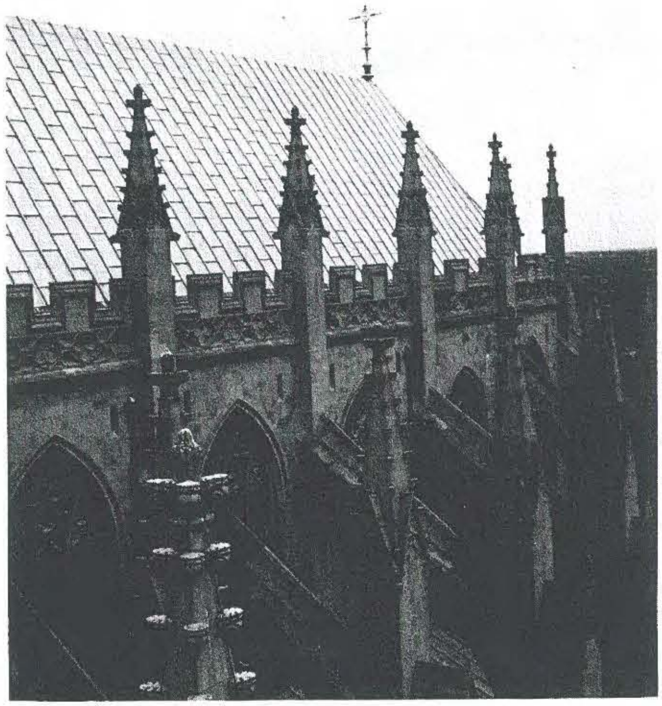
Replacing the Historic Roofing Material

Professional advice will be needed to assess the various aspects of replacing a historic roof. With some exceptions, most historic roofing materials are available today. If not, an architect or preservation group who has previously worked with the same type material may be able to recommend suppliers. Special roofing materials, such as tile or embossed metal shingles, can be produced by manufacturers of related products that are commonly used elsewhere, either on the exterior or interior of a structure. With some creative thinking and research, the historic materials usually can be found.



Because of the roof's visibility, the slate detailing around the dormers is important to the character of this structure. Note how the slates swirl from a horizontal pattern on the main roof to a diamond pattern on the dormer roofs and side walls. (18th and Que Streets, NW, Washington, D.C.)

Craft Practices: Determining the craft practices used in the installation of a historic roof is another major concern in roof restoration. Early builders took great pride in their work, and experience has shown that the "rustic" or irregular designs commercially labled "Early American" are a 20th-century invention. For example, historically, wood shingles underwent several distinct operations in their manufacture including splitting by hand, and smoothing the surface with a draw knife. In modern nomenclature, the same item would be a "tapersplit" shingle which has been dressed. Unfortunately, the rustic appearance of today's commercially available "handsplit" and re-sawn shingle bears no resemblance to the hand-made roofing materials used on early American buildings.



Good design and quality materials for the roof surface, fastenings, and flashing minimize roofing failures. This is essential on roofs such as on the National Cathedral where a thorough maintenance inspection and minor repairs cannot be done easily without special scaffolding. However, the success of the roof on any structure depends on frequent cleaning and repair of the gutter system. (Washington, D.C., photo courtesy of John Burns, A.I.A.)

Early craftsmen worked with a great deal of common sense; they understood their materials. For example they knew that wood shingles should be relatively narrow; shingles much wider than about 6" would split when walked on, or they may curl or crack from varying temperature and moisture. It is important to understand these aspects of craftsmanship, remembering that people wanted their roofs to be weather-tight and to last a long time. The recent use of "mother-goose" shingles on historic structures is a gross underestimation of the early craftsman's skills.

Supervision: Finding a modern craftsman to reproduce historic details may take some effort. It may even involve some special instruction to raise his understanding of certain historic craft practices. At the same time, it may be pointless (and expensive) to follow historic craft practices in any construction that will not be visible on the finished product. But if the roofing details are readily visible, their appearance should be based on architectural evidence or on historic prototypes. For instance, the spacing of the seams on a standing-seam metal roof will affect the building's overall scale and should therefore match the original dimensions of the seams.

Many older roofing practices are no longer performed because of modern improvements. Research and review of specific detailing in the roof with the contractor before beginning the project is highly recommended. For example, one early craft practice was to finish the ridge of a wood shingle roof with a roof "comb"—that is, the top course of one slope of the roof was extended uniformly beyond the peak to shield the ridge, and to provide some weather protection for the raw horizontal edges of the shingles on the other slope. If the "comb" is known to have been the correct detail, it should be used. Though this method leaves the top course vulnerable to the weather, a disguised strip of flashing will strengthen this weak point.

Detail drawings or a sample mock-up will help ensure that the contractor or craftsman understands the scope and special requirements of the project. It should never be assumed that the modern carpenter, slater, sheet metal worker, or roofer will know all the historic details. Supervision is as important as any other stage of the process.

Special problems inherent in the design of an elaborate historic roof can be controlled through the use of good materials and regular maintenance. The shape and detailing are essential elements of the building's historic character, and should not be modified, despite the use of alternative surface materials. (Gamwell House, Bellingham, Washington)

Alternative Materials

The use of the historic roofing material on a structure may be restricted by building codes or by the availability of the materials, in which case an appropriate alternative will have to be found.

Some municipal building codes allow variances for roofing materials in historic districts. In other instances, individual variances may be obtained. Most modern heating and cooking is fueled by gas, electricity, or oil—none of which emit the hot embers that historically have been the cause of roof fires. Where wood burning fireplaces or stoves are used, spark arrestor screens at the top of the chimneys help to prevent flaming material from escaping, thus reducing the number of fires that start at the roof. In most states, insurance rates have been equalized to reflect revised considerations for the risks involved with various roofing materials.

In a rehabilitation project, there may be valid reasons for replacing the roof with a material other than the original. The historic roofing may no longer be available, or the cost of obtaining specially fabricated materials may be prohibitive. But the decision to use an alternative material should be weighed carefully against the primary concern to keep the historic character of the building. If the roof is flat and is not visible from any elevation of the building, and if there are advantages to substituting a modern built-up composition roof for what might have been a flat metal roof, then it may make better economic and construction sense to use a modern roofing method. But if the roof is readily visible, the alternative material should match as closely as possible the scale, texture, and coloration of the historic roofing material.

Asphalt shingles or ceramic tiles are common substitute materials intended to duplicate the appearance of wood shingles, slates, or tiles. Fire-retardant, treated wood shingles are currently available. The treated wood tends, however, to be brittle, and may require extra care (and expense) to install. In some instances, shingles laid with an interlay of fire-retardent building paper may be an acceptable alternative.

Lead-coated copper, terne-coated steel, and aluminum/zinc-coated steel can successfully replace tin, terne plate, zinc, or lead. Copper-coated steel is a less expensive (and less durable) substitute for sheet copper.

The search for alternative roofing materials is not new. As early as the 18th century, fear of fire cause many wood shingle or board roofs to be replaced by sheet metal or clay tile. Some historic roofs were failures from the start, based on overambitious and naive use of materials as they were first developed. Research on a structure may reveal that an inadequately designed or a highly combustible roof was replaced early in its history, and therefore restoration of a later roof material would have a valid precedent. In some cities, the substitution of sheet metal on early row houses occurred as soon as the rolled material became available.

Cost and ease of maintenance may dictate the substitution of a material wholly different in appearance from the original. The practical problems (wind, weather, and roof pitch) should be weighed against the historical consideration of scale, texture, and color. Sometimes the effect of the alternative material will be minimal. But on roofs with a high degree of visibility and patterning or texture, the substitution may seriously alter the architectural character of the building.

Temporary Stabilization

It may be necessary to carry out an immediate and temporary stabilization to prevent further deterioration until research can determine how the roof should be restored or rehabilitated, or until funding can be provided to do a proper job. A simple covering of exterior plywood or roll roofing might provide adequate protection, but any temporary covering should be applied with caution. One should be careful not to overload the roof structure, or to damage or destroy historic evidence or fabric that might be incorporated into a new roof at a later date. In this sense, repairs with caulking or bituminous patching compounds should be recognized as potentially harmful, since they are difficult to remove, and at their best, are very temporary.

Precautions

The architect or contractor should warn the owner of any precautions to be taken against the specific hazards in installing the roofing material. Soldering of sheet metals, for instance, can be a fire hazard, either from the open flame or from overheating and undected smoldering of the wooden substrate materials.

Thought should be given to the design and placement of any modern roof appurtenances such as plumbing stacks, air vents, or TV antennas. Consideration should begin with the placement of modern plumbing on the interior of the building, otherwise a series of vent stacks may pierce the roof membrane at various spots creating maintenance problems as well as aesthetic ones. Air handling units placed in the attic space will require vents which, in turn, require sensitive design. Incorporating these in unused chimneys has been very successful in the past.

Whenever gutters and downspouts are needed that were not on the building historically, the additions should be made as unobtrusively as possible, perhaps by painting them out with a color compatible with the nearby wall or trim.

Maintenance

Although a new roof can be an object of beauty, it will not be protective for long without proper maintenance. At least twice a year, the roof should be inspected against a checklist. All changes should be recorded and reported. Guidelines should be established for any foot traffic that may be required for the maintenance of the roof. Many roofing materials should not be walked on at all. For some—slate, asbestos, and clay tile—a self-supporting ladder might be hung over the ridge of the roof, or planks might be spanned across the roof surface. Such items should be specifically designed and kept in a storage space accessible to the roof. If exterior work ever requires hanging scaffolding, use caution to insure that the anchors do not penetrate, break, or wear the roofing surface, gutters, or flashing.

Any roofing system should be recognized as a membrane that is designed to be self-sustaining, but that can be easily damaged by intrusions such as pedestrian traffic or fallen tree branches. Certain items should be checked at specific times. For example, gutters tend to accumulate leaves and debris during the spring and fall and after heavy rain. Hidden gutter screening both at downspouts and over the full length of the gutter could help keep them clean. The surface material would require checking after a storm as well. Periodic checking of the underside of the roof from the attic after a storm or winter freezing may give early warning of any leaks. Generally, damage from water or ice is less likely on a roof that has good flashing on the outside and is well ventilated and insulated on the inside. Specific instructions for the maintenance of the different roof materials should be available from the architect or contractor.

Summary

The essential ingredients for replacing and maintaining a historic roof are:

- Understanding the historic character of the building and being sympathetic to it.
- Careful examination and recording of the existing roof and any evidence of earlier roofs.
- Consideration of the historic craftsmanship and detailing and implementing them in the renewal wherever visible.
- Supervision of the roofers or maintenance personnel to assure preservation of historic fabric and proper understanding of the scope and detailing of the project.
- Consideration of alternative materials where the original cannot be used.
- Cyclical maintenance program to assure that the staff understands how to take care of the roof and of the particular trouble spots to safeguard.

With these points in mind, it will be possible to preserve the architectural character and maintain the physical integrity of the roofing on a historic building.

This Preservation Brief was written by Sarah M. Sweetser, Architectural Historian, Technical Preservation Services Division. Much of the technical information was based upon an unpublished report prepared under contract for this office by John G. and Dianà S. Waite. Some of the historical information was from Charles E. Peterson, FAIA, "American Notes," *Journal of the Society of Architectural Historians.*

The illustrations for this brief not specifically credited are from the files of the Technical Preservation Services Division.

This publication was prepared pursuant to Executive Order 11593, "Protection and Enhancement of the Cultural Environment," which directs the Secretary of the Interior to "develop and make available to Federal agencies and State and local governments information concerning professional methods and techniques for preserving, improving, restoring and maintaining historic properties." The Brief has been developed under the technical editorship of Lee H. Nelson, AIA, Chief, Preservation Assistance Division, National Park Service, U.S. Department of the Interior, Washington, D.C. 20240. Comments on the usefulness of this information are welcome and can be sent to Mr. Nelson at the above address. This publication is not copyrighted and can be reproduced without penalty. Normal procedures for credit to the author and the National Park Service are appreciated. **February 1978.**

Decorative features such as cupolas require extra maintenance. The flashing is carefully detailed to promote run-off, and the wooden ribbing must be kept well-painted. This roof surface, which was originally tin plate, has been replaced with lead-coated copper for maintenance purposes. (Lyndhurst, Tarrytown, New York, photo courtesy of the National Trust for Historic Preservation)

Additional readings on the subject of roofing are listed below.

Boaz, Joseph N., ed. *Architectural Graphic Standards.* New York: John Wiley and Sons, Inc., 1970. (Modern roofing types and detailing)

Briggs, Martin S. *A Short History of the Building Crafts.* London: Oxford University Press, 1925. (Descriptions of historic roofing materials)

Bulletin of the Association for Preservation Technology. Vol. 2 (nos. 1-2) 1970. (Entirely on roofing)

Holstrom, Ingmar; and Sandstrom, Christina. *Maintenance of Old Buildings: Preservation from the Technical and Antiquarian Standpoint.* Stockholm: National Swedish Building Research, 1972. (Contains a section on roof maintenance problems)

Insall, Donald. *The Care of Old Buildings Today.* London: The Architectural Press, 1972. (Excellent guide to some problems and solutions for historic roofs)

Labine, R.A. Clem. "Repairing Slate Roofs." *The Old House Journal* 3 (no. 12, Dec. 1975): 6-7.

Lefer, Henry. "A Birds-eye View." *Progressive Architecture.* (Mar. 1977), pp. 88-92. (Article on contemporary sheet metal)

National Slate Association. *Slate Roofs.* Reprint of 1926 edition, now available from the Vermont Structural Slate Co., Inc., Fairhaven, VT 05743. (An excellent reference for the many designs and details of slate roofs)

Peterson, Charles E. "Iron in Early American Roofs." *The Smithsonian Journal of History* 3 (no. 3). Edited by Peter C. Welsh. Washington, D.C.: Smithsonian Institution, 1968, pp. 41-76.

Waite, Diana S. *Nineteenth Century Tin Roofing and its Use at Hyde Hall.* Albany: New York State Historic Trust, 1971.

——. "Roofing for Early America." *Building Early America.* Edited by Charles E. Peterson. Radnor, Penn.: Chilton Book Co., 1976.

U.S. Department of the Interior

National Park Service
Preservation Assistance Division
Technical Preservation Services

Preservation Briefs: 9

The Repair of Historic Wooden Windows

John H. Myers

The windows on many historic buildings are an important aspect of the architectural character of those buildings. Their design, craftsmanship, or other qualities may make them worthy of preservation. This is self-evident for ornamental windows, but it can be equally true for warehouses or factories where the windows may be the most dominant visual element of an otherwise plain building (see figure 1). Evaluating the significance of these windows and planning for their repair or replacement can be a complex process involving both objective and subjective considerations. The *Secretary of the Interior's Standards for Rehabilitation,* and the accompanying guidelines, call for respecting the significance of original materials and features, repairing and retaining them wherever possible, and when necessary, replacing them in kind. This **Brief** is based on the issues of significance and repair which are implicit in the standards, but the primary emphasis is on the technical issues of planning for the repair of windows including evaluation of their physical condition, techniques of repair, and design considerations when replacement is necessary.

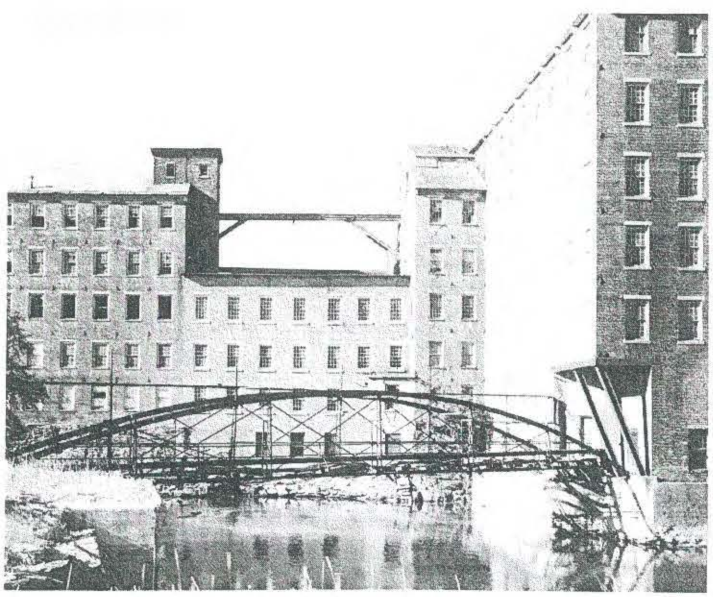


Figure 1. *Windows are frequently important visual focal points, especially on simple facades such as this mill building. Replacement of the multi-pane windows here with larger panes could dramatically change the appearance of the building. The areas of missing windows convey the impression of such a change. Photo: John T. Lowe*

Much of the technical section presents repair techniques as an instructional guide for the do-it-yourselfer. The information will be useful, however, for the architect, contractor, or developer on large-scale projects. It presents a methodology for approaching the evaluation and repair of existing windows, and considerations for replacement, from which the professional can develop alternatives and specify appropriate materials and procedures.

Architectural or Historical Significance

Evaluating the architectural or historical significance of windows is the first step in planning for window treatments, and a general understanding of the function and history of windows is vital to making a proper evaluation. As a part of this evaluation, one must consider four basic window functions: admitting light to the interior spaces, providing fresh air and ventilation to the interior, providing a visual link to the outside world, and enhancing the appearance of a building. No single factor can be disregarded when planning window treatments; for example, attempting to conserve energy by closing up or reducing the size of window openings may result in the use of *more* energy by increasing electric lighting loads and decreasing passive solar heat gains.

Historically, the first windows in early American houses were casement windows; that is, they were hinged at the side and opened outward. In the beginning of the eighteenth century single- and double-hung windows were introduced. Subsequently many styles of these vertical sliding sash windows have come to be associated with specific building periods or architectural styles, and this is an important consideration in determining the significance of windows, especially on a local or regional basis. Site-specific, regionally oriented architectural comparisons should be made to determine the significance of windows in question. Although such comparisons may focus on specific window types and their details, the ultimate determination of significance should be made within the context of the whole building, wherein the windows are one architectural element (see figure 2).

After all of the factors have been evaluated, *windows should be considered significant to a building if they:* 1) are original, 2) reflect the original design intent for the building, 3) reflect period or regional styles or building practices, 4) reflect changes to the building resulting from major periods or events, or 5) are examples of exceptional craftsmanship or design. Once this evaluation of significance has been completed, it is possible to pro-

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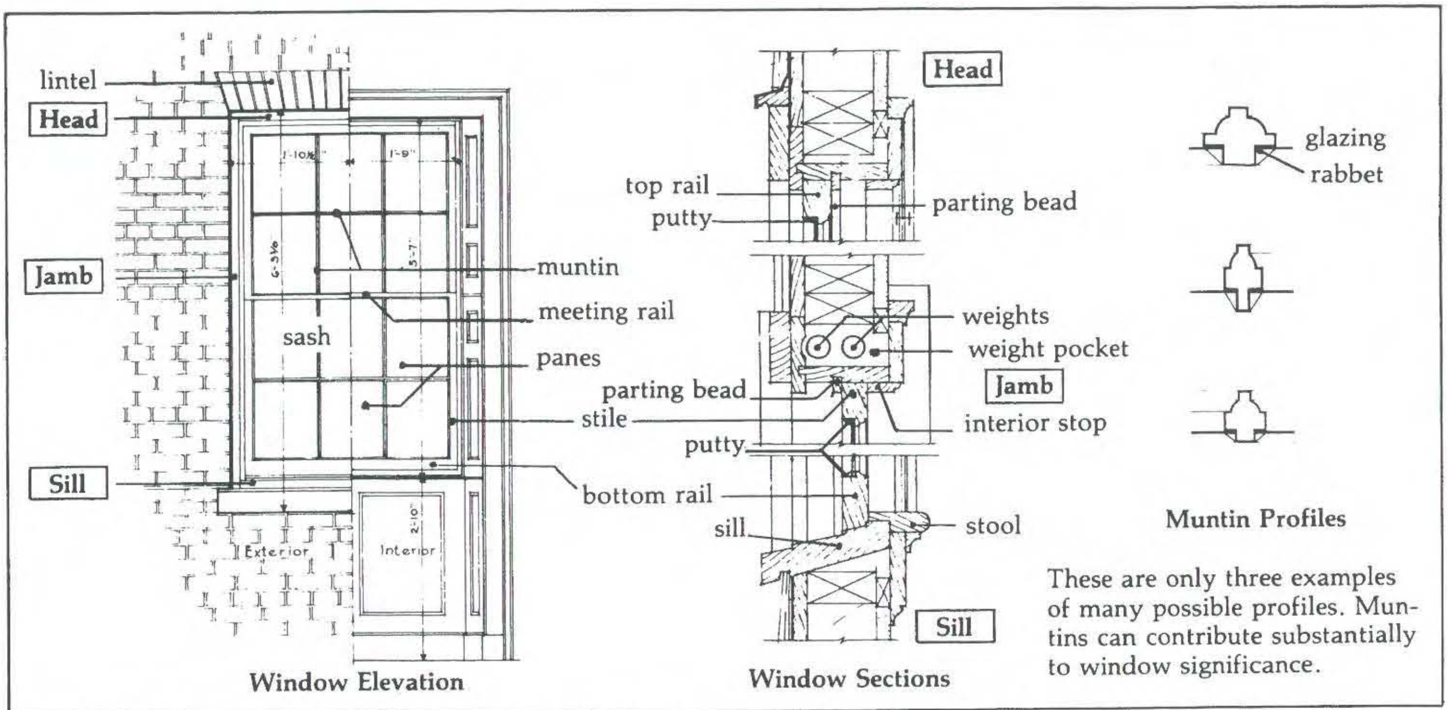

Figure 2. *These drawings of window details identify major components, terminology, and installation details for a wooden double-hung window.*

ceed with planning appropriate treatments, beginning with an investigation of the physical condition of the windows.

Physical Evaluation

The key to successful planning for window treatments is a careful evaluation of existing physical conditions on a unit-by-unit basis. A graphic or photographic system may be devised to record existing conditions and illustrate the scope of any necessary repairs. Another effective tool is a window schedule which lists all of the parts of each window unit. Spaces by each part allow notes on existing conditions and repair instructions. When such a schedule is completed, it indicates the precise tasks to be performed in the repair of each unit and becomes a part of the specifications. In any evaluation, one should note at a minimum, 1) window location, 2) condition of the paint, 3) condition of the frame and sill, 4) condition of the sash (rails, stiles and muntins), 5) glazing problems, 6) hardware, and 7) the overall condition of the window (excellent, fair, poor, and so forth).

Many factors such as poor design, moisture, vandalism, insect attack, and lack of maintenance can contribute to window deterioration, but moisture is the primary contributing factor in wooden window decay. All window units should be inspected to see if water is entering around the edges of the frame and, if so, the joints or seams should be caulked to eliminate this danger. The glazing putty should be checked for cracked, loose, or missing sections which allow water to saturate the wood, especially at the joints. The back putty on the interior side of the pane should also be inspected, because it creates a seal which prevents condensation from running down into the joinery. The sill should be examined to insure that it slopes downward away from the building and allows water to drain off. In addition, it may be advisable to cut a dripline along the underside of the sill. This almost invisible treatment will insure proper water run-off, particularly if the bottom of the sill is flat. Any conditions, including poor original design, which permit water to come in contact with the wood or to puddle on the sill must be corrected as they contribute to deterioration of the window.

One clue to the location of areas of excessive moisture is the condition of the paint; therefore, each window should be examined for areas of paint failure. Since excessive moisture is detrimental to the paint bond, areas of paint blistering, cracking, flaking, and peeling usually identify points of water penetration, moisture saturation, and potential deterioration. Failure of the paint should not, however, be mistakenly interpreted as a sign that the wood is in poor condition and hence, irreparable. Wood is frequently in sound physical condition beneath unsightly paint. After noting areas of paint failure, the next step is to inspect the condition of the wood, particularly at the points identified during the paint examination.

