ERDC/CERL TR-23-23

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José María Gil Adobe

Historic Context, Maintenance Issues, Measured Drawings, and Adaptive Reuse

August S. Fuelberth, Karlee E. Feinen, Peter B. Stynoski, Joseph A. Gamez, Allison R. Young, Carey L. Baxter, Madelyn G. McCoy, Joseph S. Murphey, Madison L. Story, and Adam D. Smith

October 2023

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Construction Engineering Research Laboratory

Cover: *Top photo* looking southwest at the José María Gil Adobe, July 2021. Rendering drawn by Madelyn McCoy, July 2022.

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Final Report

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Prepared for Cultural Resources Program
DPW Environmental Division
USAG Fort Hunter Liggett and Parks Reserve Forces Training Area, CA 93928

Under Project Number 491767, “Gil Adobe Rehabilitation,” MIPR 11657500

Abstract

The José María Gil Adobe, located on Fort Hunter Liggett, California, was added to the National Register of Historic Places (NRHP) in 1974. The building has been vacant since the early 1970s. It is a fine example of a small adobe ranch house possessing character-defining features of its period of significance of the mid-19th century on its exterior, interior, and within the site itself. This document is a reconstruction, repair, maintenance, and adaptive reuse report compiled with photographed, written, and drawn as-is conditions of construction materials of the José María Gil Adobe building and site. The building was 3D scanned to obtain the necessary information for the measured drawings. The secretary of the interior's guidelines on rehabilitation and repair per material are discussed to provide the cultural resources manager at Fort Hunter Liggett a guide to maintain this historic building. Rehabilitation is the best option for the successful reuse of the José María Gil Adobe as it will move the building from a vacant status to an occupied status. It is highly likely that this building can again serve an appropriate use as outlined in Section 11, reflecting its appearance in the early 20th century or WWII periods.

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Preface

This study was conducted for the Cultural Resources Program, Environmental Division, Directorate of Public Works (DPW) at USAG Fort Hunter Liggett and Parks Reserve Forces Training Area, California, under Project 491767, "Gil Adobe Rehabilitation," MIPR 11657500. The technical monitor was Ms. Lisa M. Cipolla (cultural resources manager, DPW).

The work was performed by the Training Lands and Heritage Branch of the Operational Science and Engineering Division of the Engineer Research and Development Center, Construction Engineering Research Laboratory (ERDC-CERL). At the time of publication, Ms. Angela Rhodes was chief, Training Lands and Heritage Branch; Dr. George Calfas was chief, Operational Science and Engineering Division; and Mr. Jim Allen was the technical director for Operational Science and Engineering. The deputy director of ERDC-CERL was Ms. Michelle Hanson, and the director was Dr. Andrew Nelson.

Section 4 reprints and modifies portions of Adam Smith and Marcia Harris, *Fort Leonard Wood Maintenance and Repair Manual: Black Officer's Club*, ERDC/CERL SR-05-41 (Champaign, IL: ERDC-CERL, 2005). Public domain.

COL Christian Patterson was commander of ERDC, and Dr. David W. Pittman was the director.

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1 Introduction

1.1 Background

The US Congress codified the National Historic Preservation Act of 1966 (NHPA), the nation's most effective cultural resources legislation to date, in order to provide guidelines and requirements for identifying tangible elements of our nation's past. This legislative requirement was met through creation of the National Register of Historic Places (NRHP). Contained within this piece of legislation are requirements for federal agencies to address their cultural resources, defined as any prehistoric or historic district, site, building, structure, or object. Section 110 requires federal agencies to inventory and evaluate their cultural resources. Section 106 requires the determination of effect of federal undertakings on properties deemed eligible or potentially eligible for the NRHP.[1]

Fort Hunter Liggett is located in Monterey County, California, approximately 150 miles south of San Francisco and 250 miles north of Los Angeles (Figure 1).[2] It is bounded by the Salinas Valley to the north, the Santa Lucia Mountains to the east, and the Los Padres National Forest to the west. It was first established as a training center in 1940 when the US government purchased the property from William Randolph Hearst, Jr., and neighboring landowners.[3]

Today, Fort Hunter Liggett is the military's premier Total Force Training Center. As the largest US Army Reserve Command post at approximately 165,000 acres, it is well suited for large-scale joint exercises. Fort Hunter Liggett's mission is to maintain and allocate training areas, airspace,

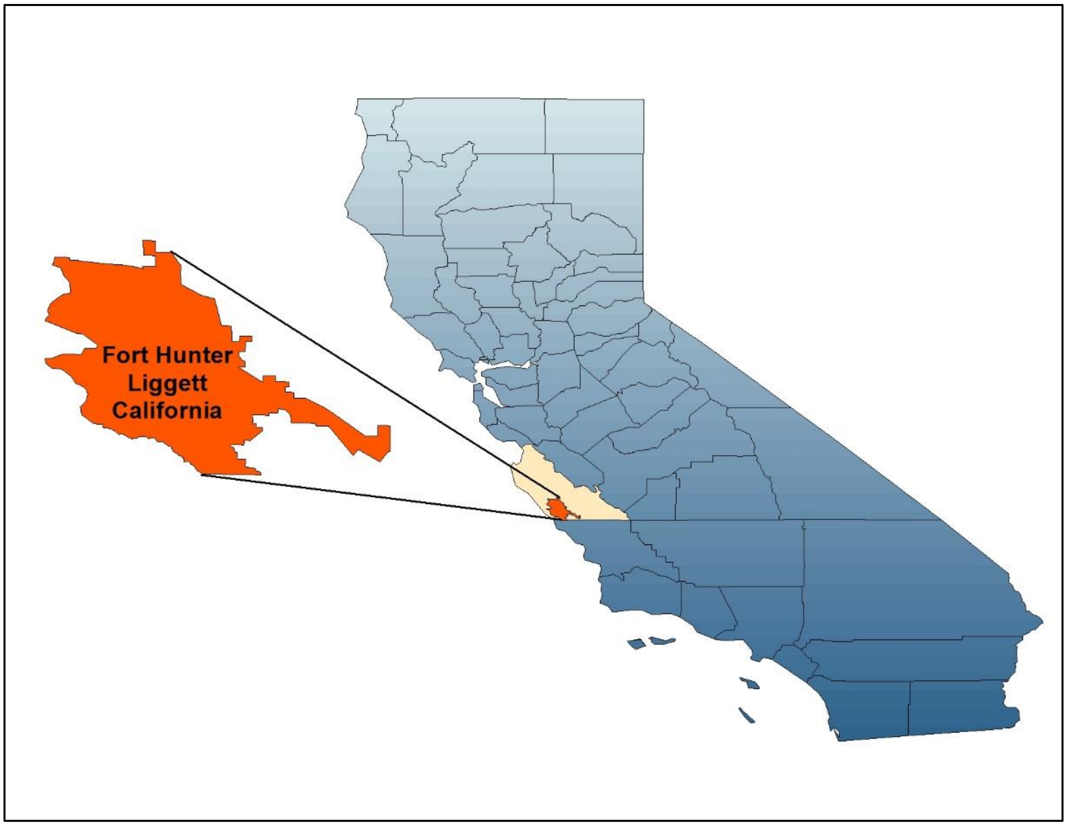
1. National Historic Preservation Act, Pub. L. No. 89-665, as amended by Pub. L. No. 96-515, Sections 110, 106 (1966).