Each window should be examined for operational soundness beginning with the lower portions of the frame and sash. Exterior rainwater and interior condensation can flow downward along the window, entering and collecting at points where the flow is blocked. The sill, joints between the sill and jamb, corners of the bottom rails and muntin joints are typical points where water collects and deterioration begins (see figure 3). The operation of the window (continuous opening and closing over the years and seasonal temperature changes) weakens the joints, causing movement and slight separation. This process makes the joints more vulnerable to water which is readily absorbed into the end-grain of the wood. If severe deterioration exists in these areas, it will usually be apparent on visual inspection, but other less severely deteriorated areas of the wood may be tested by two traditional methods using a small ice pick.

An ice pick or an awl may be used to test wood for soundness. The technique is simply to jab the pick into a wetted wood surface at an angle and pry up a small sec-

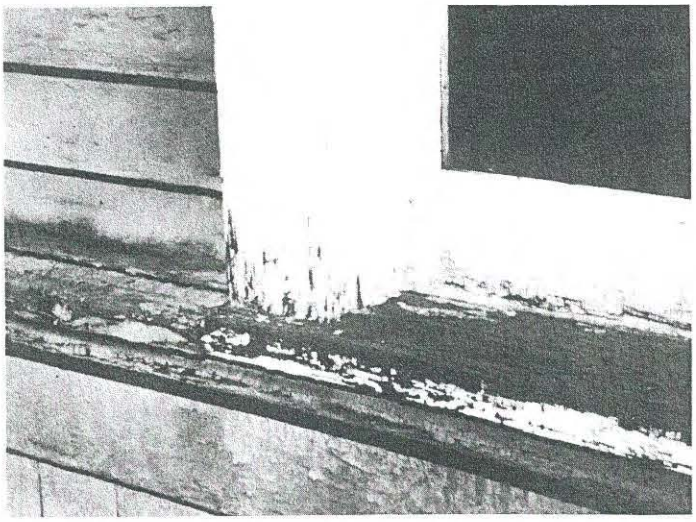

Figure 3. *Deterioration of poorly maintained windows usually begins on horizontal surfaces and at joints where water can collect and saturate the wood. The problem areas are clearly indicated by paint failure due to moisture. Photo: Baird M. Smith, AIA*

tion of the wood. Sound wood will separate in long fibrous splinters, but decayed wood will lift up in short irregular pieces due to the breakdown of fiber strength.

Another method of testing for soundness consists of pushing a sharp object into the wood, perpendicular to the surface. If deterioration has begun from the hidden side of a member and the core is badly decayed, the visible surface may appear to be sound wood. Pressure on the probe can force it through an apparently sound skin to penetrate deeply into decayed wood. This technique is especially useful for checking sills where visual access to the underside is restricted.

Following the inspection and analysis of the results, the scope of the necessary repairs will be evident and a plan for the rehabilitation can be formulated. Generally the actions necessary to return a window to "like new" condition will fall into three broad categories: 1) routine maintenance procedures, 2) structural stabilization, and 3) parts replacement. These categories will be discussed in the following sections and will be referred to respectively as Repair Class I, Repair Class II, and Repair Class III. Each successive repair class represents an increasing level of difficulty, expense, and work time. Note that most of the points mentioned in Repair Class I are routine maintenance items and should be provided in a regular maintenance program for any building. The neglect of these routine items can contribute to many common window problems.

Before undertaking any of the repairs mentioned in the following sections all sources of moisture penetration should be identified and eliminated, and all existing decay fungi destroyed in order to arrest the deterioration process. Many commercially available fungicides and wood preservatives are toxic, so it is extremely important to follow the manufacturer's recommendations for application, and store all chemical materials away from children and animals. After fungicidal and preservative treatment the windows may be stabilized, retained, and restored with every expectation for a long service life.

Repair Class I: Routine Maintenance

Repairs to wooden windows are usually labor intensive and relatively uncomplicated. On small scale projects this allows the do-it-yourselfer to save money by repairing all or part of the windows. On larger projects it presents the opportunity for time and money which might otherwise be spent on the removal and replacement of existing windows, to be spent on repairs, subsequently saving all or part of the material cost of new window units. Regardless of the actual costs, or who performs the work, the evaluation process described earlier will provide the knowledge from which to specify an appropriate work program, establish the work element priorities, and identify the level of skill needed by the labor force.

The routine maintenance required to upgrade a window to "like new" condition normally includes the following steps: 1) some degree of interior and exterior paint removal, 2) removal and repair of sash (including reglazing where necessary), 3) repairs to the frame, 4) weatherstripping and reinstallation of the sash, and 5) repainting. These operations are illustrated for a typical double-hung wooden window (see figures 4a-f), but they may be adapted to other window types and styles as applicable.

Historic windows have usually acquired many layers of paint over time. Removal of excess layers or peeling and flaking paint will facilitate operation of the window and restore the clarity of the original detailing. Some degree of paint removal is also necessary as a first step in the proper surface preparation for subsequent refinishing (if paint color analysis is desired, it should be conducted prior to the onset of the paint removal). There are several safe and effective techniques for removing paint from wood, depending on the amount of paint to be removed. Several techniques such as scraping, chemical stripping, and the use of a hot air gun are discussed in "Preservation Briefs: 10 Paint Removal from Historic Woodwork" (see Additional Reading section at end).

Paint removal should begin on the interior frames, being careful to remove the paint from the interior stop and the parting bead, particularly along the seam where these stops meet the jamb. This can be accomplished by running a utility knife along the length of the seam, breaking the paint bond. It will then be much easier to remove the stop, the parting bead and the sash. The interior stop may be initially loosened from the sash side to avoid visible scarring of the wood and then gradually pried loose using a pair of putty knives, working up and down the stop in small increments (see figure 4b). With the stop removed, the lower or interior sash may be withdrawn. The sash cords should be detached from the sides of the sash and their ends may be pinned with a nail or tied in a knot to prevent them from falling into the weight pocket.

Removal of the upper sash on double-hung units is similar but the parting bead which holds it in place is set into a groove in the center of the stile and is thinner and more delicate than the interior stop. After removing any paint along the seam, the parting bead should be carefully pried out and worked free in the same manner as the interior stop. The upper sash can be removed in the same manner as the lower one and both sash taken to a convenient work area (in order to remove the sash the interior stop and parting bead need only be removed from one side of the window). Window openings can be covered with polyethylene sheets or plywood sheathing while the sash are out for repair.

The sash can be stripped of paint using appropriate techniques, but if any heat treatment is used (see figure 4c), the glass should be removed or protected from the sudden temperature change which can cause breakage. An

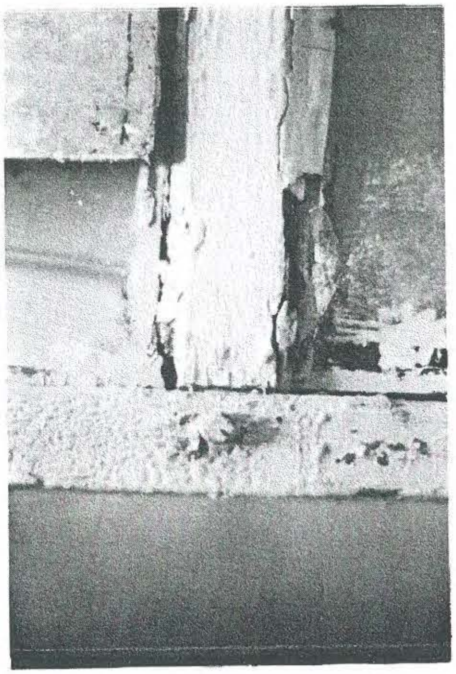

Figure 4a. *The following series of photographs of the repair of a historic double-hung window use a unit which is structurally sound but has many layers of paint, some cracked and missing putty, slight separation at the joints, broken sash cords, and one cracked pane. Photo: John H. Myers*

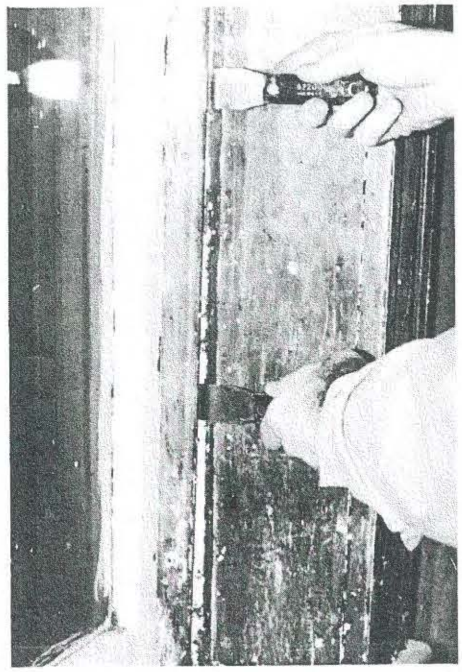

Figure 4b. *After removing paint from the seam between the interior stop and the jamb, the stop can be pried out and gradually worked loose using a pair of putty knives as shown. To avoid visible scarring of the wood, the sash can be raised and the stop pried loose initially from the outer side. Photo: John H. Myers*

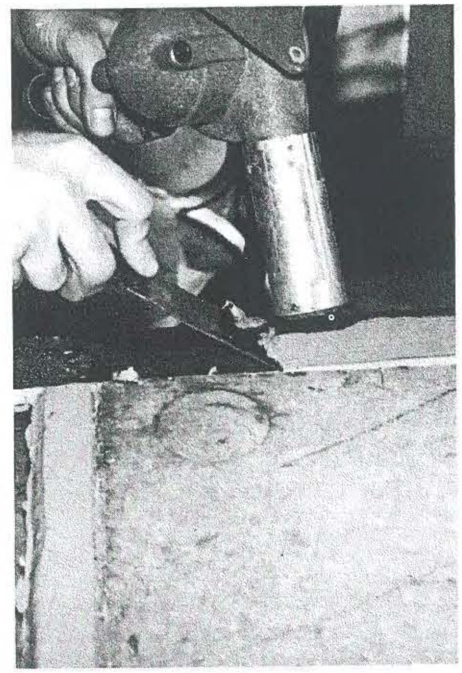

Figure 4c. *Sash can be removed and repaired in a convenient work area. Paint is being removed from this sash with a hot air gun while an asbestos sheet protects the glass from sudden temperature change. Photo: John H. Myers*

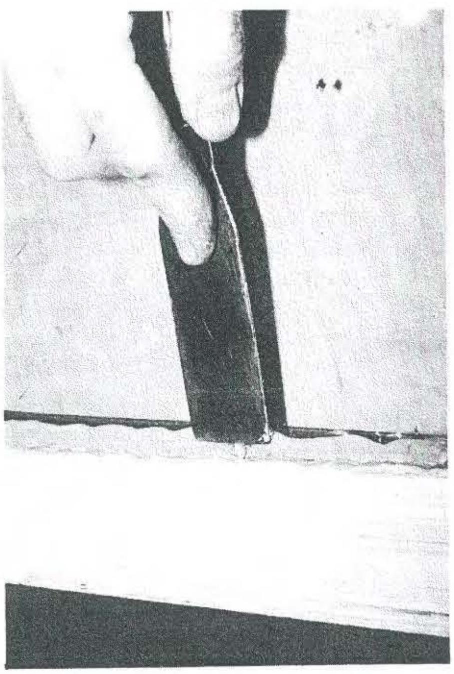

Figure 4d. *Reglazing or replacement of the putty requires that the existing putty be removed manually, the glazing points be extracted, the glass removed, and the back putty scraped out. To reglaze, a bed of putty is laid around the perimeter of the rabbet, the pane is pressed into place, glazing points are inserted to hold the pane (shown), and a final seal of putty is beveled around the edge of the glass. Photo: John H. Myers*

Figure 4e. *A common repair is the replacement of broken sash cords with new cords (shown) or with chains. The weight pocket is often accessible through a removable plate in the jamb, or by removing the interior trim. Photo: John H. Myers*

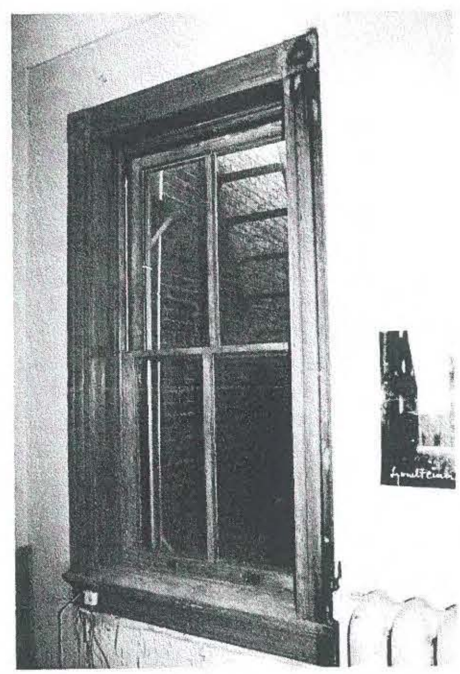

Figure 4f. *Following the relatively simple repairs, the window is weathertight, like new in appearance, and serviceable for many years to come. Both the historic material and the detailing and craftsmanship of this original window have been preserved. Photo: John H. Myers*

overlay of aluminum foil on gypsum board or asbestos can protect the glass from such rapid temperature change. It is important to protect the glass because it may be historic and often adds character to the window. Deteriorated putty should be removed manually, taking care not to damage the wood along the rabbet. If the glass is to be removed, the glazing points which hold the glass in place can be extracted and the panes numbered and removed for cleaning and reuse in the same openings. With the glass panes out, the remaining putty can be removed and the sash can be sanded, patched, and primed with a preservative primer. Hardened putty in the rabbets may be softened by heating with a soldering iron at the point of removal. Putty remaining on the glass may be softened by soaking the panes in linseed oil, and then removed with less risk of breaking the glass. Before reinstalling the glass, a bead of glazing compound or linseed oil putty should be laid around the rabbet to cushion and seal the glass. Glazing compound should only be used on wood which has been brushed with linseed oil and primed with an oil based primer or paint. The pane is then pressed into place and the glazing points are pushed into the wood around the perimeter of the pane (see figure 4d). The final glazing compound or putty is applied and beveled to complete the seal. The sash can be refinished as desired on the inside and painted on the outside as soon as a "skin" has formed on the putty, usually in 2 or 3 days. Exterior paint should cover the beveled glazing compound or putty and lap over onto the glass slightly to complete a weathertight seal. After the proper curing times have elapsed for paint and putty, the sash will be ready for reinstallation.

While the sash are out of the frame, the condition of the wood in the jamb and sill can be evaluated. Repair and refinishing of the frame may proceed concurrently with repairs to the sash, taking advantage of the curing times for the paints and putty used on the sash. One of the most common work items is the replacement of the sash cords with new rope cords or with chains (see figure 4e). The weight pocket is frequently accessible through a door on the face of the frame near the sill, but if no door exists, the trim on the interior face may be removed for access. Sash weights may be increased for easier window operation by elderly or handicapped persons. Additional repairs to the frame and sash may include consolidation or replacement of deteriorated wood. Techniques for these repairs are discussed in the following sections.

The operations just discussed summarize the efforts necessary to restore a window with minor deterioration to "like new" condition (see figure 4f). The techniques can be applied by an unskilled person with minimal training and experience. To demonstrate the practicality of this approach, and photograph it, a Technical Preservation Services staff member repaired a wooden double-hung, two over two window which had been in service over ninety years. The wood was structurally sound but the window had one broken pane, many layers of paint, broken sash cords and inadequate, worn-out weatherstripping. The staff member found that the frame could be stripped of paint and the sash removed quite easily. Paint, putty and glass removal required about one hour for each sash, and the reglazing of both sash was accomplished in about one hour. Weatherstripping of the sash and frame, replacement of the sash cords and reinstallation of the sash, parting bead, and stop required an hour and a half. These times refer only to individual operations; the entire process took several days due to the drying and curing times for putty, primer, and paint, however, work on other window units could have been in progress during these lag times.

Repair Class II: Stabilization

The preceding description of a window repair job focused on a unit which was operationally sound. Many windows will show some additional degree of physical deterioration, especially in the vulnerable areas mentioned earlier, but even badly damaged windows can be repaired using simple processes. Partially decayed wood can be waterproofed, patched, built-up, or consolidated and then painted to achieve a sound condition, good appearance, and greatly extended life. Three techniques for repairing partially decayed or weathered wood are discussed in this section, and all three can be accomplished using products available at most hardware stores.

One established technique for repairing wood which is split, checked or shows signs of rot, is to: 1) dry the wood, 2) treat decayed areas with a fungicide, 3) waterproof with two or three applications of boiled linseed oil (applications every 24 hours), 4) fill cracks and holes with putty, and 5) after a "skin" forms on the putty, paint the surface. Care should be taken with the use of fungicide which is toxic. Follow the manufacturers' directions and use only on areas which will be painted. When using any technique of building up or patching a flat surface, the finished surface should be sloped slightly to carry water away from the window and not allow it to puddle. Caulking of the joints between the sill and the jamb will help reduce further water penetration.

When sills or other members exhibit surface weathering they may also be built-up using wood putties or homemade mixtures such as sawdust and resorcinol glue, or whiting and varnish. These mixtures can be built up in successive layers, then sanded, primed, and painted. The same caution about proper slope for flat surfaces applies to this technique.

Wood may also be strengthened and stabilized by consolidation, using semi-rigid epoxies which saturate the porous decayed wood and then harden. The surface of the consolidated wood can then be filled with a semi-rigid epoxy patching compound, sanded and painted (see figure 5). Epoxy patching compounds can be used to build up

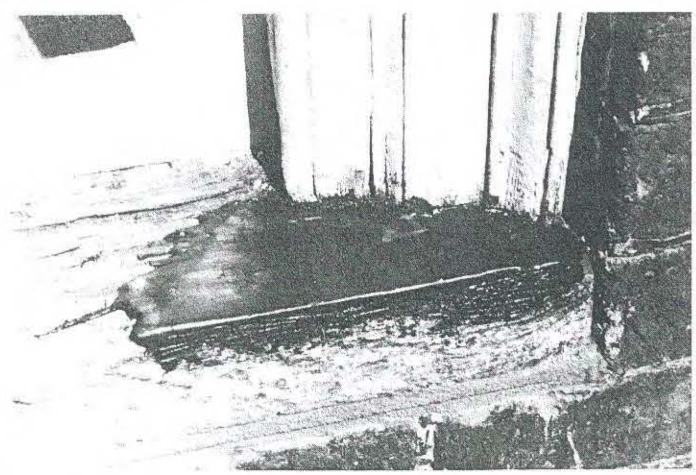

Figure 5. *This illustrates a two-part epoxy patching compound used to fill the surface of a weathered sill and rebuild the missing edge. When the epoxy cures, it can be sanded smooth and painted to achieve a durable and waterproof repair. Photo: John H. Myers*

missing sections or decayed ends of members. Profiles can be duplicated using hand molds, which are created by pressing a ball of patching compound over a sound section of the profile which has been rubbed with butcher's wax. This can be a very efficient technique where there are many typical repairs to be done. Technical Preservation Services has published *Epoxies for Wood Repairs in Historic Buildings* (see Additional Reading section at end), which discusses the theory and techniques of epoxy repairs. The process has been widely used and proven in marine applications; and proprietary products are available at hardware and marine supply stores. Although epoxy materials may be comparatively expensive, they hold the promise of being among the most durable and long lasting materials available for wood repair.

Any of the three techniques discussed can stabilize and restore the appearance of the window unit. There are times, however, when the degree of deterioration is so advanced that stabilization is impractical, and the only way to retain some of the original fabric is to replace damaged parts.

Repair Class III: Splices and Parts Replacement

When parts of the frame or sash are so badly deteriorated that they cannot be stabilized there are methods which permit the retention of some of the existing or original fabric. These methods involve replacing the deteriorated parts with new matching pieces, or splicing new wood into existing members. The techniques require more skill and are more expensive than any of the previously discussed alternatives. It is necessary to remove the sash and/or the affected parts of the frame and have a carpenter or woodworking mill reproduce the damaged or missing parts. Most millwork firms can duplicate parts, such as muntins, bottom rails, or sills, which can then be incorporated into the existing window, but it may be necessary to shop around because there are several factors controlling the practicality of this approach. Some woodworking mills do not like to repair old sash because nails or other foreign objects in the sash can damage expensive knives (which cost far more than their profits on small repair jobs); others do not have cutting knives to duplicate muntin profiles. Some firms prefer to concentrate on larger jobs with more profit potential, and some may not have a craftsman who can duplicate the parts. A little searching should locate a firm which will do the job, and at a reasonable price. If such a firm does not exist locally, there are firms which undertake this kind of repair and ship nationwide. It is possible, however, for the advanced do-it-yourselfer or craftsman with a table saw to duplicate moulding profiles using techniques discussed by Gordie Whittington in "Simplified Methods for Reproducing Wood Mouldings," *Bulletin* of the Association for Preservation Technology, Vol. III, No. 4, 1971, or illustrated more recently in *The Old House*, Time-Life Books, Alexandria, Virginia, 1979.

The repairs discussed in this section involve window frames which may be in very deteriorated condition, possibly requiring removal; therefore, caution is in order. The actual construction of wooden window frames and sash is not complicated. Pegged mortise and tenon units can be disassembled easily, *if* the units are out of the building. The installation or connection of some frames to the surrounding structure, especially masonry walls, can complicate the work immeasurably, and may even require dismantling of the wall. It may be useful, therefore, to take the following approach to frame repair: 1) conduct regular maintenance of sound frames to achieve the longest life possible, 2) make necessary repairs in place wherever possible, using stabilization and splicing techniques, and 3) if removal is necessary, thoroughly investigate the structural detailing and seek appropriate professional consultation.

Another alternative may be considered if parts replacement is required, and that is sash replacement. If extensive replacement of parts is necessary and the job becomes prohibitively expensive it may be more practical to purchase new sash which can be installed into the existing frames. Such sash are available as exact custom reproductions, reasonable facsimiles (custom windows with similar profiles), and contemporary wooden sash which are similar in appearance. There are companies which still manufacture high quality wooden sash which would duplicate most historic sash. A few calls to local building suppliers may provide a source of appropriate replacement sash, but if not, check with local historical associations, the state historic preservation office, or preservation related magazines and supply catalogs for information.

If a rehabilitation project has a large number of windows such as a commercial building or an industrial complex, there may be less of a problem arriving at a solution. Once the evaluation of the windows is completed and the scope of the work is known, there may be a potential economy of scale. Woodworking mills may be interested in the work from a large project; new sash in volume may be considerably less expensive per unit; crews can be assembled and trained on site to perform all of the window repairs; and a few extensive repairs can be absorbed (without undue burden) into the total budget for a large number of sound windows. While it may be expensive for the average historic home owner to pay seventy dollars or more for a mill to grind a custom knife to duplicate four or five bad muntins, that cost becomes negligible on large commercial projects which may have several hundred windows.

Most windows should not require the extensive repairs discussed in this section. The ones which do are usually in buildings which have been abandoned for long periods or have totally lacked maintenance for years. It is necessary to thoroughly investigate the alternatives for windows which do require extensive repairs to arrive at a solution which retains historic significance and is also economically feasible. Even for projects requiring repairs identified in this section, if the percentage of parts replacement per window is low, or the number of windows requiring repair is small, repair can still be a cost effective solution.