2. For a full list of the spelled-out forms of the units of measure used in this document and their conversions, please refer to *US Government Publishing Office Style Manual*, 31st ed. (Washington, DC: US Government Publishing Office, 2016), 248–52 and 345–47, https://www.govinfo.gov/content/pkg/GPO-STYLEMANUAL-2016/pdf/GPO-STYLEMANUAL-2016.pdf.

3. "Fort Hunter Liggett In-Depth Overview," Military Installations, Military One Source, accessed July 12, 2022, https://installations.militaryonesource.mil/in-depth-overview/fort-hunter-liggett.

facilities, and ranges to support reserve and active components' field maneuvers, live-fire exercises, testing, and institutional training.[4]

Figure 1. Boundary outline and location of Fort Hunter Liggett, in Central California. (Image from Engineer Research and Development Center, Construction Engineering Research Laboratory [ERDC-CERL]. Public domain.)



According to Stone et al., "All buildings, especially historic ones, require regular planned maintenance and repair. The most notable cause of historic building element failure and decay is not due to the historic building's age but, rather, an incorrect or inappropriate repair and neglect of the historic building fabric."[5] The José María Gil Adobe has had multiple owners throughout its existence, having been constructed circa 1860. The building was added to the NRHP in 1974 and since then has been left to decay. This report satisfies Section 110 of the NHPA of 1966 as amended and will help Fort Hunter Liggett manage this historic building

4. "History," US Army Garrison Fort Hunter Liggett, Army.mil, accessed July 12, 2022, https://home.army.mil/liggett/index.php/about/history; "About," US Army Garrison Fort Hunter Liggett, Army.mil, accessed July 12, 2022, https://home.army.mil/liggett/index.php/about.

5. Sunny Stone, Adam Smith, and Ryan Murphy, *Fort Bliss Standards for the Treatment of Historic Buildings : An Illustrated Maintenance and Repair Manual*, ERDC/CERL SR-08-6 (Champaign, IL: Engineer Research and Development Center, Construction Engineering Research Laboratory, 2008).

by prioritizing appropriate maintenance, repair, and reconstruction. The goal of these practices is to

- reduce the cost of maintenance in the long run,
- increase the life expectancy of the building and its elements,
- use the building and its elements efficiently,
- increase safety and security, and
- ensure compliance with federal and Department of Defense historic preservation regulations.

1.2 Objective

The objective of this work was to gather building data through field inspections, archival research, and 3D scanning of the José María Gil Adobe, located south of Jolon, California, and to compile this data to help Fort Hunter Liggett manage this historic building and site by prioritizing appropriate reconstruction, repair, maintenance, and adaptive reuse.

1.3 Approach

The José María Gil Adobe historical information, evaluation, site location and information, feature evaluation, and adaptive reuse report is based on five successive steps—Stages I, II, III, IV, V—with each step providing a foundation for the next level. An architectural historian, an archeologist, a preservation professional, and two students (one in preservation and one in architecture) gathered building and site data through field inspections, archival research, and 3D scanning. The researchers then compiled this data into the five stages described below.

- Stage I is the identification and documentation of the historic building and classification of the building for comparison to adobes constructed using similar techniques in the same time period or prior to that of the José María Gil Adobe. This stage produces general identification information, including the background material necessary to establish a frame of reference for the building's history, architecture, and construction techniques and materials. Stage I includes data on Californian settlement history, adobe construction history, techniques, and history of the Gil family, as well as of the many owners of the property post its original construction to today.
- Stage II includes the site location and general site information, as well as an architectural description of the Gil residence and site.

- Stage III organizes of the building into one or more zones or areas of varying historical and architectural importance. This section contains descriptive information and photographs, drawings, and keys to identify the areas.
- Stage IV contains the identification, evaluation, and description of individual architectural features (both building and site) or elements within each zone that were established in Stage III (referred to as the "Element Report"). Stage IV also identifies deficient elements and provides work recommendations and cost estimates to correct these deficiencies. The elements are organized into divisions such as exterior and interior. The data in Stage IV is most applicable to reconstruction, repair, and maintenance.
- Stage V contains methods of and strategies for adaptive reuse.

1.4 Scope

The data collected for work related to this report for the José María Gil Adobe are organized in two parts: graphic documentation and written information.

The graphic portion consists of historical photographs, both of precedents and the José María Gil Adobe, historic maps and aerials, current condition drawings based on 3D-scan data, plus the color-coded zone building plans that were developed in this report. An archeological zone plan as well as material analysis results are also provided.

The written portion consists of the various elements of the building and potential repair or replacement options guided by "The Secretary of the Interior's Standards."[6]

1.5 Researchers

This project was conducted by the US Army Corps of Engineers, Engineer Research Development Center, Construction and Engineering Research Laboratory (ERDC-CERL) in Champaign, Illinois. The research team included Adam D. Smith, master of architecture, as project manager with 25 years of experience in military architectural history;

6. National Park Service, "The Secretary of the Interior's Standards for the Treatment of Historic Properties: Rehabilitation as a Treatment and Standards for Rehabilitation," last updated October 26, 2022, https://www.nps.gov/articles/000/treatment-standards-rehabilitation.htm.

Carey L. Baxter, archeologist and 3D scanning expert with 22 years of experience; Joseph A. Gamez, master of science in geotechnical engineering, with more than 20 years of engineering and military experience; Peter B. Stynoski, PhD, research civil engineer with more than 15 years of experience in construction materials characterization and specification; Allison R. Young, master of urban planning, Leadership in Energy and Environmental Design (LEED) Green associate, research architect and community planner with 9 years of experience, Madison L. Story, master of science in historic preservation, preservation professional with 3 years of experience; Karlee E. Feinen, student intern (preservation), with 3 years of experience; and Madelyn G. McCoy, student intern (architectural rendering). Joseph S. Murphey, master of architecture and licensed architect with 42 years of experience, supervised the work of August S. Fuelberth, student intern (architecture), with 3 years of experience.

1.6 Site visits

ERDC-CERL personnel made two trips to Fort Hunter Liggett: first in September 2020 to 3D scan the José María Gil Adobe, then in July 2021 to evaluate, photograph, and gather historical information at the Cultural Resources Management (CRM) office at Fort Hunter Liggett.

Throughout 2021 and 2022, Fort Hunter Liggett CRM staff assisted with the gathering of additional photographs and information in consultation with ERDC-CERL personnel upon their site visits as well as via phone and email.