Weatherization

A window which is repaired should be made as energy efficient as possible by the use of appropriate weatherstripping to reduce air infiltration. A wide variety of products are available to assist in this task. Felt may be fastened to the top, bottom, and meeting rails, but may have the disadvantage of absorbing and holding moisture, particularly at the bottom rail. Rolled vinyl strips may also be tacked into place in appropriate locations to reduce infiltration. Metal strips or new plastic spring strips may be used on the rails and, if space permits, in the channels between the sash and jamb. Weatherstripping is a historic treatment, but old weatherstripping (felt) is not likely to perform very satisfactorily. Appropriate contemporary weatherstripping should be considered an integral part of the repair process for windows. The use of sash locks installed on the meeting rail will insure that the sash are kept tightly closed so that the weatherstripping will function more effectively to reduce infiltration. Although such locks will not always be historically accurate, they will usually be viewed as an acceptable contemporary modification in the interest of improved thermal performance.

Many styles of storm windows are available to improve the thermal performance of existing windows. The use of exterior storm windows should be investigated whenever feasible because they are thermally efficient, cost-effective, reversible, and allow the retention of original windows (see "Preservation Briefs: 3"). Storm window frames may be made of wood, aluminum, vinyl, or plastic; however, the use of unfinished aluminum storms should be avoided. The visual impact of storms may be minimized by selecting colors which match existing trim color. Arched top storms are available for windows with special shapes. Although interior storm windows appear to offer an attractive option for achieving double glazing with minimal visual impact, the potential for damaging condensation problems must be addressed. Moisture which becomes trapped between the layers of glazing can condense on the colder, outer prime window, potentially leading to deterioration. The correct approach to using interior storms is to create a seal on the interior storm while allowing some ventilation around the prime window. In actual practice, the creation of such a durable, airtight seal is difficult.

Window Replacement

Although the retention of original or existing windows is always desirable and this **Brief** is intended to encourage that goal, there is a point when the condition of a window may clearly indicate replacement. The decision process for selecting replacement windows should *not* begin with a survey of contemporary window products which are available as replacements, but should begin with a look at the windows which are being replaced. Attempt to understand the contribution of the window(s) to the appearance of the facade including: 1) the pattern of the openings and their size; 2) proportions of the frame and sash; 3) configuration of window panes; 4) muntin profiles; 5) type of wood; 6) paint color; 7) characteristics of the glass; and 8) associated details such as arched tops, hoods, or other decorative elements. Develop an understanding of how the window reflects the period, style, or regional characteristics of the building, or represents technological development.

Armed with an awareness of the significance of the existing window, begin to search for a replacement which retains as much of the character of the historic window as possible. There are many sources of suitable new windows. Continue looking until an acceptable replacement can be found. Check building supply firms, local woodworking mills, carpenters, preservation oriented magazines, or catalogs or suppliers of old building materials, for product information. Local historical associations and state historic preservation offices may be good sources of information on products which have been used successfully in preservation projects.

Consider energy efficiency as one of the factors for replacements, but do not let it dominate the issue. Energy conservation is no excuse for the wholesale destruction of historic windows which can be made thermally efficient by historically and aesthetically acceptable means. In fact, a historic wooden window with a high quality storm window added should thermally outperform a new double-glazed metal window which does not have thermal breaks (insulation between the inner and outer frames intended to break the path of heat flow). This occurs because the wood has far better insulating value than the metal, and in addition many historic windows have high ratios of wood to glass, thus reducing the area of highest heat transfer. One measure of heat transfer is the U-value, the number of Btu's per hour transferred through a square foot of material. When comparing thermal performance, the lower the U-value the better the performance. According to *ASHRAE 1977 Fundamentals*, the U-values for single glazed wooden windows range from 0.88 to 0.99. The addition of a storm window should reduce these figures to a range of 0.44 to 0.49. A non-thermal break, double-glazed metal window has a U-value of about 0.6.

Conclusion

Technical Preservation Services recommends the retention and repair of original windows whenever possible. We believe that the repair and weatherization of existing wooden windows is more practical than most people realize, and that many windows are unfortunately replaced because of a lack of awareness of techniques for evaluation, repair, and weatherization. Wooden windows which are repaired and properly maintained will have greatly extended service lives while contributing to the historic character of the building. Thus, an important element of a building's significance will have been preserved for the future.

Additional Reading

ASHRAE Handbook-1977 Fundamentals. New York: American Society of Heating, Refrigerating and Air-conditioning Engineers, 1978 (chapter 26).

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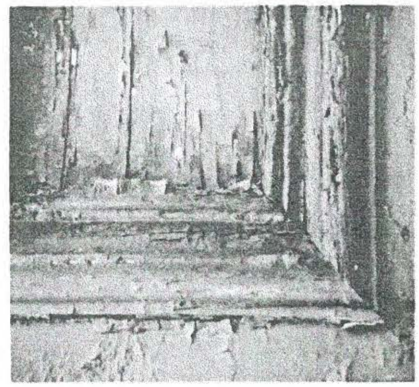
10 PRESERVATION BRIEFS



Exterior Paint Problems on Historic Woodwork

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Preservation Assistance Division Technical Preservation Services

A cautionary approach to paint removal is included in the guidelines to "The Secretary of the Interior Standards for Historic Preservation Projects." Removing paints down to bare wood surfaces using harsh methods can permanently damage those surfaces; therefore such methods are not recommended. Also, total removal obliterates evidence of the historical paints and their sequence and architectural context.

This Brief expands on that advice for the architect, building manager, contractor, or homeowner by identifying and describing common types of paint surface conditions and failures, then recommending appropriate treatments for preparing exterior wood surfaces for repainting[1] to assure the best adhesion and greatest durability of the new paint. Although the Brief focuses on responsible methods of "paint removal," several paint surface conditions will be described which do not require any paint removal, and still others which can be successfully handled by limited paint removal. In all cases, the information is intended to address the concerns related to *exterior wood.* It will also be generally assumed that, because houses built before 1950 involve one or more layers of lead-base paint,[2] the majority of conditions warranting paint removal will mean dealing with this toxic substance along with the dangers of the paint removal tools and chemical strippers themselves.

Purposes of Exterior Paint

Paint[3] applied to exterior wood must withstand yearly extremes of both temperature and humidity. While never expected to be more than a temporary physical shield—requiring re-application every 5-8 years—its importance should not be minimized. Because one of the main causes of wood deterioration is moisture penetration, a primary purpose for painting wood is to exclude such moisture, thereby slowing deterioration not only of a building's exterior siding and decorative features but, ultimately, its underlying structural members. Another important purpose for painting wood is, of course, to define and accent architectural features and to improve appearance.

Treating Paint Problems in Historic Buildings

Exterior paint is constantly deteriorating through the processes of weathering, but in a program of regular maintenance—assuming all other building systems are functioning properly—surfaces can be cleaned, lightly scraped, and hand sanded in preparation for a new finish coat. Unfortunately, these are ideal conditions. More often, complex maintenance problems are inherited by owners of historic buildings, including areas of paint that have failed[4] beyond the point of mere cleaning, scraping, and hand sanding (although much so-called "paint failure" is attributable to interior or exterior moisture problems or surface preparation and application mistakes with previous coats).

Although paint problems are by no means unique to historic buildings, treating multiple layers of hardened, brittle paint on complex, ornamental—and possibly fragile—exterior wood surfaces necessarily requires an extremely cautious approach (see figure 1). In the case of recent construction, this level of concern is not needed because the wood is generally less detailed and, in addition, retention of the sequence of paint layers as a partial record of the building's history is not an issue.

When historic buildings are involved, however, a special set of problems arises—varying in complexity depending upon their age, architectural style, historical importance, and physical soundness of the wood—which must be carefully evaluated so that decisions can be made that are sensitive to the longevity of the resource.

Justification for Paint Removal

At the outset of this Brief, it must be emphasized that removing paint from historic buildings—with the exception of cleaning, light scraping, and hand sanding as part of routine maintenance—should be avoided unless absolutely essential. *Once conditions warranting removal have*

[1] General paint type recommendations will be made, but paint color recommendations are beyond the scope of this Brief.

[2] Douglas R. Shier and William Hall, *Analysis of Housing Data Collected in a Lead-Based Paint Survey in Pittsburgh, Pennsylvania, Part 1,* National Bureau of Standards, Inter-Report 77-1250, May 1977.

[3] Any pigmented liquid, liquefiable, or mastic composition designed for application to a substrate in a thin layer which is converted to an opaque solid film after application. *Paint and Coatings Dictionary,* 1978. Federation of Societies for Coatings and Technology.

[4] For purposes of the Brief, this includes any area of painted exterior woodwork displaying signs of peeling, cracking, or alligatoring to bare wood. See descriptions of these and other paint surface conditions as well as recommended treatments on pp. 5-10.

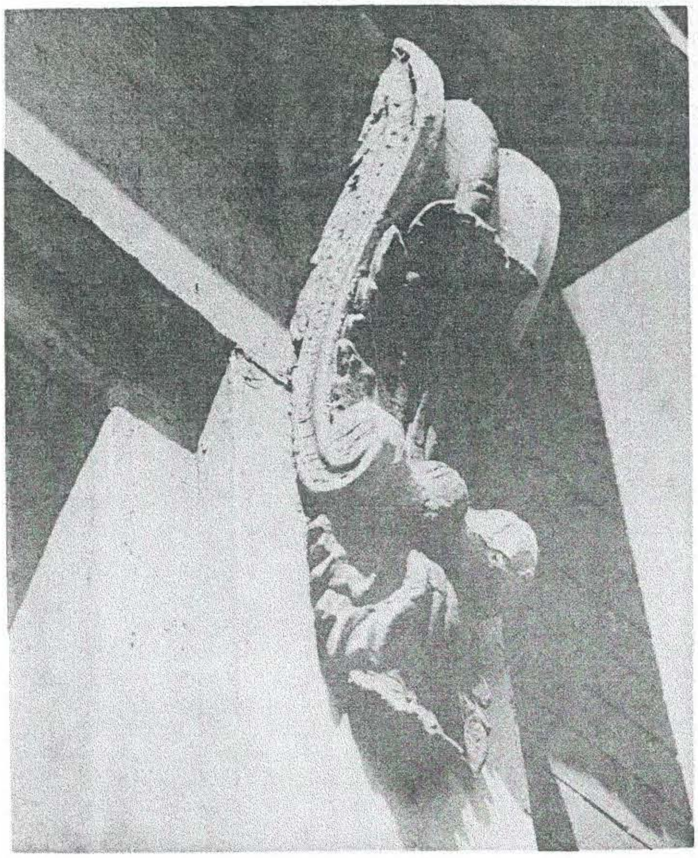

Fig. 1 *Excessive paint build-up on architectural details such as this ornamental bracket does not in itself justify total paint removal. If paint is cracked and peeling down to bare wood, however, it should be removed using the gentlest means possible. Photo: David W. Look, AIA.*

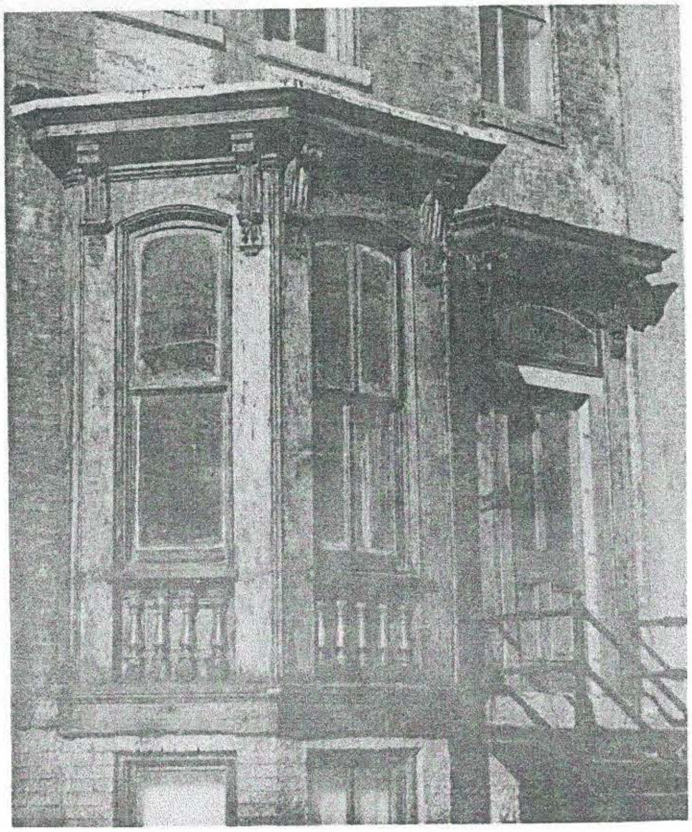

Fig. 2 *A traditionally painted bay window has been stripped to bare wood, then varnished. In addition to being historically inaccurate, the varnish will break down faster as a result of the sun's ultraviolet rays than would primer and finish coats of paint. Photo: David W. Look, AIA.*

been identified, the general approach should be to remove paint to the next sound layer using the gentlest means possible, then to repaint (see figure 2). Practically speaking as well, paint can adhere just as effectively to existing paint as to bare wood, providing the previous coats of paint are also adhering uniformly and tightly to the wood and the surface is properly prepared for repainting—cleaned of dirt and chalk and dulled by sanding. But, if painted exterior wood surfaces display continuous patterns of deep cracks or if they are extensively blistering and peeling so that bare wood is visible, then the old paint should be completely removed before repainting. The only other justification for removing all previous layers of paint is if doors, shutters, or windows have literally been "painted shut," or if new wood is being pieced-in adjacent to old painted wood and a smooth transition is desired (see figure 3).

Paint Removal Precautions

Because paint removal is a difficult and painstaking process, a number of costly, regrettable experiences have occurred—and continue to occur—for both the historic building and the building owner. Historic buildings have been set on fire with blow torches; wood irreversibly scarred by sandblasting or by harsh mechanical devices such as rotary sanders and rotary wire strippers; and layers of historic paint inadvertently and unnecessarily removed. In addition, property owners, using techniques that substitute speed for safety, have been injured by toxic lead vapors or dust from the paint they were trying to remove or by misuse of the paint removers themselves.

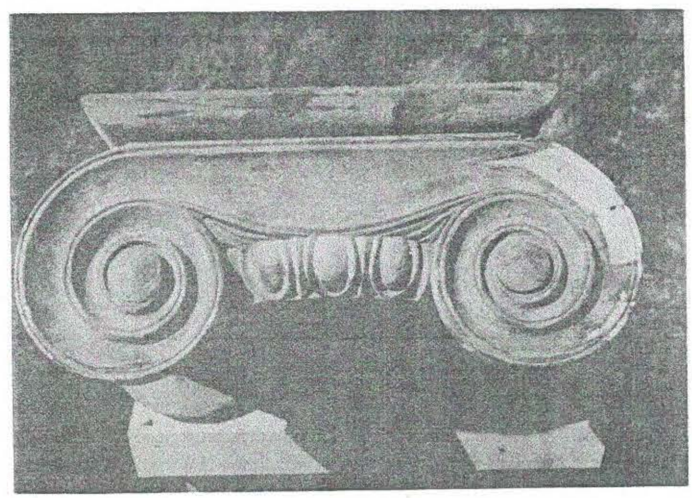

Fig. 3 *If damage to parts of a wooden element is severe, new sections of wood will need to be pieced-in. When such piecing is required, paint on the adjacent woodwork should be removed so that the old and new woods will make a smooth profile when joined. After repainting, the repair should be virtually impossible to detect. Photo: Morgan W. Phillips.*

Owners of historic properties considering paint removal should also be aware of the amount of time and labor involved. While removing damaged layers of paint from a door or porch railing might be readily accomplished within a reasonable period of time by one or two people, removing paint from larger areas of a building can, without professional assistance, easily become unmanageable and produce less than satisfactory results. The amount of work involved in any paint removal project must therefore be analyzed on a case-by-case basis. Hiring qualified professionals will often be a cost-effective decision due to the expense of materials, the special equipment required, and the amount of time involved. Further, paint removal companies experienced in dealing with the inherent health and safety dangers of paint removal should have purchased such protective devices as are needed to mitigate any dangers and should also be aware of State or local environmental and/or health regulations for hazardous waste disposal.

All in all, paint removal is a messy, expensive, and potentially dangerous aspect of rehabilitating or restoring historic buildings and should not be undertaken without careful thought concerning first, its necessity, and second, which of the available recommended methods is the safest and most appropriate for the job at hand.

Repainting Historic Buildings for Cosmetic Reasons

If existing exterior paint on wood siding, eaves, window sills, sash, and shutters, doors, and decorative features shows no evidence of paint deterioration such as chalking, blistering, peeling, or cracking, then there is no *physical reason* to repaint, much less remove paint! Nor is color fading, of itself, sufficient justification to repaint a historic building.

The decision to repaint may not be based altogether on paint failure. Where there is a new owner, or even where ownership has remained constant through the years, taste in colors often changes. Therefore, if repainting is primarily to alter a building's primary and accent colors, a technical factor of paint accumulation should be taken into consideration. When paint builds up to a thickness of approximately 1/16" (approximately 16-30 layers), one or more extra coats of paint may be enough to trigger cracking and peeling in limited or even widespread areas of the building's surface. This results because excessively thick paint is less able to withstand the shrinkage or pull of an additional coat as it dries and is also less able to tolerate thermal stresses. Thick paint invariably fails at the weakest point of adhesion—the oldest layers next to the wood. Cracking and peeling follow. Therefore, if there are no signs of paint failure, it may be somewhat risky to add still another layer of unneeded paint simply for color's sake (extreme changes in color may also require more than one coat to provide proper hiding power and full color). When paint appears to be nearing the critical thickness, a change of accent colors (that is, just to limited portions of the trim) might be an acceptable compromise without chancing cracking and peeling of paint on wooden siding.

If the decision to repaint is nonetheless made, the "new" color or colors should, at a minimum, be appropriate to the style and setting of the building. On the other hand, where the intent is to restore or accurately reproduce the colors originally used or those from a significant period in the building's evolution, they should be based on the results of a paint analysis.[5]

Identification of Exterior Paint Surface Conditions/Recommended Treatments

It is assumed that a preliminary check will already have been made to determine, first, that the painted exterior surfaces are indeed wood—and not stucco, metal, or other wood substitutes—and second, that the wood has not decayed so that repainting would be superfluous. For example, if any area of bare wood such as window sills has been exposed for a long period of time to standing water, wood rot is a strong possibility (see figure 4). Repair or replacement of deteriorated wood should take place before repainting. After these two basic issues have been resolved, the surface condition identification process may commence.

The historic building will undoubtedly exhibit a variety of exterior paint surface conditions. For example, paint on the wooden siding and doors may be adhering firmly; paint on the eaves peeling; and paint on the porch balusters and window sills cracking and alligatoring. The accurate identification of each paint problem is therefore the first step in planning an appropriate overall solution.

Paint surface conditions can be grouped according to their relative severity: CLASS I conditions include minor blemishes or dirt collection and generally require *no* paint removal; CLASS II conditions include failure of the top layer or layers of paint and generally require *limited* paint removal; and CLASS III conditions include substantial or multiple-layer failure and generally require *total* paint removal. It is precisely because conditions will vary at different points on the building that a careful inspection is critical. Each item of painted exterior woodwork (i.e., siding, doors, windows, eaves, shutters, and decorative elements) should be examined early in the planning phase and surface conditions noted.

CLASS I Exterior Surface Conditions Generally Requiring No Paint Removal

- **Dirt, Soot, Pollution, Cobwebs, Insect Cocoons, etc.**

Cause of Condition

Environmental "grime" or organic matter that tends to cling to painted exterior surfaces and, in particular, protected surfaces such as eaves, do not constitute a paint problem unless painted over rather than removed prior to repainting. If not removed, the surface deposits can be a barrier to proper adhesion and cause peeling.

Recommended Treatment

Most surface matter can be loosened by a strong, direct stream of water from the nozzle of a garden hose. Stubborn dirt and soot will need to be scrubbed off using ½ cup of household detergent in a gallon of water with a medium soft bristle brush. The cleaned surface should then be rinsed thoroughly, and permitted to dry before further inspection to determine if repainting is necessary. Quite often, cleaning provides a satisfactory enough result to postpone repainting.

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[5] See the Reading List for paint research and documentation information. See also *The Secretary of the Interior's Standards for Historic Preservation Projects with Guidelines for Applying the Standards* for recommended approaches on paints and finishes within various types of project work treatments.

• **Mildew**

Cause of Condition

Mildew is caused by fungi feeding on nutrients contained in the paint film or on dirt adhering to any surface. Because moisture is the single most important factor in its growth, mildew tends to thrive in areas where dampness and lack of sunshine are problems such as window sills, under eaves, around gutters and downspouts, on the north side of buildings, or in shaded areas near shrubbery. It may sometimes be difficult to distinguish mildew from dirt, but there is a simple test to differentiate: if a drop of household bleach is placed on the suspected surface, mildew will immediately turn white whereas dirt will continue to look like dirt.

Recommended Treatment

Because mildew can only exist in shady, warm, moist areas, attention should be given to altering the environment that is conducive to fungal growth. The area in question may be shaded by trees which need to be pruned back to allow sunlight to strike the building; or may lack rain gutters or proper drainage at the base of the building. If the shady or moist conditions can be altered, the mildew is less likely to reappear. A recommend solution for removing mildew consists of one cup non-ammoniated detergent, one quart household bleach, and one gallon water. When the surface is scrubbed with this solution using a medium soft brush, the mildew should disappear; however, for particularly stubborn spots, an additional quart of bleach may be added. After the area is mildew-free, it should then be rinsed with a direct stream of water from the nozzle of a garden hose, and permitted to dry thoroughly. When repainting, specially formulated "mildew-resistant" primer and finish coats should be used.

• **Excessive Chalking**

Cause of Condition

Chalking—or powdering of the paint surface—is caused by the gradual disintegration of the resin in the paint film. (The amount of chalking is determined both by the formulation of the paint and the amount of ultraviolet light to which the paint is exposed.) In moderation, chalking is the ideal way for a paint to "age," because the chalk, when rinsed by rainwater, carries discoloration and dirt away with it and thus provides an ideal surface for repainting. In excess, however, it is not desirable because the chalk can wash down onto a surface of a different color beneath the painted area and cause streaking as well as rapid disintegration of the paint film itself. Also, if a paint contains too much pigment for the amount of binder (as the old white lead carbonate/oil paints often did), excessive chalking can result.

Recommended Treatment

The chalk should be cleaned off with a solution of ½ cup household detergent to one gallon water, using a medium soft bristle brush. After scrubbing to remove the chalk, the surface should be rinsed with a direct stream of water from the nozzle of a garden hose, allowed to dry thoroughly, (but not long enough for the chalking process to recur) and repainted, using a non-chalking paint.

• **Staining**

Cause of Condition

Staining of paint coatings usually results from excess moisture reacting with materials within the wood substrate. There are two common types of staining, neither of which requires paint removal. The most prevalent type of stain is due to the oxidation or rusting of iron nails or metal (iron, steel, or copper) anchorage devices. A second type of stain is caused by a chemical reaction between moisture and natural extractives in certain woods (red cedar or redwood) which results in a surface deposit of colored matter. This is most apt to occur in new replacement wood within the first 10-15 years.