2 Stage I: Historical Information

2.1 Indigenous groups, missions, and European settlement history in California

What is now the state of California was inhabited by Indigenous groups occupying the west coastal region and surrounding lands. Indigenous groups have maintained traditions and customs for thousands of years. Just prior to the establishment of the missions in the mid to late 18th century, Indigenous groups suffered a dramatic drop in population. The population is considered to have been reduced by two-thirds due to invasive diseases. Settlers forced Indigenous people to adapt to a new lifestyle, language, and cultures. These new settlers ignored Indigenous people's knowledge of the land, creating a disconnect between the cultures that the settlers observed and the cultures that had existed prior. European settlers sought opportunities for life and resources from the land that they had taken.[7]

The Salinan people or Xolon people, which translates to the people of the oaks, have lived in what is now Monterey County for over 13,000 years, enduring the countless changes in the area. As settlers moved west, Members of the various Indigenous peoples, like the Salinan, were separated from their families and cultures. In 1769, the Portola expedition came in contact with the Salinan people, forever changing the land. By 1771, the San Antonio Mission was built, though the mission only lasted for 64 years. During this time, the Spanish who had come to build the mission married Indigenous people, intertwining the two groups. The mission became a place to gather and is revered as an ancient "Indian Power spot" by the Salinan people.[8] It also became a place of death, with approximately 4,000 Indigenous people dying in the missions of San Antonio and San Miguel.[9] The mission system was a crucial part of Indigenous history that permanently altered the use of their land and history of their culture.

The mission system of California determined every aspect of the state's colonization (Figure 2). The first Spanish explorer, Juan Rodriguez

7. Sarah Ward Neusius and G. Timothy Gross, *Seeking Our Past: An Introduction to North American Archaeology*, 2nd ed. (New York: Oxford University Press, 2013).

8. Donna Haro, "History," Xolon Salinan Tribe, December 2018, https://www.xolonsalinantribe.org/history-1.

9. Donna Haro, "History."

Cabrillo, landed on the Californian coast in 1542; however, the mission system did not take form until 1769. The first mission founded by Father Junipero Serra was the Mission San Diego de Alcala. The Indigenous people who for many years inhabited the lands on which the mission was built were now greeted by these new colonists. This created conflicts in the area, like in 1775 when the mission was destroyed after a battle with Indigenous people.[10] This did not stop the padres, who conducted religious duties by gathering Indigenous people within the church, forming religious communities. This led to the evangelism of the Indigenous people by the Franciscan order. The mission was rebuilt in 1776, and, by 1770, the Mission San Carlos Borromeo de Carmelo was established.[11] The mission of San Antonio de Padua was the third mission to be established in 1771 and was the first of the Alta California (upper California) missions. The mission moved in 1773 to find a more stable water source and has stayed in this location since. The mission also claims 1773 as the year of the first recorded marriage in California between a Salinan woman and a Spanish soldier.[12] Once moved, the adobe brick construction of the mission took place. Renovations and additions were ongoing until 1781.[13] The mission was the first of the missions to use a clay, red-tile roof.[14]

These first missions set the precedent for architecture in California. The colonists used three distinct settlement types: missions, presidios (San Diego, San Francisco, Santa Barbara, and Monterey), and civil communities (pueblos). Monterey started as a presidio settlement like other early Californian cities. These cities were protected by soldiers for cautionary purposes due to threats of infringement on the rights and beliefs of these settlers. Early Californian settlers were affiliated with the military and were also very poor.[15] Because of this, the settlers took advantage of what the land offered for materials. The land provided resources for humans to establish and maintain settlements.

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10. Francis P. Mcmanamon, Linda S. Cordell, Kent G. Lightfoot, and George R Milner, eds., *Archaeology in America: An Encyclopedia*, vol. 4, *West Coast and Arctic/Subarctic* (Westport, CT: Greenwood Press, 2009).

11. “Missions,” California Missions, 2022, https://www.missionscalifornia.com/missions/.

12. “San Antonio de Padua,” California Missions, n.d., https://www.missionscalifornia.com/missions/san-antonio-de-padua/.

13. “History of California Mission San Antonio de Padua,” Mission San Antonio de Padua, n.d., https://www.missionsanantonio.net/history.

14. “Home,” California Missions Foundation, n.d., https://californiamissionsfoundation.org/.

15. Helen S. Giffen, *Casas & Courtyards; Historic Adobe Houses of California,* 1st California ed., (Oakland, CA: Biobooks, 1955), 2–3.

Many of the missions throughout California, while still standing today, have had considerable repairs over the years. Many adobe-built missions have proven to be unstable after earthquakes. It was not uncommon for the missions to need reconstruction after an earthquake. Subsequently, when the missions were abandoned in 1834, they became dilapidated. In recent years, the preservation of missions has become increasingly focused on stabilizing the structures to withstand earthquakes.

Figure 2. Map of missions in California dating from 1769 to 1823. (Image reproduced from "The Locations of the 21 Franciscan Missions in Alta California," courtesy of Wikipedia, accessed July 2022, SpanishMissionsinCA-Spanish missions in California - Wikipedia. Licensed under CC BY-SA 4.0, Creative Commons—Attribution-ShareAlike 4.0 International—CC BY-SA 4.0.)

2.2 Adobe construction methods

Earth, or a mixture of soil and other natural materials, are formed into a building material known as adobe, which was a popular method of construction. Adobe construction methods were used for some of the first buildings in California. Adobe was originally used for structural purposes and was considered a sufficient and valuable material for this purpose. Adobe construction was highly suitable for smaller structures, such as residences. Even though it was used for larger structures, such as missions, and some of these notable adobe buildings are still standing multiple centuries later, due to adobe's structural weakness in large-scale construction, its inadequate foundations, and its insecure roof ties, the large, surviving structures do not act as proof that it is a safe construction method at this scale.[16]

As early settlers built their homes out of adobe, the first dwellings were built for function, not for style. In general, adobe construction uses soil, which is a more readily available material than wood in California. Mixtures of straw, clay, or soil are used to erect walls and load-bearing members within the structure. Plaster coats the exterior adobe brick facades to weatherproof the building. Wooden accents, rafters, trim, and structural components are added throughout the progression of the construction process and as availability allows.[17]

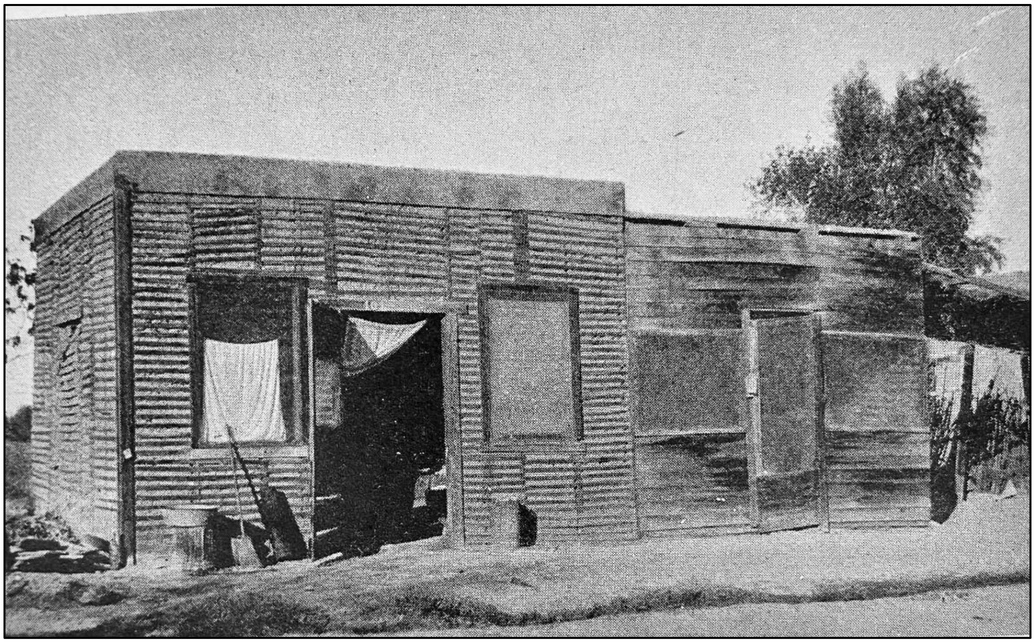
There are five standard methods of adobe construction: cajon, poured adobe, cob, adobe brick, and rammed earth methods. All of the methods involve the use of soil and grains or grasses, such as straw.