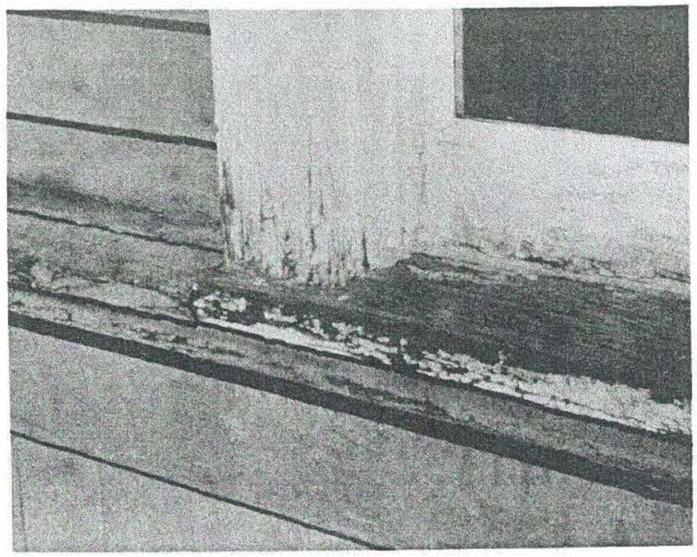

Fig. 4 *Paint films wear unevenly depending on exposure and location. Exterior locations which are susceptible to accelerated deterioration are horizontal surfaces such as window sills. These and similar areas will require repainting more often than less vulnerable surfaces. In the case of this window sill where paint has peeled off and adjacent areas have cracked and alligatored, the paint should be totally removed. Prior to repainting, any weathered wood should be rejuvenated using a solution of 3 cups exterior varnish, 1 oz. paraffin wax, and mineral spirits/ paint thinner/or turpentine to make 1 gallon. Liberal brush application should be made. This formula was tested over a 20-year period by the U.S. Department of Agriculture's Forest Products Laboratory and proved to be just as effective as water-repellent preservatives containing pentachlorophenol. After the surface has thoroughly dried (2-3 days of warm weather), the treated surface can be painted. A high quality oil-base primer followed by two top coats of a semi-gloss oil-enamel or latex-enamel paint is recommended. Photo: Baird M. Smith, AIA.*

Recommended Treatment

In both cases, the source of the stain should first be located and the moisture problem corrected.

When stains are caused by rusting of the heads of nails used to attach shingles or siding to an exterior wall or by rusting or oxidizing iron, steel, or copper anchorage devices adjacent to a painted surface, the metal objects themselves should be hand sanded and coated with a rust-inhibitive primer followed by two finish coats. (Exposed nail heads should ideally be countersunk, spot primed, and the holes filled with a high quality wood filler except where exposure of the nail head was part of the original construction system or the wood is too fragile to withstand the countersinking procedure.)

Discoloration due to color extractives in replacement wood can usually be cleaned with a solution of equal parts denatured alcohol and water. After the affected area has been rinsed and permitted to dry, a "stain-blocking primer" especially developed for preventing this type of stain should be applied (two primer coats are recommended for severe cases of bleeding prior to the finish coat). Each primer coat should be allowed to dry at least 48 hours.

CLASS II Exterior Surface Conditions Generally Requiring Limited Paint Removal

• Crazing

Cause of Condition

Crazing—fine, jagged interconnected breaks in the top layer of paint—results when paint that is several layers thick becomes excessively hard and brittle with age and is consequently no longer able to expand and contract with the wood in response to changes in temperature and humidity (see figure 5). As the wood swells, the bond between paint layers is broken and hairline cracks appear. Although somewhat more difficult to detect as opposed to other more obvious paint problems, it is well worth the time to scrutinize all surfaces for crazing. If not corrected, exterior moisture will enter the crazed surface, resulting in further swelling of the wood and, eventually, deep cracking and alligatoring, a Class III condition which requires total paint removal.

Recommended Treatment

Crazing can be treated by hand or mechanically sanding the surface, then repainting. Although the hairline cracks may tend to show through the new paint, the surface will be protected against exterior moisture penetration.

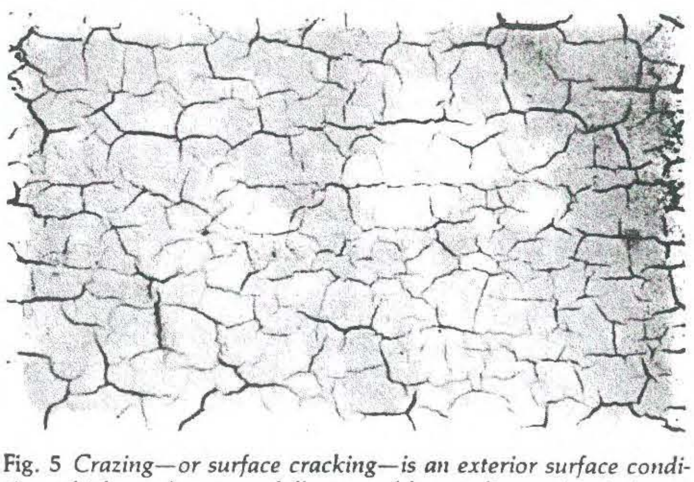

Fig. 5 *Crazing—or surface cracking—is an exterior surface condition which can be successfully treated by sanding and painting. Photo: Courtesy, National Decorating Products Association.*

• Intercoat Peeling

Cause of Condition

Intercoat peeling can be the result of improper surface preparation prior to the last repainting. This most often occurs in protected areas such as eaves and covered porches because these surfaces do not receive a regular rinsing from rainfall, and salts from air-borne pollutants thus accumulate on the surface. If not cleaned off, the new paint coat will not adhere properly and that layer will peel.

Another common cause of intercoat peeling is incompatibility between paint types (see figure 6). For example, if oil paint is applied over latex paint, peeling of the top coat can sometimes result since, upon aging, the oil paint becomes harder and less elastic than the latex paint. If latex paint is applied over old, chalking oil paint, peeling can also occur because the latex paint is unable to penetrate the chalky surface and adhere.

Recommended Treatment

First, where salts or impurities have caused the peeling, the affected area should be washed down thoroughly after scraping, then wiped dry. Finally, the surface should be hand or mechanically sanded, then repainted.

Where peeling was the result of using incompatible paints, the peeling top coat should be scraped and hand or mechanically sanded. Application of a high quality oil type exterior primer will provide a surface over which either an oil or a latex topcoat can be successfully used.

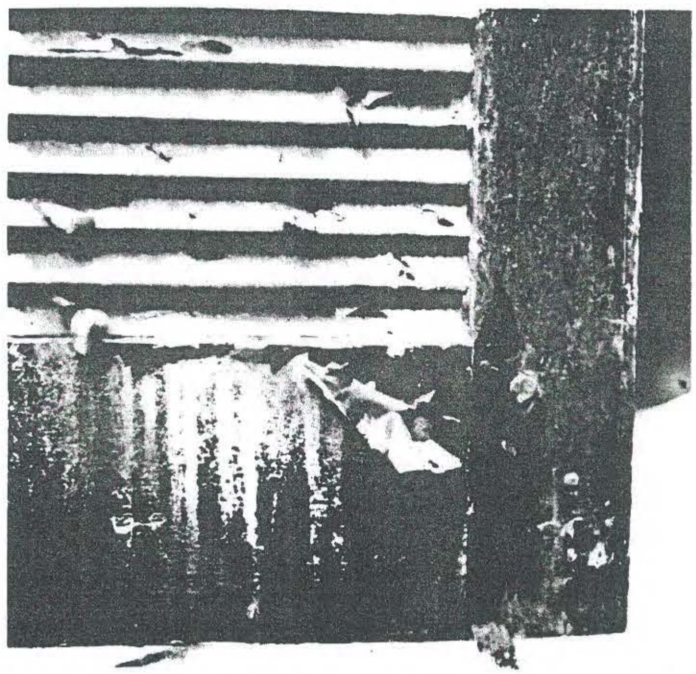

Fig. 6 *This is an example of intercoat peeling. A latex top coat was applied directly over old oil paint and, as a result, the latex paint was unable to adhere. If latex is being used over oil, an oil-base primer should be applied first. Although much of the peeling latex paint can be scraped off, in this case, the best solution may be to chemically dip strip the entire shutter to remove all of the paint down to bare wood, rinse thoroughly, then repaint. Photo: Mary L. Oehrlein, AIA.*

• Solvent Blistering

Cause of Condition

Solvent blistering, the result of a less common application error, is not caused by moisture, but by the action of ambient heat on paint solvent or thinners in the paint film. If solvent-rich paint is applied in direct sunlight, the top surface can dry too quickly and, as a result, solvents become trapped beneath the dried paint film. When the solvent vaporizes, it forces its way through the paint film, resulting in surface blisters. This problem occurs more often with dark colored paints because darker colors absorb more heat than lighter ones. To distinguish between solvent blistering and blistering caused by moisture, a blister should be cut open. If another layer of paint is visible, then solvent blistering is likely the problem whereas if bare wood is revealed, moisture is probably to blame. Solvent blisters are generally small.

Recommended Treatment

Solvent-blistered areas can be scraped, hand or mechanically sanded to the next sound layer, then repainted. In order to prevent blistering of painted surfaces, paint should not be applied in direct sunlight.

- **Wrinkling**

Cause of Condition

Another error in application that can easily be avoided is wrinkling (see figure 7). This occurs when the top layer of paint dries before the layer underneath. The top layer of paint actually moves as the paint underneath (a primer, for example) is drying. Specific causes of wrinkling include: (1) applying paint too thick; (2) applying a second coat before the first one dries; (3) inadequate brushing out; and (4) painting in temperatures higher than recommended by the manufacturer.

Recommended Treatment

The wrinkled layer can be removed by scraping followed by hand or mechanical sanding to provide as even a surface as possible, then repainted following manufacturer's application instructions.

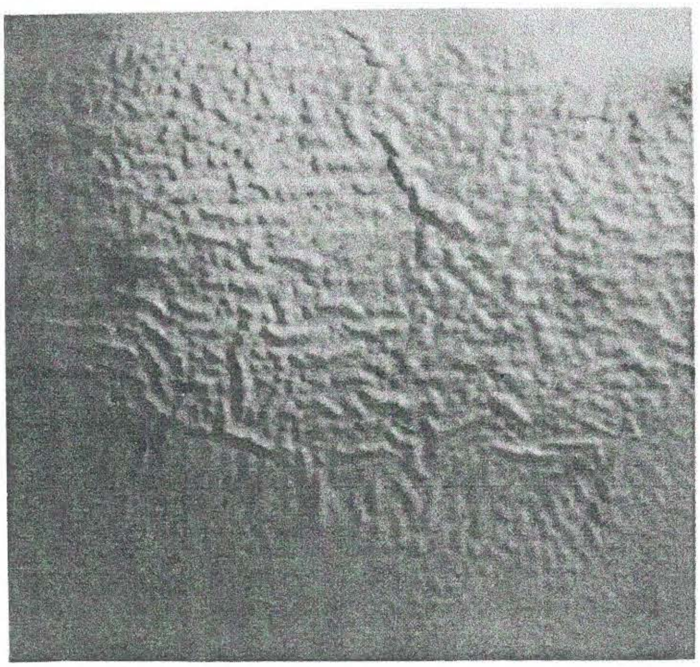

Fig. 7 *Wrinkled layers can generally be removed by scraping and sanding as opposed to total paint removal. Following manufacturers' application instructions is the best way to avoid this surface condition. Photo: Courtesy, National Decorating Products Association.*

CLASS III Exterior Surface Conditions Generally Requiring Total Paint Removal

If surface conditions are such that the majority of paint will have to be removed prior to repainting, it is suggested that a small sample of intact paint be left in an inconspicuous area either by covering the area with a metal plate, or by marking the area and identifying it in some way. (When repainting does take place, the sample should not be painted over). This will enable future investigators to have a record of the building's paint history.

- **Peeling**

Cause of Condition

Peeling to bare wood is most often caused by excess interior or exterior moisture that collects behind the paint film, thus impairing adhesion (see figure 8). Generally beginning as blisters, cracking and peeling occur as moisture causes the wood to swell, breaking the adhesion of the bottom layer.

Recommended Treatment

There is no sense in repainting before dealing with the moisture problems because new paint will simply fail. Therefore, the first step in treating peeling is to locate and remove the source or sources of the moisture, not only because moisture will jeopardize the protective coating of paint but because, if left unattended, it can ultimately cause permanent damage to the wood. Excess interior moisture should be removed from the building through installation of exhaust fans and vents. Exterior moisture should be eliminated by correcting the following conditions prior to repainting: faulty flashing; leaking gutters; defective roof shingles; cracks and holes in siding and trim; deteriorated caulking in joints and seams; and shrubbery growing too close to painted wood. After the moisture problems have been solved, the wood must be permitted to dry out thoroughly. The damaged paint can then be scraped off with a putty knife, hand or mechanically sanded, primed, and repainted.

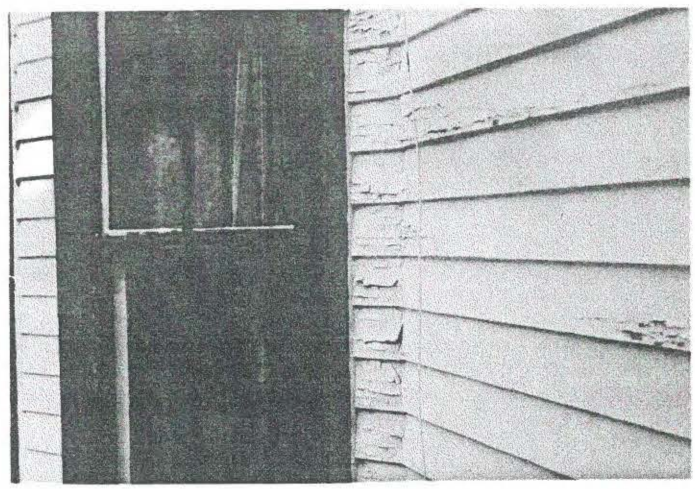

Fig. 8 *Peeling to bare wood—one of the most common types of paint failure—is usually caused by an interior or exterior moisture problem. Photo: Anne E. Grimmer.*

- **Cracking/Alligatoring**

Cause of Condition

Cracking and alligatoring are advanced stages of crazing (see figure 9). Once the bond between layers has been broken due to intercoat paint failure, exterior moisture is able to penetrate the surface cracks, causing the wood to swell and deeper cracking to take place. This process continues until cracking, which forms parallel to grain, extends to bare wood. Ultimately, the cracking becomes an overall pattern of horizontal and vertical breaks in the paint layers that looks like reptile skin; hence, "alligatoring." In advanced stages of cracking and alligatoring, the surfaces will also flake badly.

Recommended Treatment

If cracking and alligatoring are present only in the top layers they can probably be scraped, hand or mechanically sanded to the next sound layer, then repainted. However, if cracking and/or alligatoring have progressed to bare wood and the paint has begun to flake, it will need to be totally removed. Methods include scraping or paint removal with the electric heat plate, electric heat gun, or chemical strippers, depending on the particular area involved. Bare wood should be primed within 48 hours, then repainted.

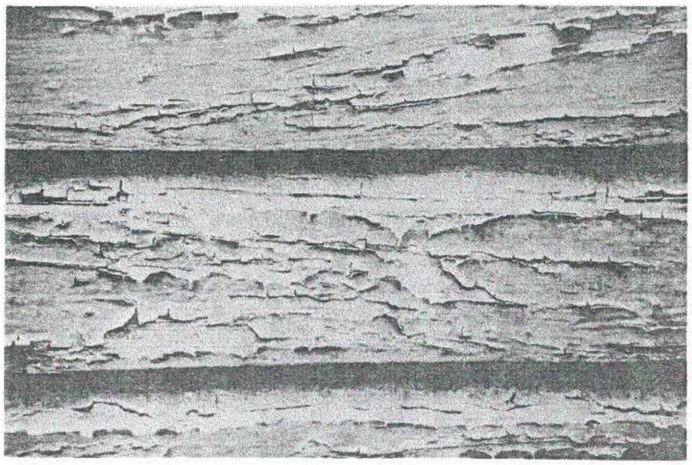

Fig. 9 *Cracking, alligatoring, and flaking are evidence of long-term neglect of painted surfaces. The remaining paint on the clapboard shown here can be removed with an electric heat plate and wide-bladed scraper. In addition, unsound wood should be replaced and moisture problems corrected before primer and top coats of paint are applied. Photo: David W. Look, AIA.*

Selecting the Appropriate/Safest Method to Remove Paint

After having presented the "hierarchy" of exterior paint surface conditions—from a mild condition such as mildewing which simply requires cleaning prior to repainting to serious conditions such as peeling and alligatoring which require total paint removal—one important thought bears repeating: if a paint problem has been identified that warrants either limited or total paint removal, the gentlest method possible for the particular wooden element of the historic building should be selected from the many available methods.

The treatments recommended—based upon field testing as well as onsite monitoring of Department of Interior grant-in-aid and certification of rehabilitation projects—are therefore those which take three over-riding issues into consideration (1) the continued protection and preservation of the historic exterior woodwork; (2) the retention of the sequence of historic paint layers; and (3) the health and safety of those individuals performing the paint removal. By applying these criteria, it will be seen that no paint removal method is without its drawbacks and all recommendations are qualified in varying degrees.

Methods for Removing Paint

After a particular exterior paint surface condition has been identified, the next step in planning for repainting—if paint removal is required—is selecting an appropriate method for such removal.

The method or methods selected should be suitable for the specific paint problem as well as the particular wooden element of the building. Methods for paint removal can be divided into three categories (frequently, however, a combination of the three methods is used). Each method is defined below, then discussed further and specific recommendations made:

Abrasive—"Abrading" the painted surface by manual and/or mechanical means such as scraping and sanding. Generally used for surface preparation and limited paint removal.

Thermal—Softening and raising the paint layers by applying heat followed by scraping and sanding. Generally used for total paint removal.

Chemical—Softening of the paint layers with chemical strippers followed by scraping and sanding. Generally used for total paint removal.

- **Abrasive Methods (Manual)**

If conditions have been identified that require limited paint removal such as crazing, intercoat peeling, solvent blistering, and wrinkling, scraping and hand sanding should be the first methods employed before using mechanical means. Even in the case of more serious conditions such as peeling—where the damaged paint is weak and already sufficiently loosened from the wood surface—scraping and hand sanding may be all that is needed prior to repainting.

Recommended Abrasive Methods (Manual)

Putty Knife/Paint Scraper: Scraping is usually accomplished with either a putty knife or a paint scraper, or both. Putty knives range in width from one to six inches and have a beveled edge. A putty knife is used in a pushing motion going under the paint and working from an area of loose paint toward the edge where the paint is still firmly adhered and, in effect, "beveling" the remaining layers so that as smooth a transition as possible is made between damaged and undamaged areas (see figure 10).

Paint scrapers are commonly available in 1⁵⁄₁₆, 2½, and 3½ inch widths and have replaceable blades. In addition, profiled scrapers can be made specifically for use on moldings. As opposed to the putty knife, the paint scraper is used in a pulling motion and works by raking the damaged areas of paint away.

The obvious goal in using the putty knife or the paint scraper is to selectively remove the affected layer or layers of paint; however, both of these tools, particularly the paint scraper with its hooked edge, must be used with care to properly prepare the surface and to avoid gouging the wood.

Sandpaper/Sanding Block/Sanding sponge: After manually removing the damaged layer or layers by scraping, the uneven surface (due to the almost inevitable removal of varying numbers of paint layers in a given area) will need to be smoothed or "feathered out" prior to repainting. As stated before, hand sanding, as opposed to harsher mechanical sanding, is recommended if the area is relatively limited. A coarse grit, open-coat flint sandpaper—the least expensive kind—is useful for this purpose because, as the sandpaper clogs with paint it must be discarded and this process repeated until all layers adhere uniformly.

Blocks made of wood or hard rubber and covered with sandpaper are useful for handsanding flat surfaces. Sanding sponges—rectangular sponges with an abrasive aggregate on their surfaces—are also available for detail work that requires reaching into grooves because the sponge easily conforms to curves and irregular surfaces. All sanding should be done with the grain.

Summary of Abrasive Methods (Manual)

Recommended: Putty knife, paint scraper, sandpaper, sanding block, sanding sponge.
Applicable areas of building: All areas.
For use on: Class I, Class II, and Class III conditions.
Health/Safety factors: Take precautions against lead dust, eye damage; dispose of lead paint residue properly.

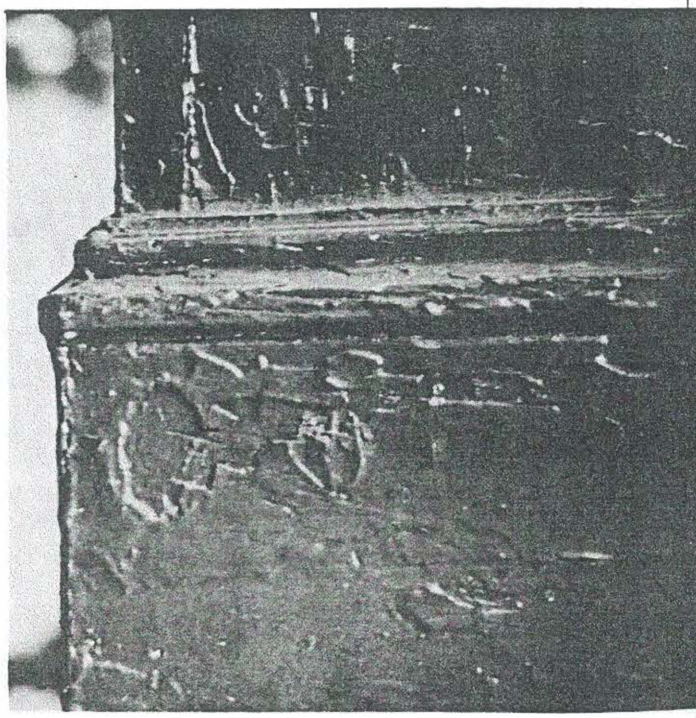

Fig. 10 *An excellent example of inadequate scraping before repainting, the problems here are far more than cosmetic. This improperly prepared surface will permit moisture to get behind the paint film which, in turn, will result in chipping and peeling. Photo: Baird M. Smith, AIA.*

• Abrasive Methods (Mechanical)

If hand sanding for purposes of surface preparation has not been productive or if the affected area is too large to consider hand sanding by itself, mechanical abrasive methods, i.e., power-operated tools may need to be employed; however, it should be noted that the majority of tools available for paint removal can cause damage to fragile wood and must be used with great care.

Recommended Abrasive Methods (Mechanical)

Orbital sander: Designed as a finishing or smoothing tool—not for the removal of multiple layers of paint—the oribital sander is thus recommended when limited paint removal is required prior to repainting. Because it sands in a small diameter circular motion (some models can also be switched to a back-and-forth vibrating action), this tool is particularly effective for "feathering" areas where paint has first been scraped (see figure 11). The abrasive surface varies from about 3×7 inches to 4×9 inches and sandpaper is attached either by clamps or sliding clips. A medium grit, open-coat aluminum oxide sandpaper should be used; fine sandpaper clogs up so quickly that it is ineffective for smoothing paint.

Belt sander: A second type of power tool—the belt sander—can also be used for removing limited layers of paint but, in this case, the abrasive surface is a continuous belt of sandpaper that travels at high speeds and consequently offers much less control than the orbital sander. Because of the potential for more damage to the paint or the wood, use of the belt sander (also with a medium grit sandpaper) should be limited to flat surfaces and only skilled operators should be permitted to operate it within a historic preservation project.

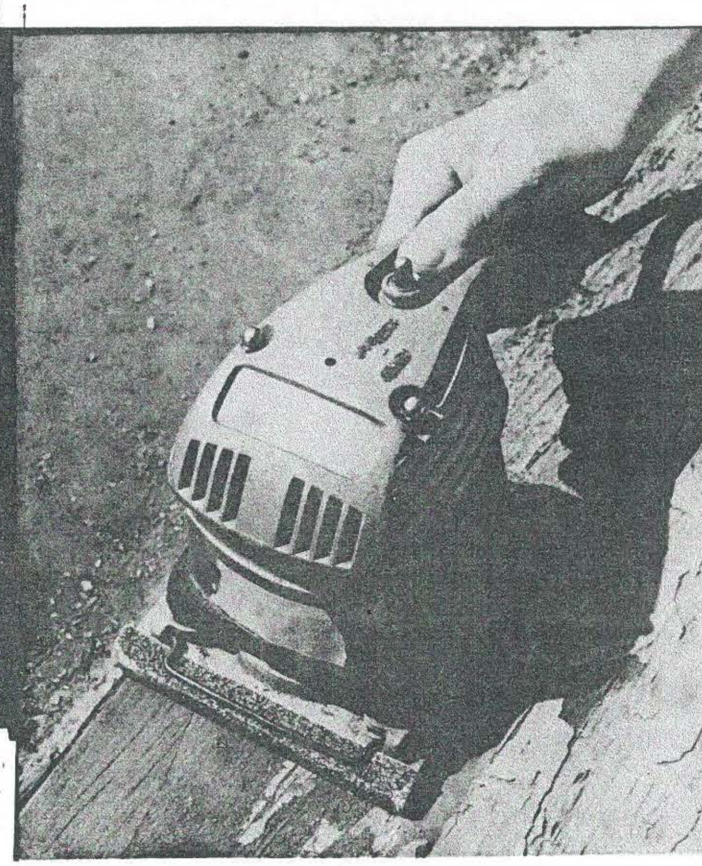

Fig. 11 *The orbital sander can be used for limited paint removal, i.e., for smoothing flat surfaces after the majority of deteriorated paint has already been scraped off. Photo: Charles E. Fisher, III.*

Not Recommended

Rotary Drill Attachments: Rotary drill attachments such as the rotary sanding disc and the rotary wire stripper should be avoided. The disc sander—usually a disc of sandpaper about 5 inches in diameter secured to a rubber based attachment which is in turn connected to an electric drill or other motorized housing—can easily leave visible circular depressions in the wood which are difficult to hide, even with repainting. The rotary wire stripper—clusters of metals wires similarly attached to an electric drill-type unit—can actually shred a wooden surface and is thus to be used exclusively for removing corrosion and paint from metals.

Waterblasting: Waterblasting above 600 p.s.i. to remove paint is not recommended because it can force water into the woodwork rather than cleaning loose paint and grime from the surface; at worst, high pressure waterblasting causes the water to penetrate exterior sheathing and damages interior finishes. A detergent solution, a medium soft bristle brush, and a garden hose for purposes of rinsing, is the gentlest method involving water and is recommended when cleaning exterior surfaces prior to repainting.

Sandblasting: Finally—and undoubtedly most vehemently "not recommended"—sandblasting painted exterior woodwork will indeed remove paint, but at the same time can scar wooden elements beyond recognition. As with rotary wire strippers, sandblasting erodes the soft porous fibers (spring wood) faster than the hard, dense fibers (summer wood), leaving a pitted surface with ridges and valleys. Sandblasting will also erode projecting areas of carvings and moldings before it removes paint from concave areas (see figure 12). Hence, this abrasive method is potentially the most damaging of all possibilities, even if a contractor promises that blast pressure can be controlled so that the paint is removed without harming the historic exterior woodwork. (For Additional Information, See Presevation Briefs 6, "Dangers of Abrasive Cleaning to Historic Buildings".)

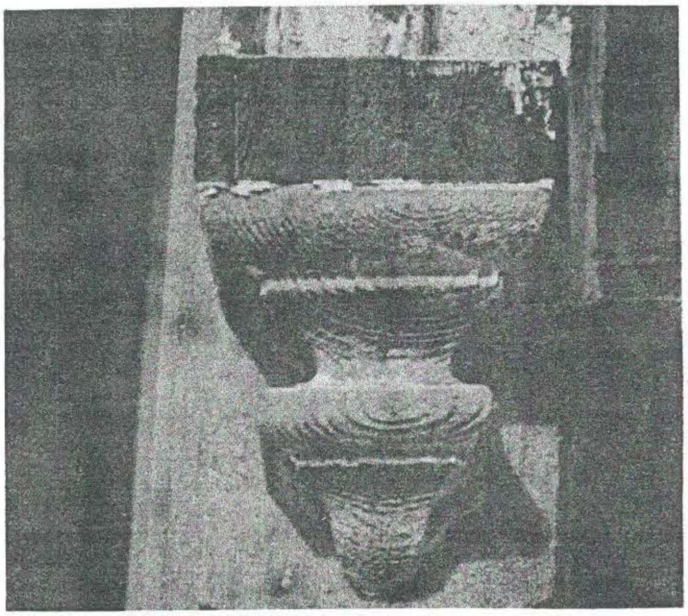

Fig. 12 *Sandblasting has permanently damaged this ornamental bracket. Even paint will not be able to hide the deep erosion of the wood. Photo: David W. Look, AIA.*

Summary of Abrasive Methods (Mechanical)

Recommended: Orbital sander, belt sander (skilled operator only).
Applicable areas of building: Flat surfaces, i.e., siding, eaves, doors, window sills.
For use on: Class II and Class III conditions.
Health/Safety factors: Take precautions against lead dust and eye damage; dispose of lead paint residue properly.
Not Recommended: Rotary drill attachments, high pressure waterblasting, sandblasting.

- **Thermal Methods**

Where exterior surface conditions have been identified that warrant total paint removal such as peeling, cracking, or alligatoring, two thermal devices—the electric heat plate and the electric heat gun—have proven to be quite successful for use on different wooden elements of the historic building. One thermal method—the blow torch—is not recommended because it can scorch the wood or even burn the building down!

Recommended Thermal Methods

Electric heat plate: The electric heat plate (see figure 13) operates between 500 and 800 degrees Fahrenheit (not hot enough to vaporize lead paint), using about 15 amps of power. The plate is held close to the painted exterior surface until the layers of paint begin to soften and blister, then moved to an adjacent location on the wood while the softened paint is scraped off with a putty knife (it should be noted that the heat plate is most successful when the paint is very thick!). With practice, the operator can successfully move the heat plate evenly across a flat surface such as wooden siding or a window sill or door in a continuous motion, thus lessening the risk of scorching the wood in an attempt to reheat the edge of the paint sufficiently for effective removal. Since the electric heat plate's coil is "red hot," extreme caution should be taken to avoid igniting clothing or burning the skin. If an extension cord is used, it should be a heavy-duty cord (with 3-prong grounded plugs). A heat plate could overload a circuit or, even worse, cause an electrical fire; therefore, it is recommended that this implement be used with a single circuit and that a fire extinguisher always be kept close at hand.

Fig. 13 *The electric heat plate (with paint scraper) is particularly useful for removing paint down to bare wood on flat surfaces such as doors, window frames, and siding. After scraping, some light sanding will probably be necessary to smooth the surface prior to application of primer and top coats. Photo: David W. Look, AIA.*

Electric heat gun: The electric heat gun (electric hot-air gun) looks like a hand-held hairdryer with a heavy-duty metal case (see figure 14). It has an electrical resistance coil that typically heats between 500 and 750 degrees Fahrenheit and, again, uses about 15 amps of power which requires a heavy-duty extension cord. There are some heat guns that operate at higher temperatures but they should not be purchased for removing old paint because of the danger of lead paint vapors. The temperature is controlled by a vent on the side of the heat gun. When the vent is closed, the heat increases. A fan forces a stream of hot air against the painted woodwork, causing a blister to form. At that point, the softened paint can be peeled back with a putty knife. It can be used to best advantage when a paneled door was originally varnished, then painted a number of times. In this case, the paint will come off quite easily, often leaving an almost pristine varnished surface behind. Like the heat plate, the heat gun works best on a heavy paint build-up. (It is, however, not very successful on only one or two layers of paint or on surfaces that have only been varnished. The varnish simply becomes sticky and the wood scorches.)

Although the heat gun is heavier and more tiring to use than the heat plate, it is particularly effective for removing paint from detail work because the nozzle can be directed at curved and intricate surfaces. Its use is thus more limited than the heat plate, and most successfully used in conjunction *with* the heat plate. For example, it takes about two to three hours to strip a paneled door with a heat gun, but if used in combination with a heat plate for the large, flat area, the time can usually be cut in half. Although a heat gun seldom scorches wood, it can cause fires (like the blow torch) if aimed at the dusty cavity between the exterior sheathing and siding and interior lath and plaster. A fire may smolder for hours before flames break through to the surface. Therefore, this thermal device is best suited for use on solid decorative elements, such as molding, balusters, fretwork, or "gingerbread."

Fig. 14 *The nozzle on the electric heat gun permits hot air to be aimed into cavities on solid decorative elements such as this applied column. After the paint has been sufficiently softened, it can be removed with a profiled scraper. Photo: Charles E. Fisher, III.*

Not Recommended

Blow Torch: Blow torches, such as hand-held propane or butane torches, were widely used in the past for paint removal because other thermal devices were not available. With this technique, the flame is directed toward the paint until it begins to bubble and loosen from the surface. Then the paint is scraped off with a putty knife. Although this is a relatively fast process, at temperatures between 3200 and 3800 degrees Fahrenheit the open flame is not only capable of burning a careless operator and causing severe damage to eyes or skin, it can easily scorch or ignite the wood. The other fire hazard is more insidious. Most frame buildings have an air space between the exterior sheathing and siding and interior lath and plaster. This cavity usually has an accumulation of dust which is also easily ignited by the open flame of a blow torch. Finally, lead-base paints will vaporize at high temperatures, releasing toxic fumes that can be unknowingly inhaled. Therefore, because both the heat plate and the heat gun are generally safer to use—that is, the risks are much more controllable—the blow torch should definitely be avoided!

Summary of Thermal Methods

Recommended: Electric heat plate, electric heat gun.
Applicable areas of building: Electric heat plate—flat surfaces such as siding, eaves, sash, sills, doors. Electric heat gun—solid decorative molding, balusters, fretwork, or "gingerbread."
For use on: Class III conditions.
Health/Safety factors: Take precautions against eye damage and fire. Dispose of lead paint residue properly.
Not Recommended: Blow torch.

• Chemical Methods

With the availability of effective thermal methods for total paint removal, the need for chemical methods—in the context of preparing historic exterior woodwork for repainting—becomes quite limited. Solvent-base or caustic strippers may, however, play a supplemental role in a number of situations, including:

- Removing paint residue from intricate decorative features, or in cracks or hard to reach areas if a heat gun has not been completely effective;
- Removing paint on window muntins because heat devices can easily break the glass;
- Removing varnish on exterior doors after all layers of paint have been removed by a heat plate/heat gun if the original varnish finish is being restored;
- Removing paint from detachable wooden elements such as exterior shutters, balusters, columns, and doors by dip-stripping when other methods are too laborious.

Recommended Chemical Methods
(Use With Extreme Caution)

Because all chemical paint removers can involve potential health and safety hazards, no wholehearted recommendations can be made from that standpoint. Commonly known as "paint removers" or "strippers," both solvent-base or caustic products are commercially available that, when poured, brushed, or sprayed on painted exterior woodwork are capable of softening several layers of paint at a time so that the resulting "sludge"—which should be remembered is nothing less than the sequence of historic paint layers—can be removed with a putty knife. Detachable wood elements such as exterior shutters can also be "dip-stripped."

Solvent-base Strippers: The formulas tend to vary, but generally consist of combinations of organic solvents such as methylene chloride, isopropanol, toluol, xylol, and methanol; thickeners such as methyl cellulose; and various additives such as paraffin wax used to prevent the volatile solvents from evaporating before they have time to soak through multiple layers of paint. Thus, while some solvent-base strippers are quite thin and therefore unsuitable for use on vertical surfaces, others, called "semi-paste" strippers, are formulated for use on vertical surfaces or the underside of horizontal surfaces.

However, whether liquid or semi-paste, there are two important points to stress when using any solvent-base stripper: First, the vapors from the organic chemicals can be highly toxic if inhaled; skin contact is equally dangerous because the solvents can be absorbed; second, many solvent-base strippers are flammable. Even though application out-of-doors may somewhat mitigate health and safety hazards, a respirator with special filters for organic solvents is recommended and, of course, solvent-base strippers should never be used around open flames, lighted cigarettes, or with steel wool around electrical outlets.

Although appearing to be the simplest for exterior use, a particular type of solvent-base stripper needs to be mentioned here because it can actually cause the most problems. Known as "water-rinsable," such products have a high proportion of methylene chloride together with emulsifiers. Although the dissolved paint can be rinsed off with water with a minimum of scraping, this ultimately creates more of a problem in cleaning up and properly disposing of the sludge. In addition, these strippers can leave a gummy residue on the wood that requires removal with solvents. Finally, water-rinsable strippers tend to raise the grain of the wood more than regular strippers.

On balance, then, the regular strippers would seem to work just as well for exterior purposes and are perhaps even better from the standpoint of proper lead sludge disposal because they must be hand scraped as opposed to rinsed off (a coffee-can with a wire stretched across the top is one effective way to collect the sludge; when the putty knife is run across the wire, the sludge simply falls into the can. Then, when the can is filled, the wire is removed, the can capped, and the lead paint sludge disposed of according to local health regulations).

Caustic Strippers: Until the advent of solvent-base strippers, caustic strippers were used exclusively when a chemical method was deemed appropriate for total paint removal prior to repainting or refinishing. Now, it is more difficult to find commercially prepared caustic solutions in hardware and paint stores for home-owner use with the exception of lye (caustic soda) because solvent-base strippers packaged in small quantities tend to dominate the market.

Most commercial dip stripping companies, however, continue to use variations of the caustic bath process because it is still the cheapest method available for removing paint. Generally, dip stripping should be left to professional companies because caustic solutions can dissolve skin and permanently damage eyes as well as present serious disposal problems in large quantities.

If exterior shutters or other detachable elements are being sent out[6] for stripping in a caustic solution, it is wise to see samples of the company's finished work. While some companies do a first-rate job, others can leave a residue of paint in carvings and grooves. Wooden elements may also be soaked too long so that the wood grain is raised and roughened, requiring extensive hand sanding later. In addition, assurances should be given by these companies that caustic paint removers will be neutralized with a mild acid solution or at least thoroughly rinsed with water after dipping (a caustic residue makes the wood feel slippery). If this is not done, the lye residue will cause new paint to fail.

Summary of Chemical Methods

Recommended, with extreme caution: Solvent-base strippers, caustic strippers.
Applicable areas of buildings: decorative features, window muntins, doors, exterior shutters, columns, balusters, and railings.
For use on: Class III Conditions.
Health/Safety factors: Take precautions against inhaling toxic vapors; fire; eye damage; and chemical poisoning from skin contact. Dispose of lead residue properly

General Paint Type Recommendations

Based on the assumption that the exterior wood has been painted with oil paint many times in the past and the existing top coat is therefore also an oil paint,* it is recommended that for CLASS I and CLASS II paint surface conditions, a top coat of high quality oil paint be applied when repainting. The reason for recommending oil rather than latex paints is that a coat of latex paint applied directly over old oil paint is more apt to fail. The considerations are twofold. First, because oil paints continue to harden with age, the old surface is sensitive to the added stress of shrinkage which occurs as a new coat of paint dries. Oil paints shrink less upon drying than latex paints and thus do not have as great a tendency to pull the old paint loose. Second, when exterior oil paints age, the binder releases pigment particles, causing a chalky surface. Although for best results, the chalk (or dirt, etc.) should *always* be cleaned off prior to repainting, a coat of new oil paint is more able to penetrate a chalky residue and adhere than is latex paint. Therefore, unless it is possible to thoroughly clean a heavy chalked surface, oil paints—on balance—give better adhesion.

If however, a latex top coat is going to be applied over several layers of old oil paint, an oil primer should be applied first (the oil primer creates a flat, porous surface to which the latex can adhere). After the primer has thoroughly dried, a latex top coat may be applied. In the long run, changing paint types is more time consuming and expensive. An application of a new oil-type top coat on the old oil paint is, thus, the preferred course of action.

[6] Marking the original location of the shutter by number (either by stamping numbers into the end grain with metal numeral dies or cutting numbers into the end with a pen knife) will minimize difficulties when rehanging them.

* If the top coat is latex paint (when viewed by the naked eye or, preferably, with a magnifying glass, it looks like a series of tiny craters) it may either be repainted with new latex paint or with oil paint. Normal surface preparation should precede any repainting.

If CLASS III conditions have necessitated total paint removal, there are two options, both of which assure protection of the exterior wood: (1) an oil primer may be applied followed by an oil-type top coat, preferably by the same manufacturer; or (2) an oil primer may be applied followed by a latex top coat, again using the same brand of paint. It should also be noted that primers were never intended to withstand the effects of weathering; therefore, the top coat should be applied as soon as possible after the primer has dried.

Conclusion

The recommendations outlined in this Brief are cautious because at present there is no completely safe and effective method of removing old paint from exterior woodwork. This has necessarily eliminated descriptions of several methods still in a developmental or experimental stage, which can therefore neither be recommended nor precluded from future recommendation. With the ever-increasing number of buildings being rehabilitated, however, paint removal technology should be stimulated and, in consequence, existing methods refined and new methods developed which will respect both the historic wood and the health and safety of the operator.

Reading List

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Special thanks go to Baird M. Smith, AIA (formerly Chief, Preservation Technology Branch, TPS) for providing general direction in the development of the manuscript. In addition, the following individuals are to be thanked for their contributions as technical experts in the field: Royal T. Brown, National Paint and Coatings Association, Washington, D.C.; Dr. Judith E. Selwyn, Preservation Technology Associates, Boston, Massachusetts; and Dennis R. Vacca, Pratt & Lambert Co., Carlstadt, New Jersey. Finally, thanks go to several National Park Service staff members whose valuable comments were incorporated into the text and who contributed to the production of the brief: James A. Caufield, Anne E. Grimmer, Jean E. Travers, David G. Battle, Sharon C. Park, AIA, Charles E. Fisher III, Sara K. Blumenthal, and Martha A. Gutrick.

This publication has been prepared pursuant to The Economic Recovery Tax Act of 1981, which directs the Secretary of the Interior to certify rehabilitations of historic buildings that are consistent with their historic character; the advice and guidance in this brief will assist property owners in complying with the requirements of this law.

Preservation Briefs 10 has been developed under the technical editorship of Lee H. Nelson, AIA, Chief, Preservation Assistance Division, National Park Service, U.S. Department of the Interior, Washington, D.C. 20240. Comments on the usefulness of this information are welcomed and can be sent to Mr. Nelson at the above address.

September 1982

For sale by the Superintendent of Documents, U.S. Government Printing Office
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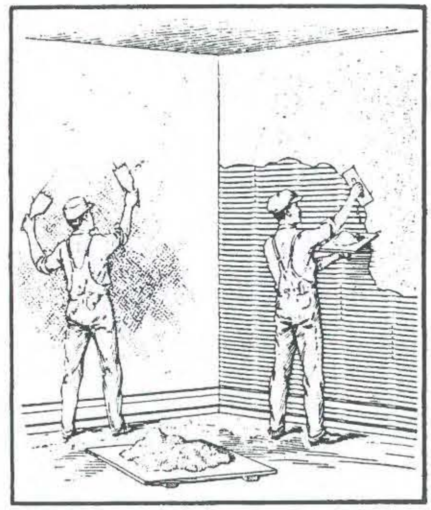


Repairing Historic Flat Plaster— Walls and Ceilings

Marylee MacDonald

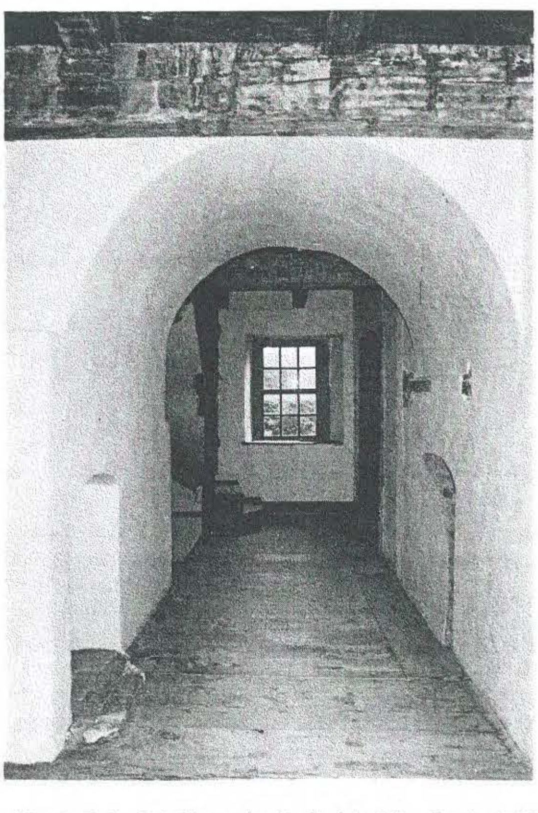
U.S. Department of the Interior National Park Service
Preservation Assistance Division Technical Preservation Services

Plaster in a historic building is like a family album. The handwriting of the artisans, the taste of the original occupants, and the evolving styles of decoration are embodied in the fabric of the building. From modest farmhouses to great buildings, regardless of the ethnic origins of the occupants, plaster has traditionally been used to finish interior walls.

A versatile material, plaster could be applied over brick, stone, half-timber, or frame construction. It provided a durable surface that was easy to clean and that could be applied to flat or curved walls and ceilings.

Plaster could be treated in any number of ways: it could receive stenciling, decorative painting, wallpaper, or whitewash. This variety and the adaptability of the material to nearly any building size, shape, or configuration meant that plaster was the wall surface chosen for nearly all buildings until the 1930s or 40s (Fig. 1).

Historic plaster may first appear so fraught with problems that its total removal seems the only alternative. But there are practical and historical reasons for saving it. First, three-coat plaster is unmatched in strength



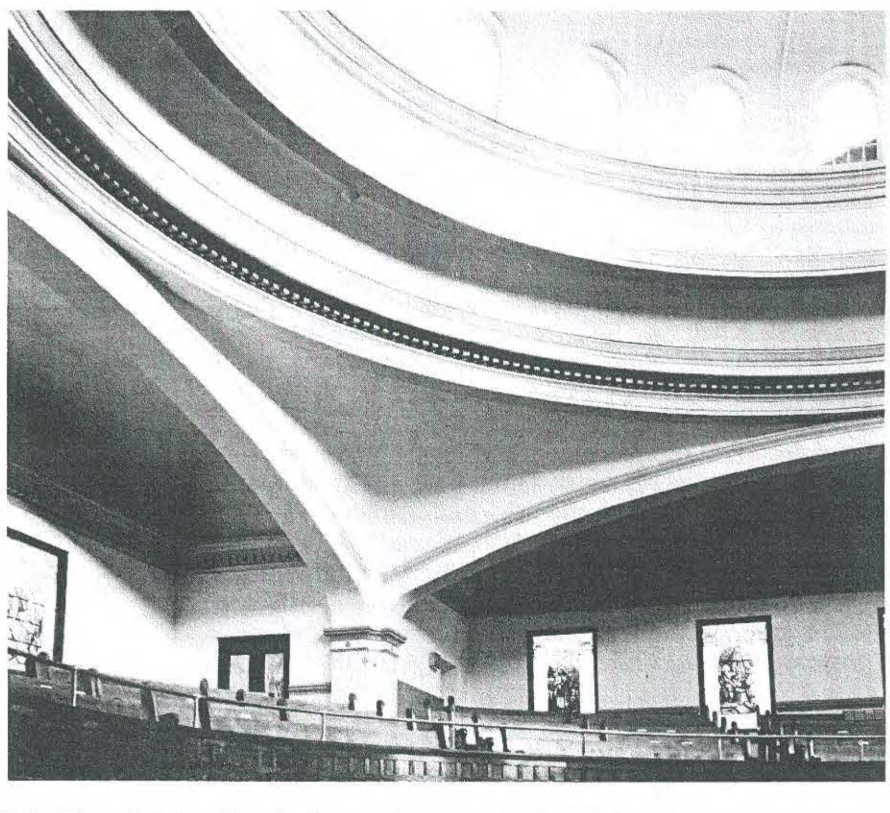


Fig. 1. Left: Schifferstadt, Frederick, Maryland, 1756. Right: First Christian Church, Eugene, Oregon, 1911. Although these two structures are separated in history by over 150 years and differences in size, ethnic origin, geography, construction techniques, and architectural character, their builders both used plaster as the interior surface coating for flat and curved walls. Photo left: Kay Weeks. Photo right: Kaye Ellen Simonson.

and durability. It resists fire and reduces sound transmission. Next, replacing plaster is expensive. A building owner needs to think carefully about the condition of the plaster that remains; plaster is often not as badly damaged as it first appears. Of more concern to preservationists, however, original lime and gypsum plaster is part of the building's historic fabric—its smooth-troweled or textured surfaces and subtle contours evoke the presence of America's earlier craftsmen. Plaster can also serve as a plain surface for irreplaceable decorative finishes. For both reasons, plaster walls and ceilings contribute to the historic character of the interior and should be left in place and repaired if at all possible (Fig. 2).