The *cajon method*, also known as the wall-filling-material method, uses soil as a filler instead of the main material and is reliant on other structural means. Wood members make up the structure, and the soil is used as packing material between members, forming a complete wall. During the drying process, the wood and mud mixture can shift and can cause unevenness. Because of this, the cajon method was not as common as the other methods in California. An example of the cajon method construction can be seen in Figure 3.

16. James D. Long, *Adobe Construction* (Berkeley, CA: Agricultural Experiment Station, 1929), 4.

17. Long, Adobe Construction, 3.

Figure 3. A 2 × 4 in. wood stud home that was lathed with mud on both sides between the wooden members. (Image reproduced from Long 1929. Public domain.)

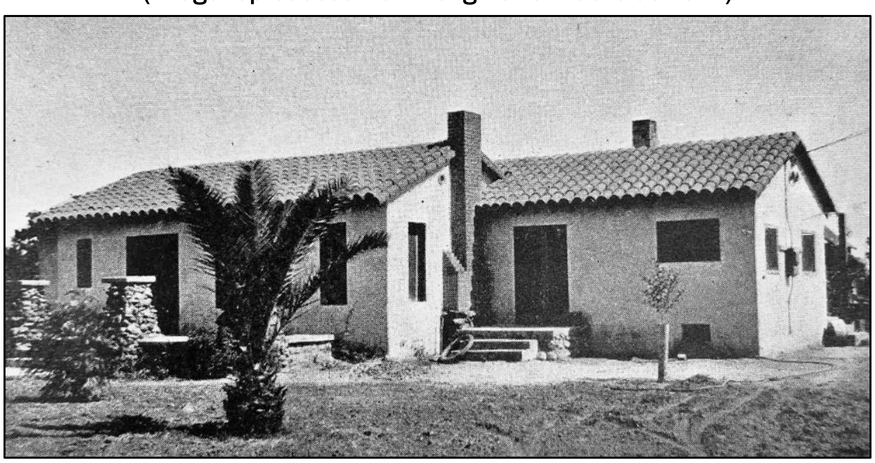


The *poured adobe method* does not use wooden wall members; instead, it uses wooden forms into which a thoroughly mixed mud is poured, forming a solid wall which supports the roof and any gravitational loads. This method is also known as the mud concrete method. The solidity of the mixture forms at the end of the curing process, similar to concrete in construction today. The wall material starts off near a liquid state and then a solid wall is formed once the curing process is complete. The window and door openings are accounted for when creating the form. The forms must be constructed precisely for an even distribution of the adobe mixture once it has cured. The forms used to create poured adobe structures can be constructed out of various-sized wooden members based on availability. A common form size is constructed out of 1 × 10 in. wood members. A wooden member is placed on both sides of the foundation extending down a certain number of inches depending on what sizes are used in the form. The boards are then clamped together tightly using a tie wire, securing the form to the foundation. Once the mud layer is poured into the form, it is allowed to dry thoroughly. The form is removed and clamped to the layer directly below it. This process is repeated until the wall has reached its desired height (Figure 4). Seen in Figure 5 is an example of a farm home constructed using the poured adobe method. This home, constructed in the early-1900s, is located near Farmersville, Tulare County, California. It was constructed using a form that was made up of 2 × 4 in. studs that were attached to both sides of the foundation and 1 in.

boards horizontally placed and tightly secured using a tie wire. The form was increased in height as fast as the adobe mud mixture could be mixed. The forms were removed once the walls dried thoroughly. This home is a fine example of a residence constructed using the poured adobe method judging by the even surfaces and precise window and door openings. This method was considered to be the cheapest and the fastest due to the fact that it was an easy process.[18]

Figure 4. An adobe wall with 1 × 10 in. wooden forms on a high layer, showing the poured adobe construction method, no date (Image reproduced from Long 1929. Public domain.)

Figure 5. Example of a poured adobe home coated in plaster, 1927 (Image reproduced from Long 1929. Public domain.)



18. Long, Adobe Construction, 7–9.

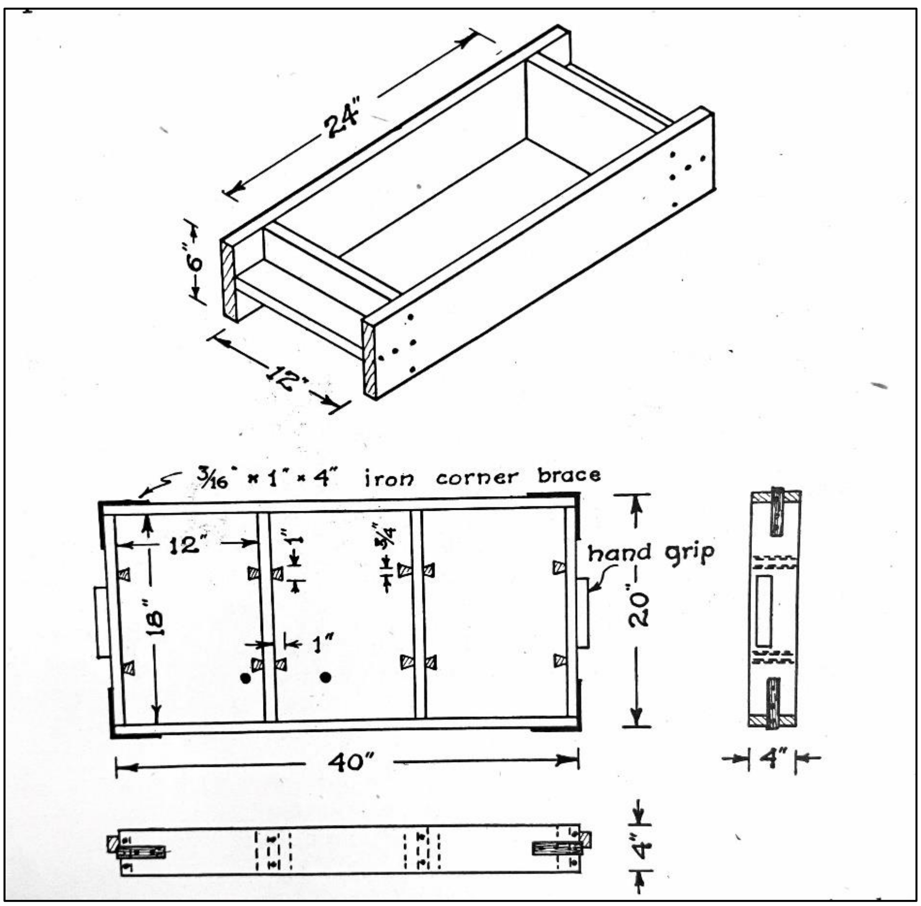
The *cob method* involves poring layers of thick mud mixed with straw or other fibers on top of one another, forming a solid wall. No wooden forms are used in this method; however, wood is used as a tool or straight edge to ensure straight sides or tops of the walls, as well as in carving techniques with other various tools to ensure uniformity. The mud mixture must be of a thicker consistency so that it holds its form as the layers are added. A common thickness of a wall formed using the cob method is 2 to 2 ½ ft. In the past, this method was occasionally used; however, it was uncommon due to the knowledge of other methods and the fact that they were faster and easier.[19]