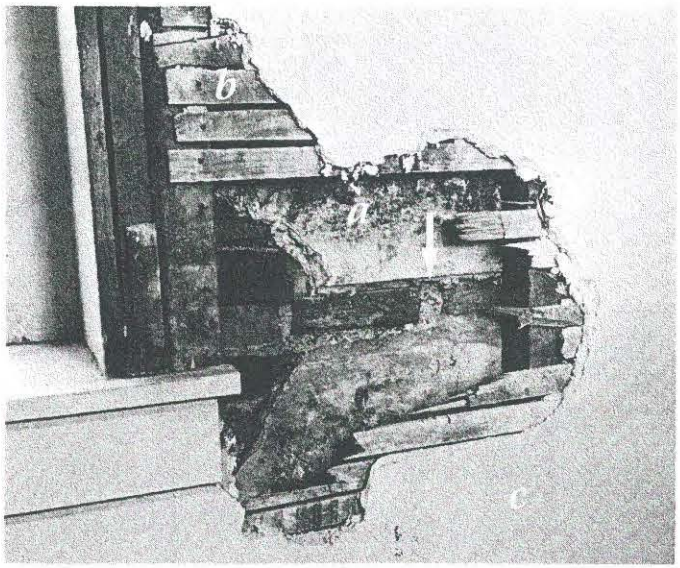


Fig. 2. A hole in the wall of a 1760s Custom House in Chestertown, Maryland illustrates the evolution of the room. (a) The original plaster was applied directly to an exterior masonry wall and the chairrail (missing here, see arrow) was in place before the wet plaster was applied to the wall. Sometime later when the interior was modified, the masonry was furred out. Machine-sawn wood lath (b) was nailed to the furring strips and (c) new three-coat plaster was applied. Photo: Maryland Historical Trust.

The approaches described in this Brief stress repairs using *wet* plaster, and traditional materials and techniques that will best assist the preservation of historic plaster walls and ceilings—and their appearance. Dry wall repairs are not included here, but have been written about extensively in other contexts. Finally, this Brief describes a replacement option when historic plaster cannot be repaired. Thus, a veneer plaster system is discussed rather than dry wall. Veneer systems include a coat or coats of *wet* plaster—although thinly applied—which can, to a greater extent, simulate traditional hand-troweled or textured finish coats. This system is generally better suited to historic preservation projects than dry wall.

To repair plaster, a building owner must often enlist the help of a plasterer. Plastering is a skilled craft, requiring years of training and special tools (Fig. 3). While minor repairs can be undertaken by building owners, most repairs will require the assistance of a plasterer.

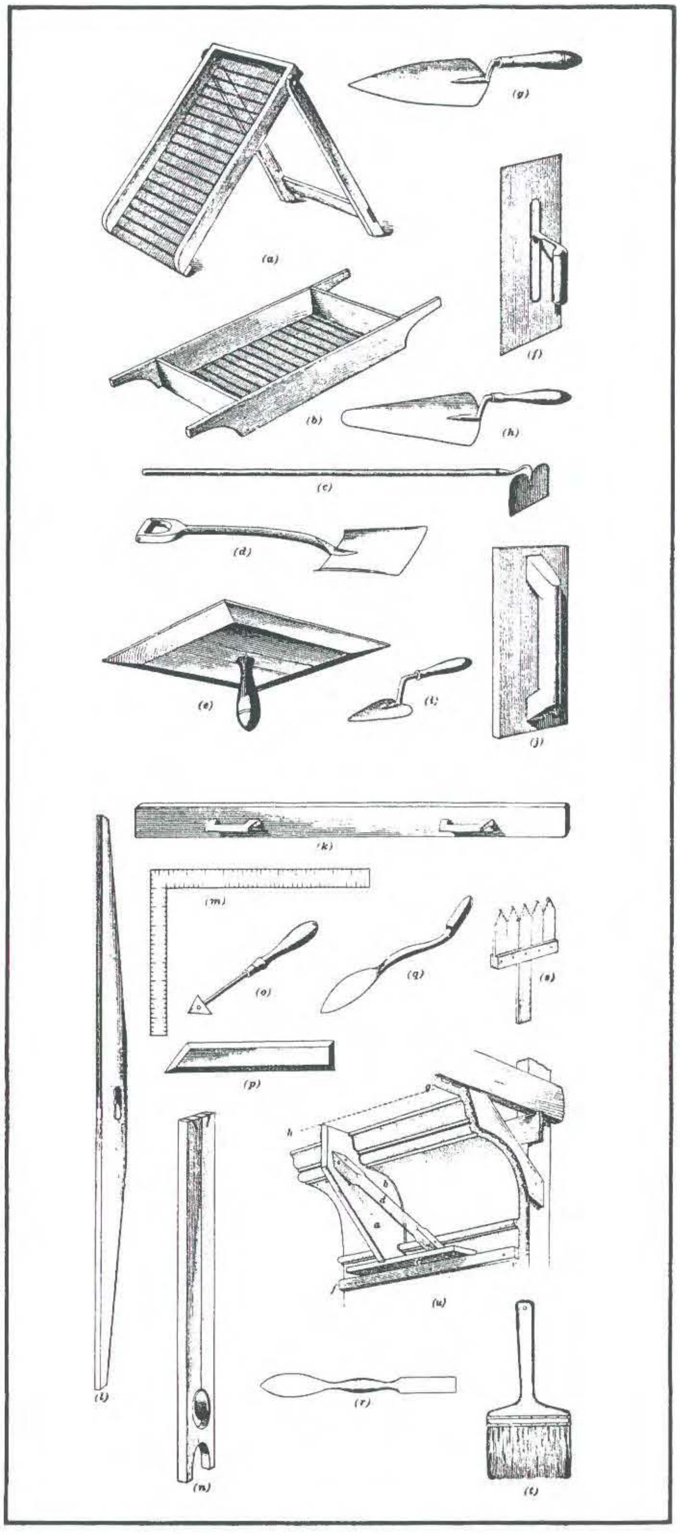


Fig. 3. Many of these traditional plastering tools are still used today: (a) screen to separate coarse sand from fine sand; (b) lime screen to remove unslaked particles of lime; (c) hoe; (d) shovel; (e) hawk to hold small amounts of plaster; (f) angle float to apply finishes to inside angles; (g), (h), (i) assorted trowels to apply basecoats and finish coat; (j) padded float to level off humps and fill in hollows caused by other tools; (k) a two-handled float or "darby" to float larger surfaces; (l) a simple straight edge; (m) a square to test the trueness of angles; (n) plumb to check verticality of plastered surfaces; (o), (p), (q), (r) jointing and mitering tools to pick out angles in decorative moldings; (s) comb made of sharpened lath pieces to scratch the basecoat of plaster; (t) brush to dampen plaster surfaces while they are worked smooth; (u) template made of wood and metal to cut a required outline for a fancy mold.

Historical Background

Plasterers in North America have relied on two materials to create their handiwork—lime and gypsum. Until the end of the 19th century, plasterers used lime plaster. Lime plaster was made from four ingredients: lime, aggregate, fiber, and water. The lime came from ground-and-heated limestone or oyster shells; the aggregate from sand; and the fiber from cattle or hog hair. Manufacturing changes at the end of the 19th century made it possible to use gypsum as a plastering material. Gypsum and lime plasters were used in combination for the base and finish coats during the early part of the 20th century; gypsum was eventually favored because it set more rapidly and, initially, had a harder finish.

Not only did the basic plastering material change, but the method of application changed also. In early America, the windows, doors, and all other trim were installed before the plaster was applied to the wall (Fig. 4). Generally the woodwork was prime-painted before plastering. Obtaining a plumb, level wall, while working against built-up mouldings, must have been difficult. But sometime in the first half of the 19th century, builders began installing wooden plaster "grounds" around windows and doors and at the base of the wall. Installing these grounds so that they were level and plumb made the job much easier because the plasterer could work from a level, plumb, straight surface. Woodwork was then nailed to the "grounds" after the walls were plastered (Fig. 5). Evidence of plaster behind trim is often an aid to dating historic houses, or to discerning their physical evolution.

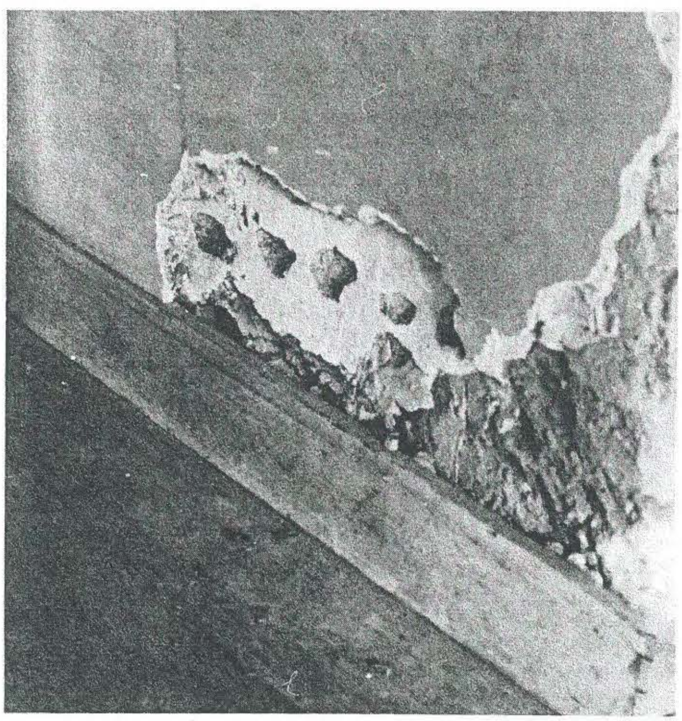


Fig. 4. The builders of this mid-18th century house installed the baseboard moulding first, then applied a mud and horse hair plaster (called paling) to the masonry wall. Lime was used for the finish plaster. Also shown are the hacking marks which prepared the wall for a subsequent layer of plaster. Photo: Kay Weeks.

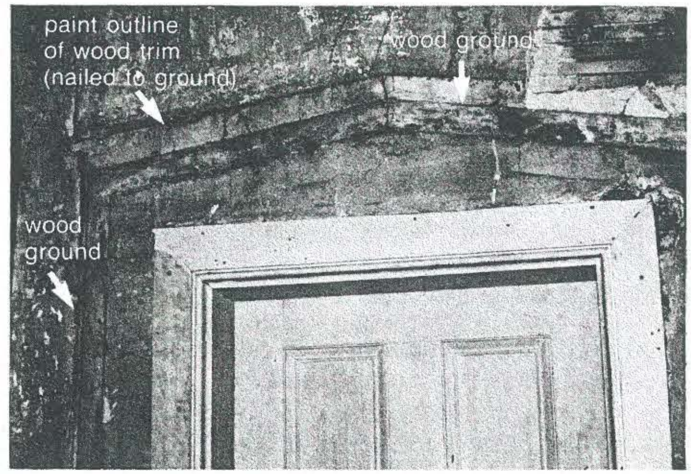
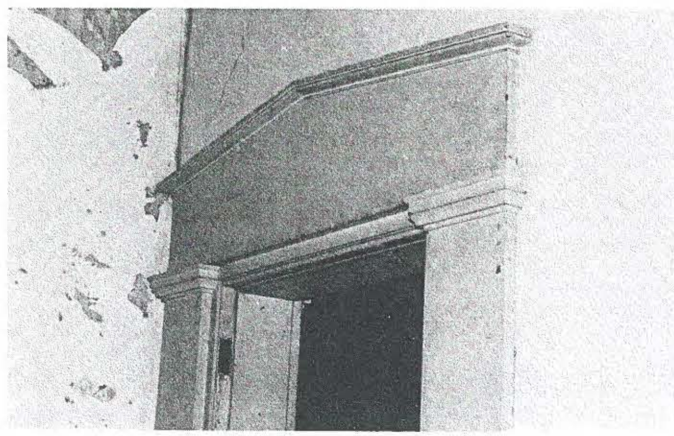


Fig. 5 (a). The photo above shows the use of wooden plaster "grounds" nailed to the wall studs of the mid-19th century Lockwood House in Harpers Ferry, West Virginia. This allowed the plasterer to work flush with the surface of the grounds. Afterwards, the carpenter could nail the finish woodwork to the ground, effectively hiding the joint between the plaster and the ground. The trim was painted after its installation, leaving a paint outline on the plaster. Fig. 5 (b). The photo below shows door trim and mouldings in place after the plastering was complete. Photos: Kaye Ellen Simonson.



Lime Plaster

When building a house, plasterers traditionally mixed bags of quick lime with water to "hydrate" or "slake" the lime. As the lime absorbed the water, heat was given off. When the heat diminished, and the lime and water were thoroughly mixed, the lime putty that resulted was used to make plaster.

When lime putty, sand, water, and animal hair were mixed, the mixture provided the plasterer with "coarse stuff." This mixture was applied in one or two layers to build up the wall thickness. But the best plaster was done with three coats. The first two coats made up the coarse stuff; they were the *scratch* coat and the *brown* coat. The finish plaster, called "setting stuff" contained a much higher proportion of lime putty, little aggregate, and no fiber, and gave the wall a smooth white surface finish.

Compared to the 3/8-inch-thick layers of the scratch and brown coats, the finish coat was a mere 1/8-inch thick. Additives were used for various finish qualities.

For example, fine white sand was mixed in for a "float finish." This finish was popular in the early 1900s. (If the plasterer raked the sand with a broom, the plaster wall would retain swirl marks or stipples.) Or marble dust was added to create a hard-finish white coat which could be smoothed and polished with a steel trowel. Finally, a little plaster of Paris, or "gauged stuff," was often added to the finish plaster to accelerate the setting time.

Although lime plaster was used in this country until the early 1900s, it had certain disadvantages. A plastered wall could take more than a year to dry; this delayed painting or papering. In addition, bagged quick lime had to be carefully protected from contact with air, or it became inert because it reacted with ambient moisture and carbon dioxide. Around 1900, gypsum began to be used as a plastering material.

Gypsum Plaster

Gypsum begins to cure as soon as it is mixed with water. It sets in minutes and completely dries in two to three weeks. Historically, gypsum made a more rigid plaster and did not require a fibrous binder. However, it is difficult to tell the difference between lime and gypsum plaster once the plaster has cured.

Despite these desirable working characteristics, gypsum plaster was more vulnerable to water damage than lime. Lime plasters had often been applied directly to masonry walls (without lathing), forming a suction bond. They could survive occasional wind-driven moisture or water wicking up from the ground. Gypsum plaster needed protection from water. Furring strips had to be used against masonry walls to create a dead air space. This prevented moisture transfer.

In rehabilitation and restoration projects, one should rely on the plasterer's judgment about whether to use lime or gypsum plaster. In general, gypsum plaster is the material plasterers use today. Different types of aggregate may be specified by the architect such as clean river sand, perlite, pumice, or vermiculite; however, if historic finishes and textures are being replicated, sand should be used as the base-coat aggregate. Today, if fiber is required in a base coat, a special gypsum is available which includes wood fibers. Lime putty, mixed with about 35 percent gypsum (gauging plaster) to help it harden, is still used as the finish coat.

Lath

Lath provided a means of holding the plaster in place. Wooden lath was nailed at right angles directly to the structural members of the buildings (the joists and studs), or it was fastened to non-structural spaced strips known as furring strips. Three types of lath can be found on historic buildings (Fig. 6).

Wood Lath. Wood lath is usually made up of narrow, thin strips of wood with spaces in between. The plasterer applies a slight pressure to push the wet plaster through the spaces. The plaster slumps down on the inside of the wall, forming plaster "keys." These keys hold the plaster in place.

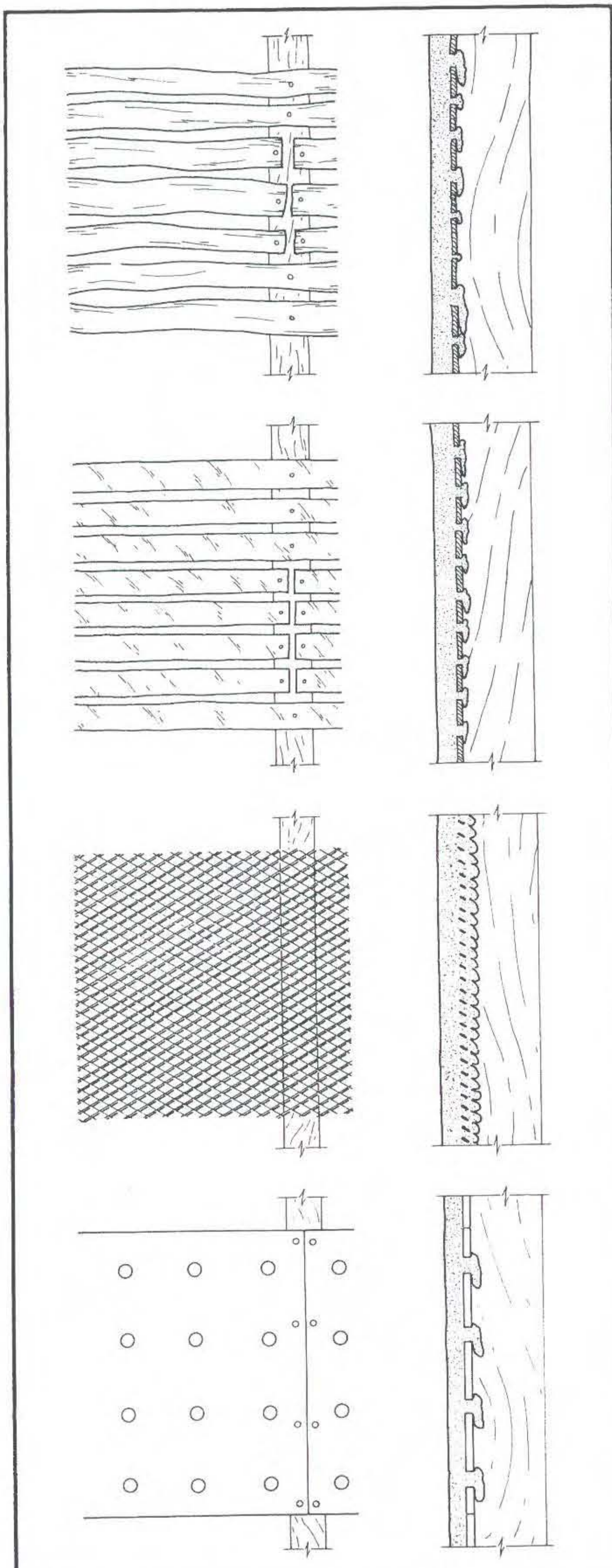


Fig. 6. Top to bottom: Hand-riven lath, machine-sawn wood lath, expanded metal (diamond mesh) lath, and perforated gypsum board lath. Profile views of their keying characteristics are shown to the right. For plaster repairs or replastering, galvanized metal lath is the most reliable in terms of longevity, stability, and proper keying. Drawing: Kaye Ellen Simonson.

Metal Lath. Metal lath, patented in England in 1797, began to be used in parts of the United States toward the end of the 19th century. The steel making up the metal lath contained many more spaces than wood lath had contained. These spaces increased the number of keys; metal lath was better able to hold plaster than wood lath had been.

Rock Lath. A third lath system commonly used was rock lath (also called plaster board or gypsum-board lath). In use as early as 1900, rock lath was made up of compressed gypsum covered by a paper facing. Some rock lath was textured or perforated to provide a key for wet plaster. A special paper with gypsum crystals in it provides the key for rock lath used today; when wet plaster is applied to the surface, a crystalline bond is achieved.

Rock lath was the most economical of the three lathing systems. Lathers or carpenters could prepare a room more quickly. By the late 1930s, rock lath was used almost exclusively in residential plastering.

Common Plaster Problems

When plaster dries, it is a relatively rigid material which should last almost indefinitely. However, there are conditions that cause plaster to crack, effloresce, separate, or become detached from its lath framework (Fig. 7). These include:

- Structural Problems
- Poor Workmanship
- Improper Curing
- Moisture

Structural Problems

Overloading. Stresses within a wall, or acting on the house as a whole, can create stress cracks. Appearing as diagonal lines in a wall, stress cracks usually start at a door or window frame, but they can appear anywhere in the wall, with seemingly random starting points.

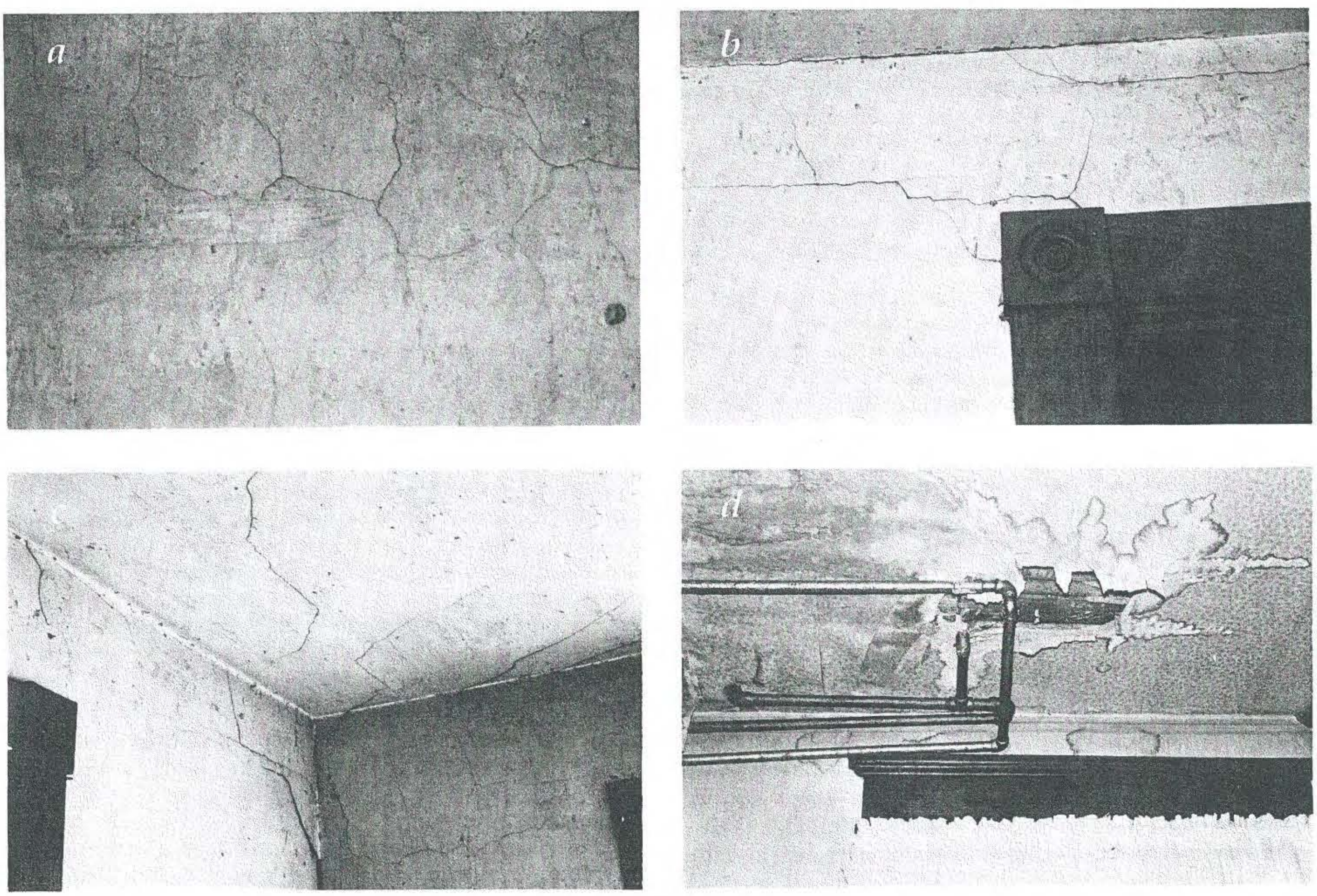


Fig. 7 (a) to (d). A series of photographs taken in different rooms of an early 20th century house in West Virginia reveal a variety of plaster wall surface problems, most of which can easily be remedied through sensitive repair: Hairline cracks (a) in an otherwise sound wall can be filled with joint compound or patching plaster. The wall can also be canvassed or wallpapered. Stress cracks (b) in plaster over a kitchen door frame can be repaired using fiberglass mesh tape and joint compound. Settlement cracks (c) in a bedroom can be similarly repaired. The dark crack at the juncture between walls, however, may be a structural crack and should be investigated for its underlying cause. Moisture damage (d) from leaking plumbing on the second floor has damaged both wallpaper and plaster in the dining room. After fixing the leaking pipes, the wall covering and rotted plaster will need to be replaced and any holes repaired. Photos: Kay Weeks.

Builders of now-historic houses had no codes to help them size the structural members of buildings. The weight of the roof, the second and third stories, the furniture, and the occupants could impose a heavy burden on beams, joists, and studs. Even when houses were built properly, later remodeling efforts may have cut in a doorway or window without adding a structural beam or "header" across the top of the opening. Occasionally, load-bearing members were simply too small to carry the loads above them. Deflection or wood "creep" (deflection that occurs over time) can create cracks in plaster.

Overloading and structural movement (especially when combined with rotting lath, rusted nails, or poor quality plaster) can cause plaster to detach from the lath. The plaster loses its key. When the mechanical bond with the lath is broken, plaster becomes loose or bowed. If repairs are not made, especially to ceilings, gravity will simply cause chunks of plaster to fall to the floor.

Settlement/Vibration. Cracks in walls can also result when houses settle. Houses built on clay soils are especially vulnerable. Many types of clay (such as montmorillonite) are highly expansive. In the dry season, water evaporates from the clay particles, causing them to contract. During the rainy season, the clay swells. Thus, a building can be riding on an unstable footing. Diagonal cracks running in opposite directions suggest that house settling and soil conditions may be at fault. Similar symptoms occur when there is a nearby source of vibration—blasting, a train line, busy highway, or repeated sonic booms.

Lath movement. Horizontal cracks are often caused by lath movement. Because it absorbs moisture from the air, wood lath expands and contracts as humidity rises and falls. This can cause cracks to appear year after year. Cracks can also appear between rock lath panels. A nail holding the edge of a piece of lath may rust or loosen, or structural movement in the wood framing behind the lath may cause a seam to open. Heavy loads in a storage area above a rock-lath ceiling can also cause ceiling cracks.

Errors in initial building construction such as improper bracing, poor corner construction, faulty framing of doors and windows, and undersized beams and floor joists eventually "telegraph" through to the plaster surface.

Poor Workmanship

In addition to problems caused by movement or weakness in the structural framework, plaster durability can be affected by poor materials or workmanship.

Poorly proportioned mix. The proper proportioning and mixing of materials are vital to the quality of the plaster job. A bad mix can cause problems that appear years later in a plaster wall. Until recently, proportions of aggregate and lime were mixed on the job. A plasterer may have skimped on the amount of cementing material (lime or gypsum) because sand was the cheaper material. Oversanding can cause the plaster to weaken or crumble (Fig. 8). Plaster made from a poorly proportioned mix may be more difficult to repair.

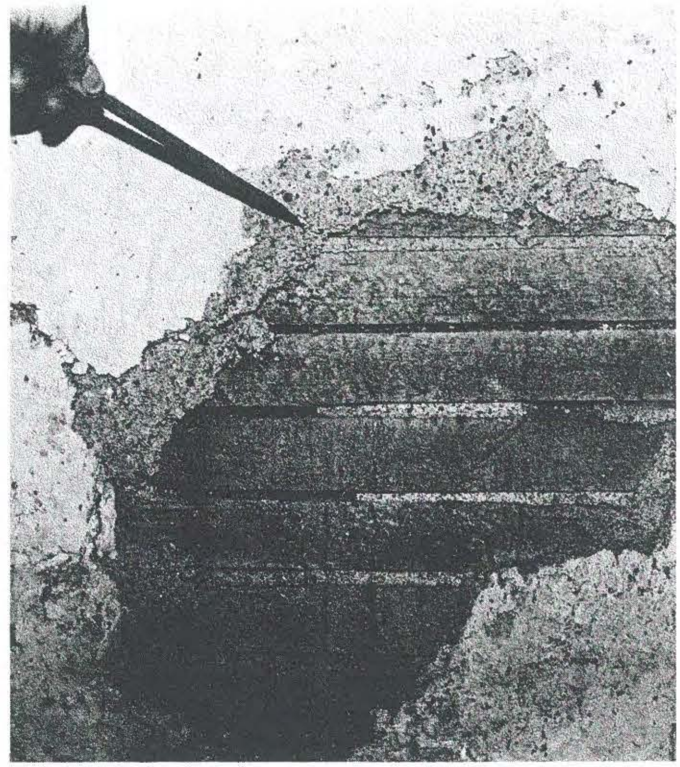


Fig. 8. Too much aggregate (sand) and not enough cementing material (lime or gypsum) in the base coat has made this plaster surface weak and crumbly. Besides losing its key with the lath, the layers are disintegrating. It will most likely need to be totally removed and replaced with all new plaster. Photo: Marylee MacDonald.

Incompatible basecoats and finish coats. Use of perlite as an aggregate also presented problems. Perlite is a lightweight aggregate used in the base coat instead of sand. It performs well in cold weather and has a slightly better insulating value. But if a smooth lime finish coat was applied over perlited base coats on wood or rock lath, cracks would appear in the finish coat and the entire job would have to be re-done. To prevent this, a plasterer had to add fine silica sand or finely crushed perlite to the finish coat to compensate for the dramatically differing shrinkage rates between the base coat and the finish coat.

Improper plaster application. The finish coat is subject to "chip cracking" if it was applied over an excessively dry base coat, or was insufficiently troweled, or if too little gauging plaster was used. Chip cracking looks very much like an alligatored paint surface. Another common problem is called map cracking—fine, irregular cracks that occur when the finish coat has been applied to an oversanded base coat or a very thin base coat.

Too much retardant. Retarding agents are added to slow down the rate at which plaster sets, and thus inhibit hardening. They have traditionally included ammonia, glue, gelatin, starch, molasses, or vegetable oil. If the plasterer has used too much retardant, however, a gypsum plaster will not set within a normal 20 to 30 minute time period. As a result, the surface becomes soft and powdery.

Inadequate plaster thickness. Plaster is applied in three coats over wood lath and metal lath—the scratch, brown, and finish coats. In three-coat work, the scratch coat and brown coat were sometimes applied on successive days to make up the required wall thickness. Using rock lath allowed the plasterer to apply one base coat and the finish coat—a two-coat job.

If a plasterer skimped on materials, the wall may not have sufficient plaster thickness to withstand the normal stresses within a building. The minimum total thickness for plaster on gypsum board (rock lath) is 1/2 inch. On metal lath the minimum thickness is 5/8 inch; and for wood lath it is about 3/4 to 7/8 inch. This minimum plaster thickness may affect the thickness of trim projecting from the wall's plane.

Improper Curing

Proper temperature and air circulation during curing are key factors in a durable plaster job. The ideal temperature for plaster to cure is between 55–70 degrees Fahrenheit. However, historic houses were sometimes plastered before window sashes were put in. There was no way to control temperature and humidity.

Dryouts, freezing, and sweat-outs. When temperatures were too hot, the plaster would return to its original condition before it was mixed with water, that is, calcined gypsum. A plasterer would have to spray the wall with alum water to re-set the plaster. If freezing occurred before the plaster had set, the job would simply have to be re-done. If the windows were shut so that air could not circulate, the plaster was subject to sweat-out or rot. Since there is no cure for rotted plaster, the affected area had to be removed and replastered.

Moisture

Plaster applied to a masonry wall is vulnerable to water damage if the wall is constantly wet. When salts from the masonry substrate come in contact with water, they migrate to the surface of the plaster, appearing as dry bubbles or efflorescence. The source of the moisture must be eliminated before replastering the damaged area.

Sources of Water Damage. Moisture problems occur for several reasons. Interior plumbing leaks in older houses are common. Roofs may leak, causing ceiling damage. Gutters and downspouts may also leak, pouring rain water next to the building foundation. In brick buildings, dampness at the foundation level can wick up into the above-grade walls. Another common source of moisture is splash-back. When there is a paved area next to a masonry building, rainwater splashing up from the paving can dampen masonry walls. In both cases water travels through the masonry and damages interior plaster. Coatings applied to the interior are not effective over the long run. The moisture problem must be stopped on the outside of the wall.

Repairing Historic Plaster

Many of the problems described above may not be easy to remedy. If major structural problems are found to be the source of the plaster problem, the structural problem should be corrected. Some repairs can be made by removing only small sections of plaster to gain access. Minor structural problems that will not endanger the building can generally be ignored. Cosmetic damages from minor building movement, holes, or bowed areas can be repaired without the need for wholesale demolition. However, it may be necessary to remove deteriorated plaster caused by rising damp in order for masonry walls to dry out. Repairs made to a wet base will fail again.

Canvassing Uneven Wall Surfaces

Uneven wall surfaces, caused by previous patching or by partial wallpaper removal, are common in old houses. As long as the plaster is generally sound, cosmetically unattractive plaster walls can be "wallpapered" with strips of a canvas or fabric-like material. Historically, canvassing covered imperfections in the plaster and provided a stable base for decorative painting or wallpaper.

Filling Cracks

Hairline cracks in wall and ceiling plaster are not a serious cause for concern as long as the underlying plaster is in good condition. They may be filled easily with a patching material (see **Patching Materials,** page 13). For cracks that re-open with seasonal humidity change, a slightly different method is used. First the crack is widened slightly with a sharp, pointed tool such as a crack widener or a triangular can opener. Then the crack is filled. For more persistent cracks, it may be necessary to bridge the crack with tape. In this instance, a fiberglass mesh tape is pressed into the patching material. After the first application of a quick-setting joint compound dries, a second coat is used to cover the tape, feathering it at the edges. A third coat is applied to even out the surface, followed by light sanding. The area is cleaned off with a damp sponge, then dried to remove any leftover plaster residue or dust.

When cracks are larger and due to structural movement, repairs need to be made to the structural system *before* repairing the plaster. Then, the plaster on each side of the crack should be removed to a width of about 6 inches down to the lath. The debris is cleaned out, and metal lath applied to the cleared area, leaving the existing wood lath in place. The metal lath usually prevents further cracking. The crack is patched with an appropriate plaster in three layers (i.e., basecoats and finish coat). If a crack seems to be expanding, a structural engineer should be consulted.

Replacing Delaminated Areas of the Finish Coat

Sometimes the finish coat of plaster comes loose from the base coat (Fig. 9). In making this type of repair, the plasterer paints a liquid plaster-bonding agent onto the areas of base-coat plaster that will be replastered with a new lime finish coat. A homeowner wishing to repair small areas of delaminated finish coat can use the methods described in **Patching Materials.**

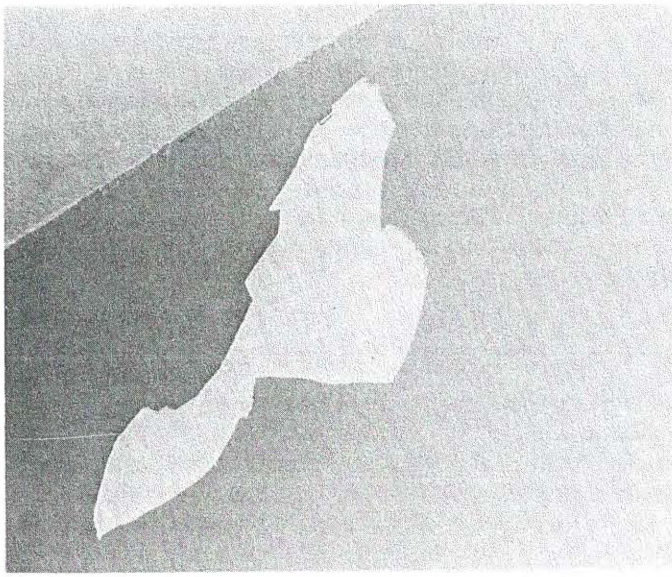


Fig. 9. The smooth-troweled lime finish coat has delaminated from the brown coat underneath. This is another repair that can be undertaken without further loss of the historic plaster. Photo: Marylee MacDonald.

Patching Holes in Walls

For small holes (less than 4 inches in diameter) that involve loss of the brown and finish coats, the repair is made in two applications. First, a layer of basecoat plaster is troweled in place and scraped back below the level of the existing plaster. When the base coat has set but not dried, more plaster is applied to create a smooth, level surface. One-coat patching is not generally recommended by plasterers because it tends to produce concave surfaces that show up when the work is painted. Of course, if the lath only had one coat of plaster originally, then a one-coat patch is appropriate (Fig. 10).

For larger holes where all three coats of plaster are damaged or missing down to the wood lath, plasterers generally proceed along these lines. First, all the old plaster is cleaned out and any loose lath is re-nailed. Next, a water mist is sprayed on the old lath to keep it from twisting when the new, wet plaster is applied, or better still, a bonding agent is used. To provide more reliable keying and to strengthen the patch, expanded metal lath (diamond mesh) should be attached to the wood lath with tie wires or nailed over the wood lath with lath nails (Fig. 11). The plaster is then applied in three layers over the metal lath, lapping each new layer of plaster over the old plaster so that old and new are evenly joined. This stepping is recommended to produce a strong, invisible patch (Fig. 12). Also, if a patch is made in a plaster wall that is slightly wavy, the contour of the patch should be made to conform to the irregularities of the existing work. A flat patch will stand out from the rest of the wall.

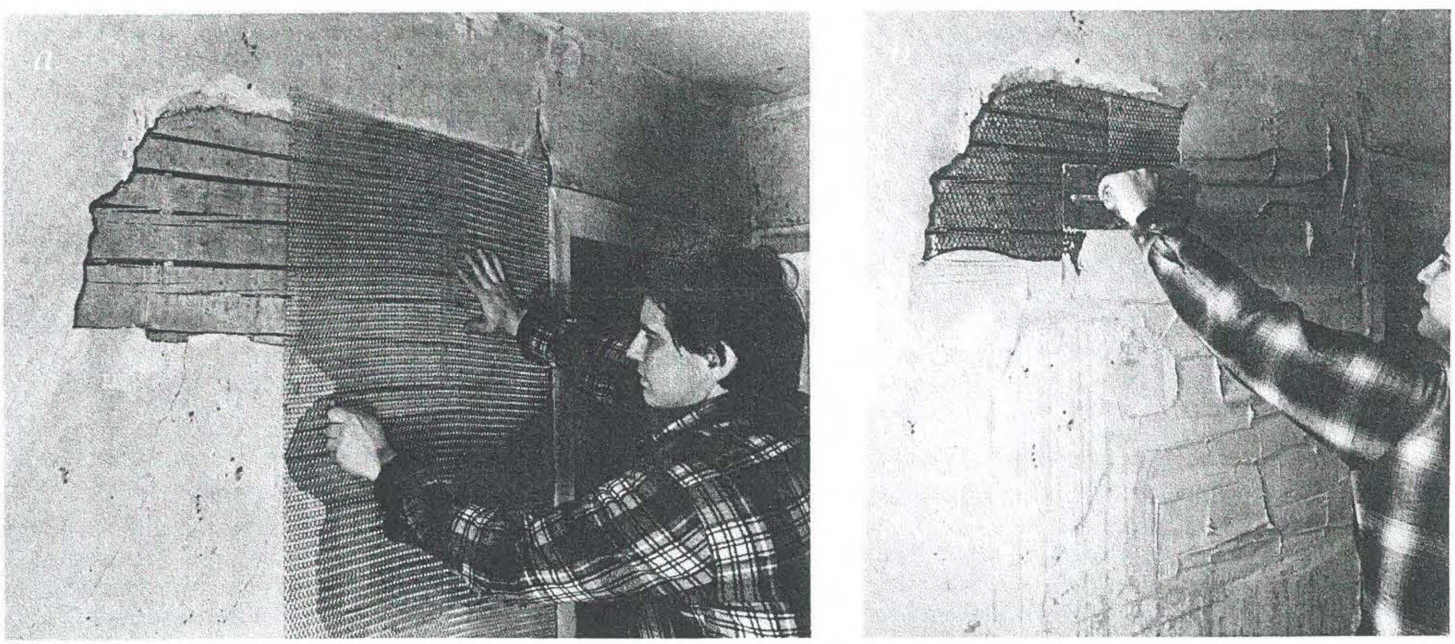


Fig. 10 (a) and (b). In this New Hampshire residence dating from the 1790s, the original plaster was a single coat of lime, sand, and horsehair applied over split lath. A one-coat repair, in this case, is appropriate. To the left: a flat sheet of galvanized expanded metal lath is placed over the patch area and an outline marked with a large soft lumber crayon. The metal lath is then cut to fit the hole and nailed to the lath. To the right: the edges of the original plaster and wood lath beneath have been thoroughly soaked with water. A steel trowel is used to apply the plaster in large, rough strokes. Finally, it will be scraped and smoothed off. Because only one coat of plaster is used, without a finish coat, a clean butt-joint is made with the original plaster. Photos: John Leeke.

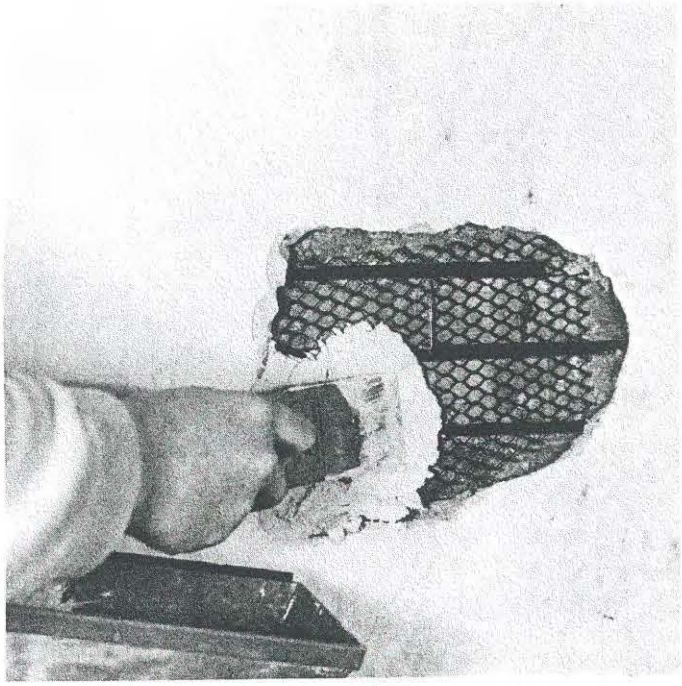


Fig. 11. Repairs are being made to the historic plaster in an early 20th century residence in Tennessee. A fairly sizeable hole in three-coat plaster extends to the wood lath. Expanded metal lath has been cut to fit the hole, then attached to the wood lath with a tie-wire. Two ready-mix gypsum base coats are in the process of being applied. After they set, the finish coat will be smooth-troweled gauged lime to match the existing wall. Photo: Walter Jowers.

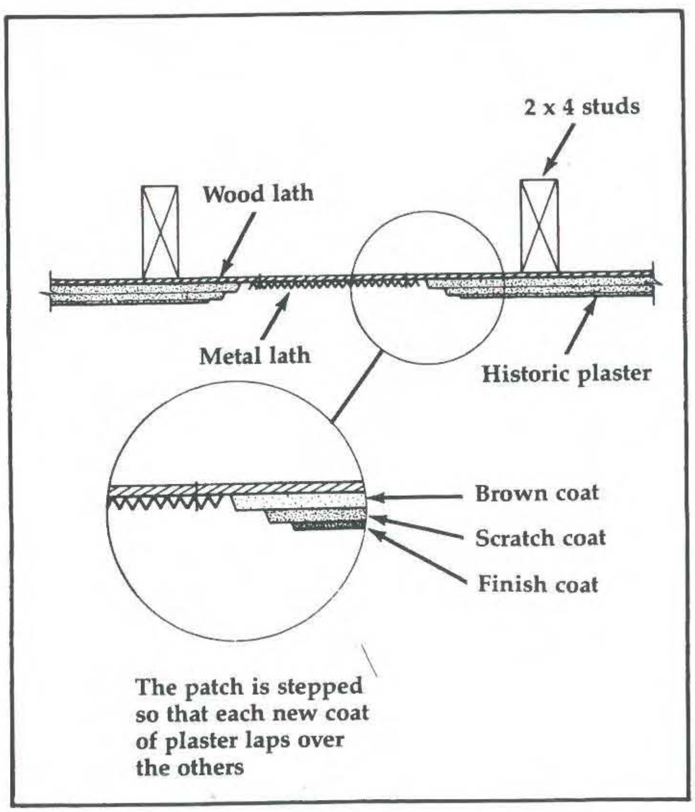


Fig. 12. This explains how a hole in historic plaster is repaired over the existing wood lath. First, metal lath is secured over the wood lath with a tie wire, then the new plaster is applied in three layers, "stepped" so that each new coat overlaps the old plaster to create a good adhesive bond. Drawing: Kaye Ellen Simonson.

Patching Holes in Ceilings

Hairline cracks and holes may be unsightly, but when portions of the ceiling come loose, a more serious problem exists (Fig. 13). The keys holding the plaster to the ceiling have probably broken. First, the plaster around the loose plaster should be examined. Keys may have deteriorated because of a localized moisture problem, poor quality plaster, or structural overloading; yet, the surrounding system may be intact. If the areas surrounding the loose area are in reasonably good condition, the loose plaster can be reattached to the lath using flat-head wood screws and plaster washers (Fig. 14). To patch a hole in the ceiling plaster, metal lath is fastened over the wood lath; then the hole is filled with successive layers of plaster, as described above.

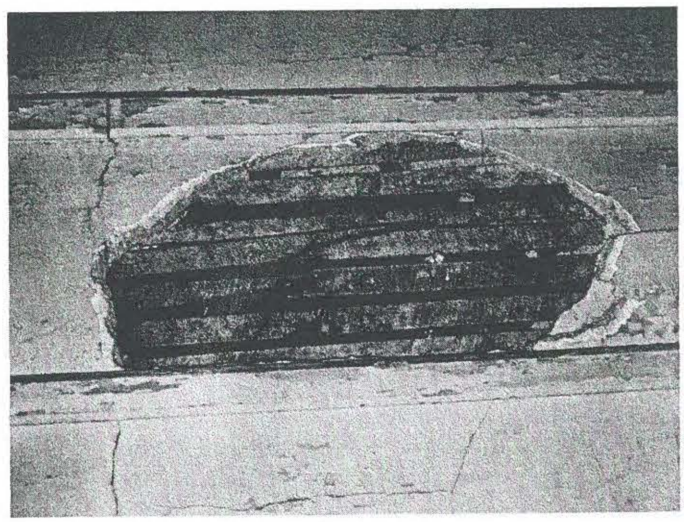


Fig. 13. This beaded ceiling in one of the bedrooms of the 1847 Lockwood House, Harpers Ferry, West Virginia, is missing portions of plaster due to broken keys. This is attributable, in part, to deterioration of the wood lath. Photo: Kaye Ellen Simonson.