The *adobe brick method* is a common method, where bricks are molded from adobe material and laid in the sun to bake. Once dried, the adobe bricks are stacked similar to brick construction today, forming a solid wall. Adobe brick making can be seen in Figure 6. Many sizes of bricks are used in the adobe brick method of construction. A common-sized mold is 4 × 8 × 12 in., weighing about 40 to 50 lb. These bricks can be laid to form a wall that has a 12 to 30 in. thickness depending on the bricks' orientation. Other common molds include 6 × 12 × 24 in. and molds that create multiple bricks at a time (Figure 7). Mortar is used in between the bricks and each layer of brick. There are two common types of mortar used with the adobe brick method. The first is a mud mortar that tends to absorb moisture. The mortar is made of mud, water, and other materials similar to what is in the brick. Lime and cement mortars are also used. Small stones, rocks, or pieces of concrete are added to the mixture to increase the aggregate as well as to create a bonding surface for exterior plaster.[20]

19. Long, Adobe Construction, 10.
20. Long, Adobe Construction, 10–14.

Figure 6. Making adobe brick and setting it in rows to bake in the sun, no date (Image reproduced from Long 1929. Public domain.)

Figure 7. Common mold sizes used to make adobe bricks: see large form on *top* and smaller forms on *bottom*, 1929 (Image reproduced from Long 1929. Public domain.)



The *rammed earth method,* also known as the *Pise de Terre method*, is similar to the poured adobe method through the use of wooden forms, but the consistency of the earth mixture is where they differ. In this case, the earth material is moist enough to possess some solidity and should be able to be squeezed into a ball. However, it should be dry enough to crumble when dropped.[21] To ensure a smooth finish, the soil is pulverized for large stones or other debris that may cause issues once the mixture dried. The wooden forms are constructed based on the desired height and thickness of the proposed structure. The forms are constructed using small planks, some measuring 1 ½ to 2 in. These planks are cleated together and are reinforced with long bolts and brackets to account for the immense internal pressure when the earth is being packed tightly into the form.

Rammed earth does not require as much time, skill, and dirt as the adobe technique where bricks must be formed individually. The thickness and straightness of the wall constructed using rammed earth can vary depending on the way the soil dries. However, the minimum thickness for most walls composed of rammed earth is 12 in. Rammed earth structures serve as very functional buildings. Regularly, rammed earth was used to create poultry houses because of its insulating qualities. An additional benefit of the rammed earth construction technique is its durability.[22] Two adobe construction methods that were common for the time and location of the José María Gil Adobe's construction were the *adobe brick method* and the *rammed earth method*. Constructed circa the 1860s, the José María Gil Adobe was constructed using the *adobe brick method*. Near the south end of the Gil residence is a cold storage building, constructed later using the *rammed earth method*. The cold storage building is discussed further in Section 3.1.2.

During the mid-to-late 19th century, various technologies and construction methods have resulted in many adobe structures that today serve as examples of historically preserved and functioning adobe buildings. The following case studies provide a basis for understanding the history and methods of construction relative to the history of the José María Gil Adobe as well as its adaptive reuse opportunities.

21. Long, Adobe Construction, 15–17.

22. Ralph L. Patty and L. W. Minium, *Rammed Earth Walls for Farm Buildings*, *Research Bulletins of the South Dakota Agricultural Experiment Station (1887–2011),* Bulletin 277 (Brookings, SD: South Dakota Experiment Station, South Dakota State College of Agriculture and Mechanical Arts, 1945), https://openprairie.sdstate.edu/agexperimentsta_bulletins/277.

2.2.1 Avila Adobe

Adobe, as a construction material, dates back to some of the earliest structures in California. The Avila Adobe, constructed in 1818, is the oldest house in Los Angeles, California (Figure 8).

The reason that the Avila Adobe is still standing today is credited to Christine Sterling, a preservationist who is known for her work in preserving the Avila Adobe as well as creating Olvera Street in Los Angeles. She fought as others pursued demolition of the building, and in 1930 after demolition was successfully stopped, the adobe became a museum. For the next 41 years, the Avila Adobe was open for public tourism until the Sylmar earthquake struck in 1971. Like many other historic adobes, the Avila Adobe faced structural issues due to being located in an earthquake-prone area. The Avila Adobe's roof and walls were thought to be past a state of repair; however in 1977, the Avila Adobe underwent yet another major restoration and reopened to the public. The building exhibits Mexican heritage and culture, as well as represents much of the history of Los Angeles.[23]

The Avila Adobe's interior is set up to replicate what living conditions would have looked like in the 19th century (Figure 9 and Figure 10).

23. Max Holm, "The Avila Adobe Still Stands After Nearly 200 Years," *USC Annenberg Media*, December 9, 2015, https://www.uscannenbergmedia.com/2015/12/09/the-avila-adobe-still-stands-after-nearly-200-years/.

Figure 8. Avila Adobe exterior, Los Angeles, California, 2022. (ERDC-CERL.)

Figure 9. Avila Adobe interior dining space re-creation, 2017. (Image reproduced with permission from “Avila Adobe: Oldest House in Los Angeles,” California Through My Lens, 2017, https://californiathroughmylens.com/avila-adobe-los-angeles/.)

Figure 10. Avila Adobe interior bedroom space re-creation, 2017. (Image reproduced with permission from “Avila Adobe: Oldest House in Los Angeles,” California Through My Lens, 2017, https://californiathroughmylens.com/avila-adobe-los-angeles/.)

The Avila Adobe is a fine example of a small-scale adobe structure that has been neglected and has been through natural disasters. Through acts of preservation, restoration, and reconstruction, the oldest house in Los Angeles is able to live on.

2.2.2 José Eusebio Boronda Adobe

The land which the José Eusebio Boronda Adobe sits on was the Rancho Rincon de Sanjon, located northwest of Salinas, California. The land that the missions were formally on was divided up and given to private owners as land grants. José Eusebio Boronda received a land grant and constructed his adobe structure in 1846, now known as the José Eusebio Boronda Adobe (Figure 11). This is near a decade before the José María Gil Adobe (also on a land grant) was constructed.