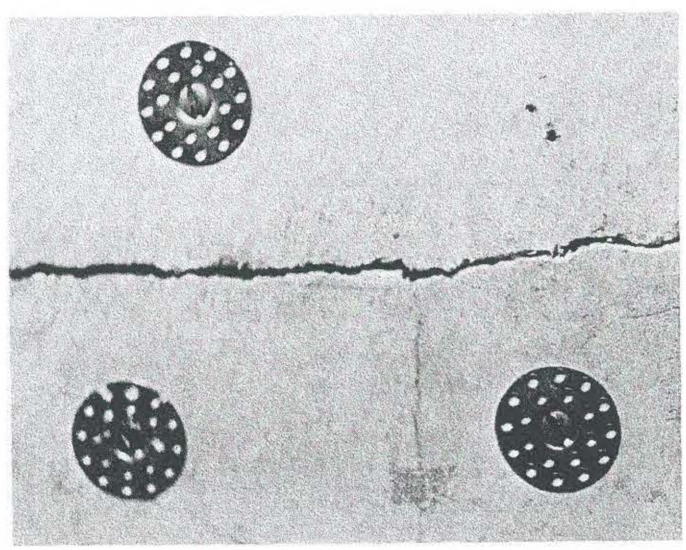


Fig. 14. In a late 18th century house in Massachusetts, flat-head wood screws and plaster washers were used to reattach loose ceiling plaster to the wood lath. After the crack is covered with fiberglass mesh tape, both the taped crack and the plaster washers will be skim-coated with a patching material. Photo: John Obed Curtis.

Establishing New Plaster Keys

If the back of the ceiling lath is accessible (usually from the attic or after removing floor boards), small areas of bowed-out plaster can be pushed back against the lath. A padded piece of plywood and braces are used to secure the loose plaster. After dampening the old lath and coating the damaged area with a bonding agent, a fairly liquid plaster mix (with a glue size retardant added) is applied to the backs of the lath, and worked into the voids between the faces of the lath and the back of the plaster. While this first layer is still damp, plaster-soaked strips of jute scrim are laid across the backs of the lath and pressed firmly into the first layer as reinforcement. The original lath must be secure, otherwise the weight of the patching plaster may loosen it.

Loose, damaged plaster can also be re-keyed when the goal is to conserve decorative surfaces or wallpaper. Large areas of ceilings and walls can be saved. This method requires the assistance of a skilled conservator—it is not a repair technique used by most plasterers. The conservator injects an acrylic adhesive mixture through holes drilled in the face of the plaster (or through the lath from behind, when accessible). The loose plaster is held firm with plywood bracing until the adhesive bonding mixture sets. When complete, gaps between the plaster and lath are filled, and the loose plaster is secure (Fig. 15).

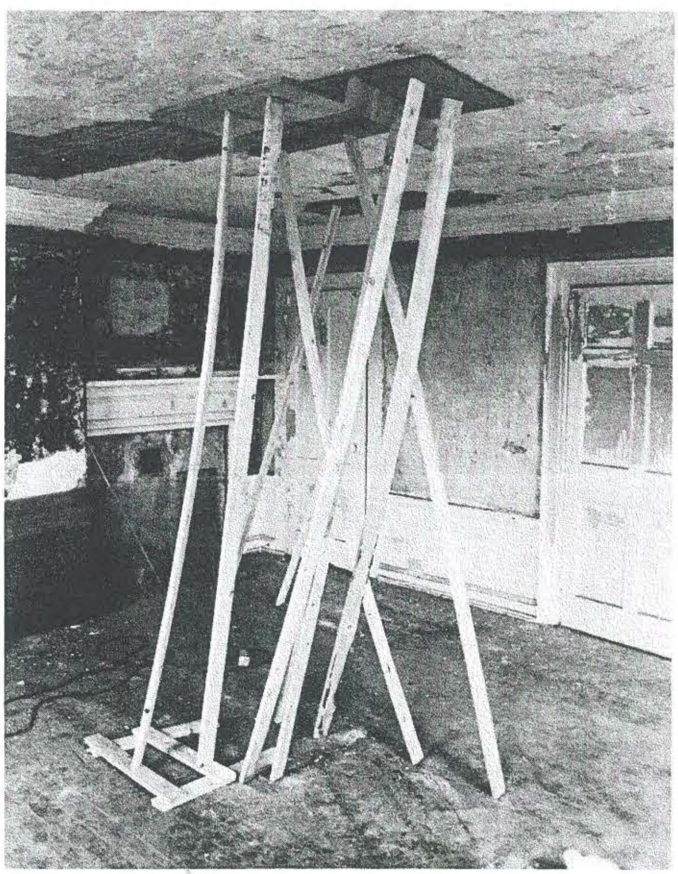


Fig. 15. When ceiling repairs are made with wet plaster or with an injected adhesive mixture, the old loose plaster must be supported with a plywood brace until re-keying is complete. Photo: John Leeke.

Replastering Over the Old Ceiling

If a historic ceiling is too cracked to patch or is sagging (but not damaged from moisture), plasterers routinely keep the old ceiling and simply relath and replaster over it. This repair technique can be used if lowering the ceiling slightly does not affect other ornamental features. The existing ceiling is covered with 1x3-inch wood furring strips, one to each joist, and fastened completely through the old lath and plaster using a screw gun. Expanded metal lath or gypsum board lath is nailed over the furring strips. Finally, two or three coats are applied according to traditional methods. Replastering over the old ceiling saves time, creates much less dust than demolition, and gives added fire protection.

When Damaged Plaster Cannot be Repaired—Replacement Options

Partial or complete removal may be necessary if plaster is badly damaged, particularly if the damage was caused by long-term moisture problems. Workers undertaking demolition should wear OSHA-approved masks because the plaster dust that flies into the air may contain decades of coal soot. Lead, from lead-based paint, is another danger. Long-sleeved clothing and head-and-eye protection should be worn. Asbestos, used in the mid-twentieth century as an insulating and fireproofing additive, may also be present and OSHA-recommended precautions should be taken. If plaster in adjacent rooms is still in good condition, walls should not be pounded—a small trowel or pry bar is worked behind the plaster carefully in order to pry loose pieces off the wall.

When the damaged plaster has been removed, the owner must decide whether to replaster over the existing lath or use a different system. This decision should be based in part on the thickness of the original plaster and the condition of the original lath. Economy and time are also valid considerations. It is important to ensure that the wood trim around the windows and doors will have the same "reveal" as before. (The "reveal" is the projection of the wood trim from the surface of the plastered wall). A lath and plaster system that will give this required depth should be selected.

Replastering—Alternative Lath Systems for New Plaster

Replastering old wood lath. When plasterers work with old lath, each lath strip is re-nailed and the chunks of old plaster are cleaned out. Because the old lath is dry, it must be thoroughly soaked before applying the base coats of plaster, or it will warp and buckle; furthermore, because the water is drawn out, the plaster will fail to set properly. As noted earlier, if new metal lath is installed *over* old wood lath as the base for new plaster, many of these problems can be avoided and the historic lath can be retained (Fig. 16). The ceiling should still be sprayed unless a vapor barrier is placed behind the metal lath.

Replastering over new metal lath. An alternative to reusing the old wood lath is to install a different lathing system. Galvanized metal lath is the most expensive, but also the most reliable in terms of longevity, stability, and proper keying. When lathing over open joists, the plasterer should cover the joists with kraft paper or a polyethylene vapor barrier. Three coats of wet plaster are applied consecutively to form a solid, monolithic unit with the lath. The scratch coat keys into the metal lath; the second, or brown, coat bonds to the scratch coat and builds the thickness; the third, or finish coat, consists of lime putty and gauging plaster.

Replastering over new rock lath. It is also possible to use rock lath as a plaster base. Plasterers may need to remove the existing wood lath to maintain the woodwork's reveal. Rock lath is a 16x36-inch, 1/2-inch thick, gypsum-core panel covered with absorbent paper with gypsum crystals in the paper. The crystals in the paper bond the wet plaster and anchor it securely. This type of lath requires two coats of new plaster—the brown coat and the finish coat. The gypsum lath itself takes the place of the first, or scratch, coat of plaster.

Painting New Plaster

The key to a successful paint job is proper drying of the plaster. Historically, lime plasters were allowed to cure for at least a year before the walls were painted or papered. With modern ventilation, plaster cures in a shorter time; however, fresh gypsum plaster with a lime finish coat should still be perfectly dry before paint is applied—or the paint may peel. (Plasterers traditionally used the "match test" on new plaster. If a match would light by striking it on the new plaster surface, the plaster was considered dry.) Today it is best to allow new plaster to cure two to three weeks. A good alkaline-resistant primer, specifically formulated for new plaster, should then be used. A compatible latex or oil-based paint can be used for the final coat.

A Modern Replacement System

Veneer Plaster. Using one of the traditional lath and plaster systems provides the highest quality plaster job. However, in some cases, budget and time considerations may lead the owner to consider a less expensive replacement alternative. Designed to reduce the cost of materials, a more recent lath and plaster system is less expensive than a two-or-three coat plaster job, but only slightly more expensive than drywall. This plaster system is called veneer plaster.

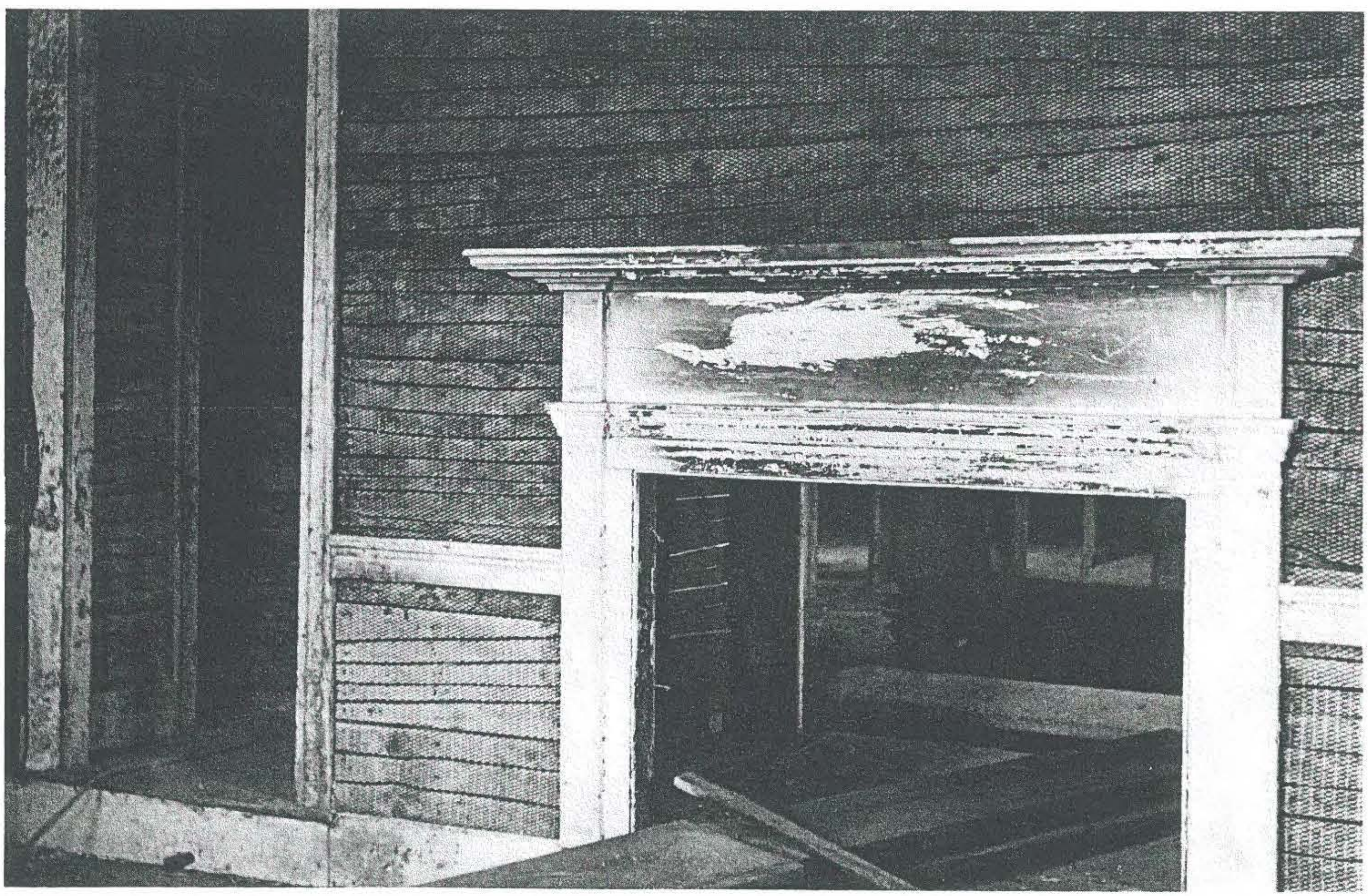


Fig. 16. In the restoration of a ca. 1830s house in Maine, split-board lath has been covered with expanded metal lath in preparation for new coats of plaster. This method permits the early lath to be saved while the metal lath, with its superior keying, serves as reinforcement. Photo: National Park Service files.

The system uses gypsum-core panels that are the same size as drywall (4x8 feet), and specially made for veneer plaster. They can be installed over furring channels to masonry walls or over old wood lath walls and ceilings. Known most commonly as "blueboard," the panels are covered with a special paper compatible with veneer plaster. Joints between the 4-foot wide sheets are taped with fiberglass mesh, which is bedded in the veneer plaster. After the tape is bedded, a thin, 1/16-inch coat of high-strength veneer plaster is applied to the entire wall surface. A second veneer layer can be used as the "finish" coat, or the veneer plaster can be covered with a gauged lime finish-coat—the same coat that covers ordinary plaster (Fig. 17).

Fig. 17. This contemporary plasterer is mixing a lime finish coat in much the same way as America's earlier artisans. The ring consists of lime putty; the white powder inside is gauging plaster. After the mixture is blended, a steel trowel will be used to apply it. It should be noted that a traditional lime finish coat can be applied over a veneer plaster base coat to approximate the look of historic plaster walls and ceilings. Photo: Marylee MacDonald.

Although extremely thin, a two-coat veneer plaster system has a 1,500 psi rating and is thus able to withstand structural movements in a building or surface abrasion. With either a veneer finish or a gauged lime-putty finish coat, the room will be ready for painting almost immediately. When complete, the troweled or textured wall surface looks more like traditional plaster than drywall.

The thin profile of the veneer system has an added benefit, especially for owners of uninsulated masonry buildings. Insulation can be installed between the pieces of furring channel used to attach blueboard to masonry walls. This can be done without having to furr out the window and door jambs. The insulation plus the veneer system will result in the same thickness as the original plaster. Occupants in the rooms will be more comfortable because they will not be losing heat to cold wall surfaces.

Summary

The National Park Service recommends retaining historic plaster if at all possible. Plaster is a significant part of the "fabric" of the building. Much of the building's history is documented in the layers of paint and paper found covering old plaster. For buildings with decorative painting, conservation of historic flat plaster is even more important. Consultation with the National Park Service, with State Historic Preservation Officers, local preservation organizations, historic preservation consultants, or with the Association for Preservation Technology is recommended. Where plaster cannot be repaired or conserved using one of the approaches outlined in this Brief, documentation of the layers of wallpaper and paint should be undertaken before removing the historic plaster. This information may be needed to complete a restoration plan.

Patching Materials

Plasterers generally use ready-mix base-coat plaster for patching, especially where large holes need to be filled. The ready-mix plaster contains gypsum and aggregate in proper proportions. The plasterer only needs to add water.

Another mix plasterers use to patch cracks or small holes, or for finish-coat repair, is a "high gauge" lime putty (50 percent lime; 50 percent gauging plaster). This material will produce a white, smooth patch. It is especially suitable for surface repairs.

Although property owners cannot duplicate the years of accumulated knowledge and craft skills of a professional plasterer, there are materials that can be used for do-it-yourself repairs. For example, fine cracks can be filled with an all-purpose drywall joint compound. For bridging larger cracks using fiberglass tape, a homeowner can use a "quick-setting" joint compound. This compound has a fast drying time—60, 90, or 120 minutes. Quick-setting joint compound dries because of a chemical reaction, not because of water evaporation. It shrinks less than all-purpose joint compound and has much the same workability as ready-mix base-coat plaster. However, because quick-set joint compounds are hard to sand, they should only be used to bed tape or to fill large holes. All-purpose joint compound should be used as the final coat prior to sanding.

Homeowners may also want to try using a ready-mix perlited base-coat plaster for scratch and brown coat repair. The plaster can be hand-mixed in small quantities, but bagged ready-mix should be protected from ambient moisture. A "mill-mixed pre-gauged" lime finish coat plaster can also be used by homeowners. A base coat utilizing perlite or other lightweight aggregates should only be used for making small repairs (less than 4 ft. patches). For large-scale repairs and entire room re-plastering, see the precautions in Table 1 for using perlite.

Homeowners may see a material sold as "patching plaster" or "plaster of Paris" in hardware stores. This dry powder cannot be used by itself for plaster repairs. It must be combined with lime to create a successful patching mixture.

When using a lime finish coat for any repair, wait longer to paint, or use an alkaline-resistant primer.

TABLE 1
REPLASTERING
Selected Plaster Bases/Compatible Basecoats and Finish Coats

Traditional Plaster Bases	*Compatible Basecoats*	*Compatible Finish Coats*
OLD WOOD LATH	gypsum/sand plaster gypsum/perlite plaster [2]	lime putty/gauging plaster lime putty/gauging plaster
METAL LATH	gypsum/sand plaster (high strength) gypsum/perlite plaster [2]	lime putty/gauging plaster lime putty/gauging plaster
GYPSUM (ROCK) LATH PANELS	gypsum/sand plaster gypsum/perlite plaster [2]	lime putty/gauging plaster lime putty/gauging plaster
UNGLAZED BRICK/CLAY TILE	gypsum/perlite plaster [2] (*masonry* type)	lime putty/gauging plaster
Modern Plaster Base	***Compatible Basecoat***	***Compatible Finish Coat***
GYPSUM CORE VENEER PANELS (BLUE BOARD)	veneer plaster	veneer plaster *or* lime putty/gauging plaster

[1] On traditional bases (wood, metal, and rock lath), the thickness of base coat plaster is one of the most important elements of a good plaster job. Grounds should be set to obtain the following minimum plaster thicknesses: (1) Over rock lath—1/2" (2) Over brick, clay tile, or other masonry—5/8" (3) Over metal lath, measured from face of lath—5/8" (4) Over wood lath—7/8". In no case should the total plaster thickness be less than 1/2". The allowance for the finish coat is approximately 1/16" which requires the base coat to be 7/16" for 1/2" grounds. This is a *minimum* base coat thickness on rock lath. The standard for other masonry units and metal lath is 5/8" thick, including the finish. Certain types of construction or fire ratings may require an increase in plaster thickness (and/or an increase in the gypsum to aggregate ration) but never a thinner application of plaster than recommended above. Job experience indicates that thin applications of plaster often evidence cracking where normal applications to standard grounds do not. This condition is a direct result of the inability of thin section areas to resist external forces as adequately as thicker, normal applications of plaster.

[2] Perlite is a lightweight aggregate often used in gypsum plaster in place of sand. It performs well in cold weather and has a slightly better insulating value than sand. In a construction with metal lath, perlite aggregate is not recommended in the basecoat except under a sand or "float" finish. When gypsum/perlite basecoats are used over any other base (i.e., wood, rock lath, brick) and the finish coat is to be a "white" finish coat (smooth-troweled gauged lime putty) it is necessary to add fine silica sand or perlite fines to the finish coat. This measure prevents cracking of the "white" finish coat due to differential shrinkage.

Plaster Terms

Scratch coat. The first base coat put on wood or metal lath. The wet plaster is "scratched" with a scarifier or comb to provide a rough surface so the next layer of base coat will stick to it.

Brown coat. The brown coat is the second application of wet, base-coat plaster with wood lath or metal systems. With gypsum board lath (rock lath, plasterboard), it is the only base coat needed.

Finish coat. Pure lime, mixed with about 35 percent gauging plaster to help it harden, is used for the very thin surface finish of the plaster wall. Fine sand can be added for a sanded finish coat.

Casing Bead. Early casing bead was made of wood. In the 19th century, metal casing beads were sometimes used around fireplace projections, and door and window openings. Like a wood ground, they indicate the proper thickness for the plaster.

Corner Bead. Wire mesh with a rigid metal spline used on outside corners. Installing the corner bead plumb is important.

Cornerite. Wire mesh used on inside corners of adjoining walls and ceilings. It keeps corners from cracking.

Ground. Plasterers use metal or wood strips around the edges of doors and windows and at the bottom of walls. These grounds help keep the plaster the same thickness and provide a stopping edge for the plaster. Early plaster work, however, did not use grounds. On early buildings, the woodwork was installed and primed before plastering began. Some time in the early 19th century, a transition occurred, and plasterers applied their wall finish before woodwork was installed.

Gypsum. Once mined from large gypsum quarries near Paris (thus the name plaster of Paris), gypsum in its natural form is calcium sulfate. When calcined (or heated), one-and-a-half water molecules are driven off, leaving a hemi-hydrate of calcium sulfate. When mixed with water, it becomes calcium sulfate again. While gypsum was used in base-coat plaster from the 1890s on, it has always been used in finish coat and decorative plaster. For finish coats, gauging plaster was added to lime putty; it causes the lime to harden. Gypsum is also the ingredient in moulding plaster, a finer plaster used to create decorative mouldings in ornamental plasterwork.

Lime. Found in limestone formations or shell mounds, naturally occurring lime is calcium carbonate. When heated, it becomes calcium oxide. After water has been added, it becomes calcium hydroxide. This calcium hydroxide reacts with carbon dioxide in the air to recreate the original calcium carbonate.

Screed. Screeds are strips of plaster run vertically or horizontally on walls or ceilings. They are used to plumb and straighten uneven walls and level ceilings. Metal screeds are used to separate different types of plaster finishes or to separate lime and cement plasters.

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Acknowledgements

Preservation Brief 21 was based on an article in *Old House Restoration* on repairing historic plaster published by the University of Illinois at Urbana-Champaign, 1984. Kay D. Weeks, Preservation Assistance Division, Technical Preservation Services Branch, expanded the article and made substantial contributions to its development as a Brief. Special thanks go to the technical experts in the field who reviewed and comment upon the draft manuscript: Andrew Ladygo (Society for the Preservation of New England Antiquities), David Flaharty, Gilbert Wolf (National Plastering Industries), Michael Kempster, and Walter Jowers. Insightful comments were offered by the Technical Preservation Services Branch which is directed by H. Ward Jandl. Finally, staff member Karen Kummer, Small Homes Council-Building Research Council, University of Illinois, provided invaluable production assistance.

The publication has been prepared pursuant to the National Historic Preservation Act of 1966, as amended. Preservation Briefs 21 was developed under the technical editorship of Lee H. Nelson, FAIA, Chief, Preservation Assistance Division, National Park Service, Department of the Interior, P.O. Box 37127, Washington, D.C. 20013-7127. Comments on the usefulness of this information are welcomed and may be sent to Mr. Nelson at the above address.