Figure 11. Daughter of Eusebio and family standing in front of Boronda Adobe, 1887. (Image reproduced with permission from Monterey County Historical Society 2021.)

Both adobes were built using similar construction methods, and they also share similar features, such as the substantial use of wood. The overall form of the José Eusebio Boronda Adobe consists of a hipped roof on all sides, a veranda, multiple fireplaces, and wooden details. The José María Gil Adobe differs with an L-shaped footprint, but it has a hipped roof and a veranda that currently surrounds all but the northwest side of the building. It has one exterior adobe chimney and two fireplaces in its interior. The José Eusebio Boronda Adobe has a wood shingle roof, which is what originally clad the roof of the José María Gil Adobe.

Within the José Eusebio Boronda Adobe, the ceiling loft space was primarily used for food storage, which was due to the lack of refrigeration at this time. It is unknown if the José María Gil Adobe's loft space was used for food storage, but in the early 20th century, a rammed earth structure was built and used as a cold storage building.

The José Eusebio Boronda Adobe was originally a one-room structure with segments added over time. The construction of interior wooden partition walls was common in small-scale adobe buildings as certain needs required a division of space. A bedroom and eating space were framed on the interior of the building, similar to the bathroom and kitchen space in the José María Gil Adobe.[24] Based on when both of these buildings were constructed, they share similar features, materials, and function.

The José Eusebio Boronda Adobe was acquired by the Monterey County Historical Society in 1972 and was designated as a California Historical Landmark and is listed on the National Register of Historic Places. Having been completely restored, it became a museum in 1976 (Figure 12 and Figure 13). As a historic structure, it was deemed worth preserving and is now functioning today despite its age and location in an earthquake-prone area. The José Eusebio Boronda Adobe is a fine example of an adaptively reused adobe.

Figure 12. The José Eusebio Boronda Adobe in 2021. (Image reproduced with permission from Monterey County Historical Society 2021.)

24. "José Eusebio Boronda Adobe," Monterey County Historical Society, 2021, http://mchsmuseum.com/salinas/index/boronda-adobe/.

Figure 13. Interior of the José Eusebio Boronda Adobe as a museum, 2021. (Image reproduced with permission from Monterey County Historical Society 2021.)

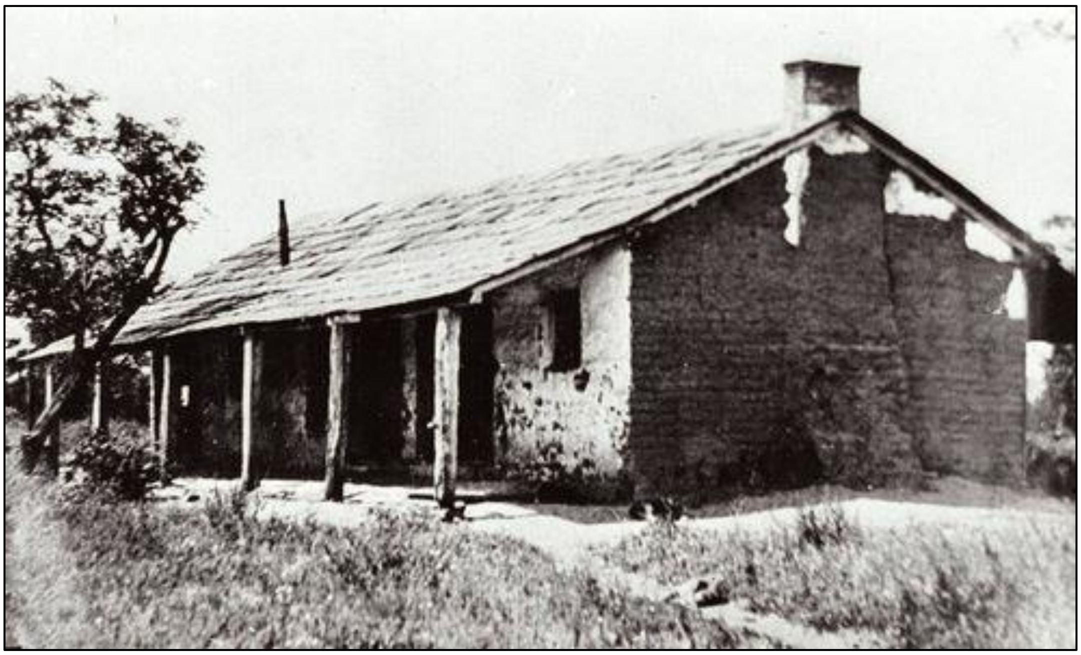
2.2.3 Pearson B. Reading Adobe

The Pearson B. Reading (sometimes his first name is spelled Pierson) Adobe, constructed circa 1850 in Cottonwood, Shasta County, California, was built near the same time as the José María Gil Adobe. The building shared many of the same features as the José María Gil Adobe, such as the use of the same construction technique (the adobe brick method) as well as the substantial use of wooden materials.

The Pearson B. Reading Adobe lacked its exterior plaster coating in most areas due to the building's age, exposure to the elements, and neglect of maintenance, which is similar to the José María Gil Adobe. The building had an extended veranda that was continuous (but had a slight break) from the roof, which was supported by wooden posts. The roof was clad in wood shingles. It had an exterior adobe brick chimney that was used as a heating source. On the roof in a central location appeared to be a metal chimney pipe, which was perhaps installed at a later date post original construction (Figure 14 and Figure 15). The early stages of the José María Gil Adobe share these characteristics.

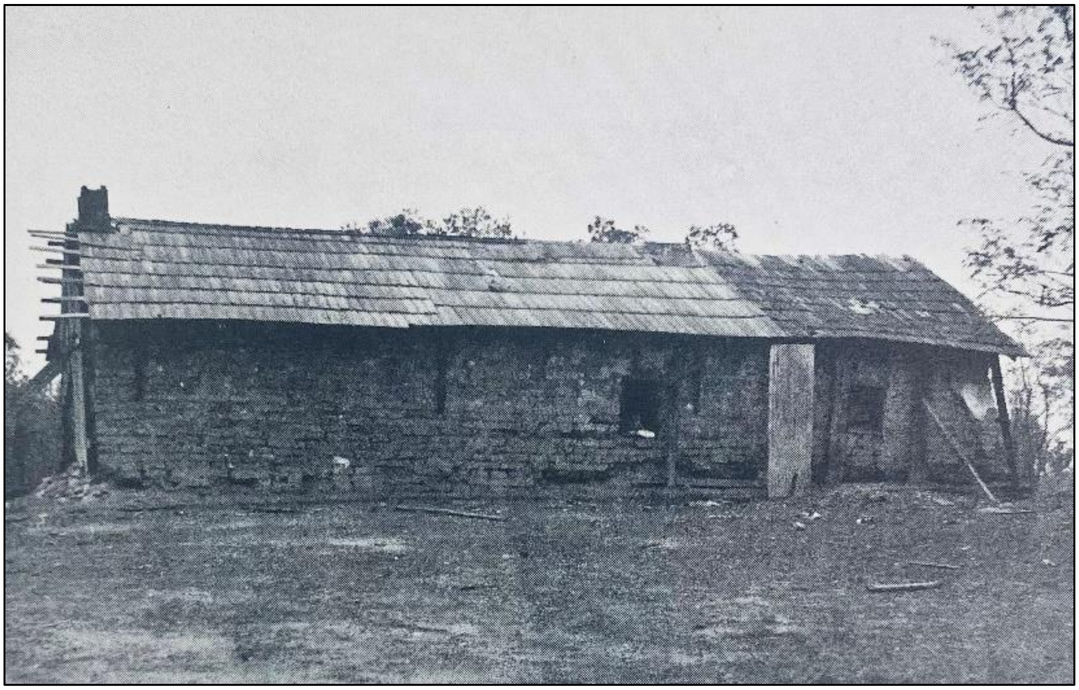
Though the Pearson B. Reading Adobe was built using the same method of construction, of similar construction materials, and during the same time period as the José María Gil Adobe, it unfortunately caught fire and therefore suffered major damage and is no longer standing; therefore, no methods of adaptive reuse ever took place.[25]

Figure 14. Pearson B. Reading Adobe, built c. 1850, showing adobe brick, chimney, wooden roof, and wooden veranda posts. (Image reproduced with permission from "Home of Major Reading," ca. 1850, Northeastern California Historical Photograph Collection.)



25. Helen S. Giffen, *Casas & Courtyards; Historic Adobe Houses of California,* 1st California ed. (Oakland, CA: Biobooks, 1955), 84–85.

Figure 15. Image showing possible back side of the Pearson B. Reading Adobe, lacking a veranda, no date. (Image reproduced from Giffen 1955, 142. Public domain.)



2.2.4 Ignacio Palomares Adobe

The Ignacio Palomares Adobe in Pomona, California, was built in 1855 (Figure 16 and Figure 17). The land, once known as Rancho San Jose, was granted to Don Ygnacio and Don Ricardo Vejar by Governor Juan B. Alvarado.[26] Though the Ignacio Palomares Adobe has a T-shaped footprint and the José María Gil Adobe has an L-shaped footprint, both structures were constructed with a wing extending from the central room.

26. Tamara Venti Shelton, "'A Moral Loyal, Union Loving People Can Nowhere be Found'" Squatters' Rights, Secession Anxiety, and the 1861 'Settlers' War'" in San Jose," *Western Historical Quarterly* 41, no. 4 (2010): 473–94.

Figure 16. Ignacio Palomares Adobe showing roof and column details, no date. (Image reproduced from Giffen 1955, 84. Public domain.)

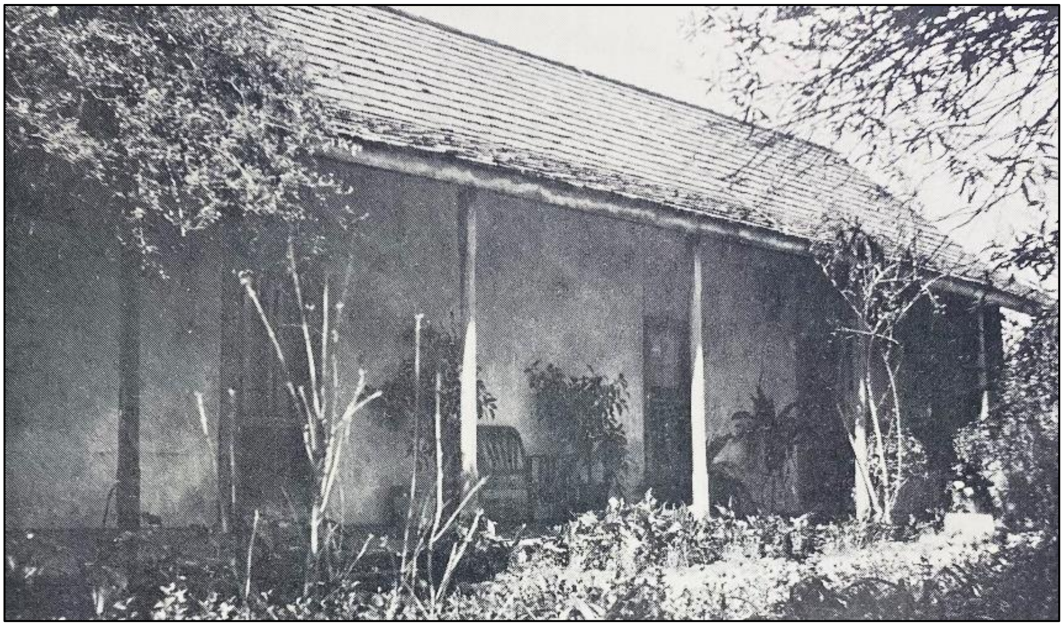
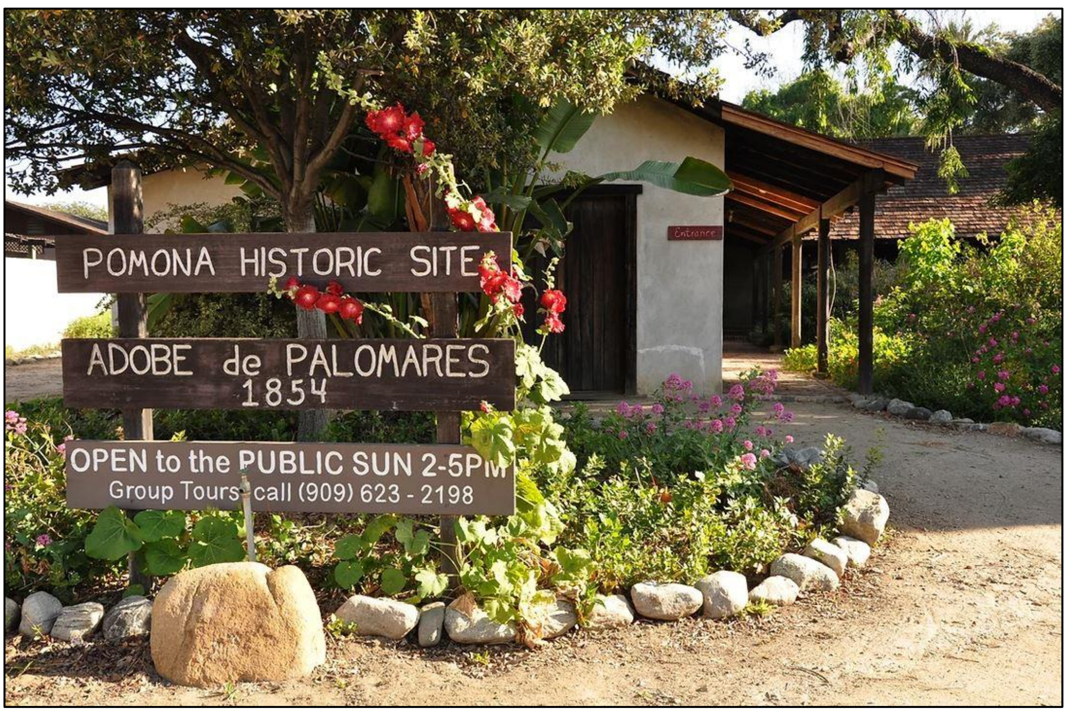


Figure 17. Roofing material crumbling at the corner of the Ignacio Palomares Adobe and plants growing into the wooden roof, no date. (Image reproduced from Giffen 1955, 84. Public domain.)

Plans for restoration began in 1934 when the Ignacio Palomares Adobe and its surrounding land were purchased by the city. The adobe structure was restored and became a public museum on life in the ranchos in 1940 (Figure 18). Based on the historic photographs, the building was in poor condition prior to restoration. During the adaptive reuse process, bricks were hand made from the same local materials that the original bricks were made from. Pieces of the original bricks were also used in the renovation. Dirt and straw were used to make the brick mixture, and they were set in the sun to bake.[27] This method would have been used by the original builders in 1855. The building was listed on the National Register of Historic Places in 1971.

According to the Historical Society of Pomona Valley's website, the museum is open to the public for tours and private rentals. This building, having been constructed in 1855, was restored for practical and beneficial use for the public. Not only does this undertaking create opportunities for the public, but it also preserves a structure that is historically significant based on both its history and its architecture. This mid-19th-century adobe structure is a fine example of adaptive reuse preserving an adobe brick and wood structure that was in poor condition.[28]

Figure 18. Restored Ignacio Palomares Adobe, no date. (Image reproduced with permission from Historical Society of Pomona Valley 2021.)



27. Giffen, *Casas & Courtyards*, 84–85.

28. "Adobe De Palomares," History and Legacy, Historical Society of Pomona Valley, 2021, https://www.pomonahistorical.org/adobe-de-palomares.

2.3 José María Gil Adobe history and historical photographs

The José María Gil Adobe was constructed circa the 1860s and throughout its life has had many owners—both private and in affiliation with the US military.

2.3.1 First property owners

The first historical record of the property that would later become the José María Gil Adobe comes from the San Antonio de Padua Mission. The mission was the third Spanish mission established in California. Established in 1771, the Spanish missions from this time period were built by enslaved Indigenous people who were forced to convert to Catholicism. The original goal of the mission was to give the land back to the Indigenous people after they converted, but that never occurred.[29] Following the 1822 Mexican War for Independence, most of the missions were left unattended, causing them to fall into disrepair. The lands that the missions were formally on were given to private owners through the grants. The land grants from the missions created about 600 ranches (Figure 19).[30] The San Antonio de Padua Mission land was divided into 10 land grants, 1 of which was called the Rancho Milpitas land grant (Figure 20). This grant was originally 8,800 acres and given to Ygnacio Pastor, a neophyte (one who is new to a belief) at Mission San Antonio. The Gil property was only a small portion of this grant. The Rancho Milpitas land grant also created the town of Jolon, California. Before the land was split up into smaller ranches, it created problems for the people living there. Families like the Gil family found that they were considered squatters on the grant land that they had previously thought was their land. After hearing of this, many families left the area, but the Gil family choose to stay on the land.[31] By 1871, a parcel of the grant land was bought by José

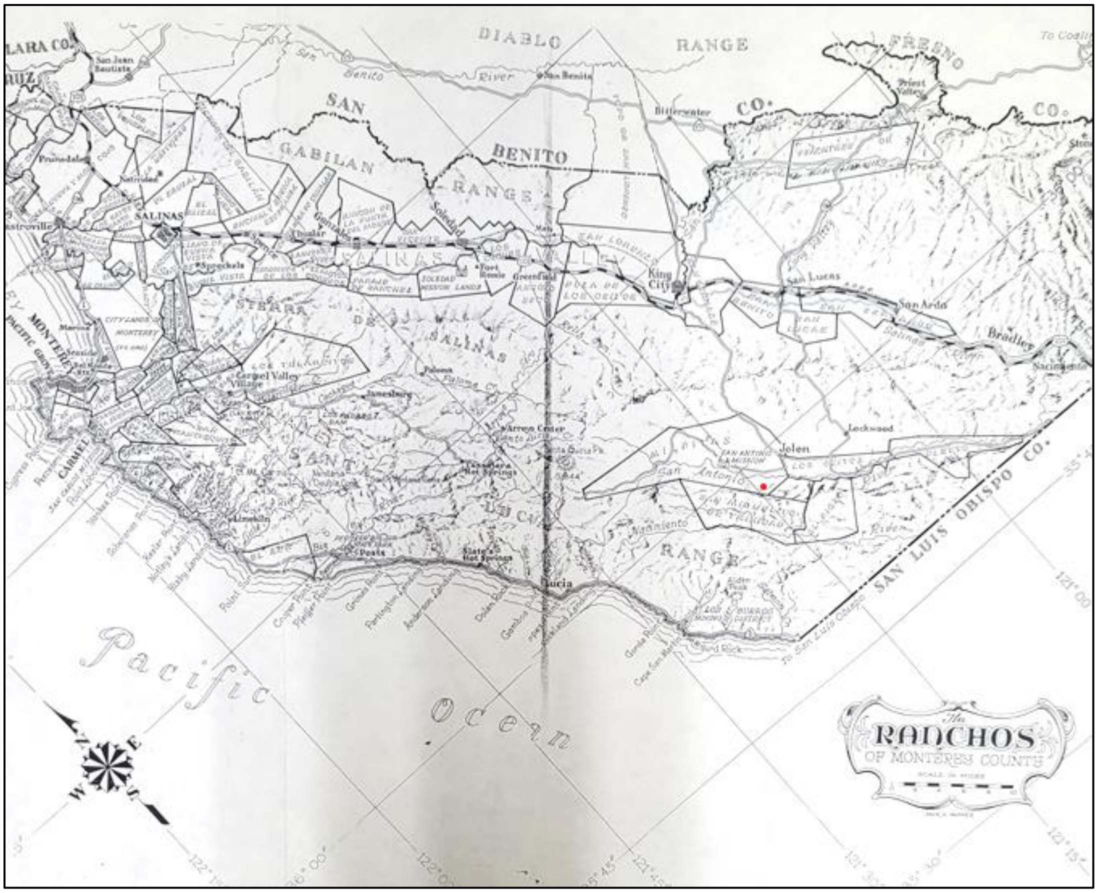
29. Edward D. Castillo, "Short Overview of California Indian History," State of California Native American Heritage Commission, 2022, https://nahc.ca.gov/resources/California-indian-history/.

30. Richard Stilsson and Roy Rosenzweig, "'California as I Saw It': First-Person Narratives or California's Early Years, 1849–1900," *Journal of American History* 92, no. 1 (2005): 324–25.

31. Daryl Allen and Gil Sanchez, "Adaptive Reuse Study for the Jose Maria Gil Adobe Site," January 1995, Records of the Cultural Resources Management Office (CRM), Fort Hunter Liggett Military Installation, California.

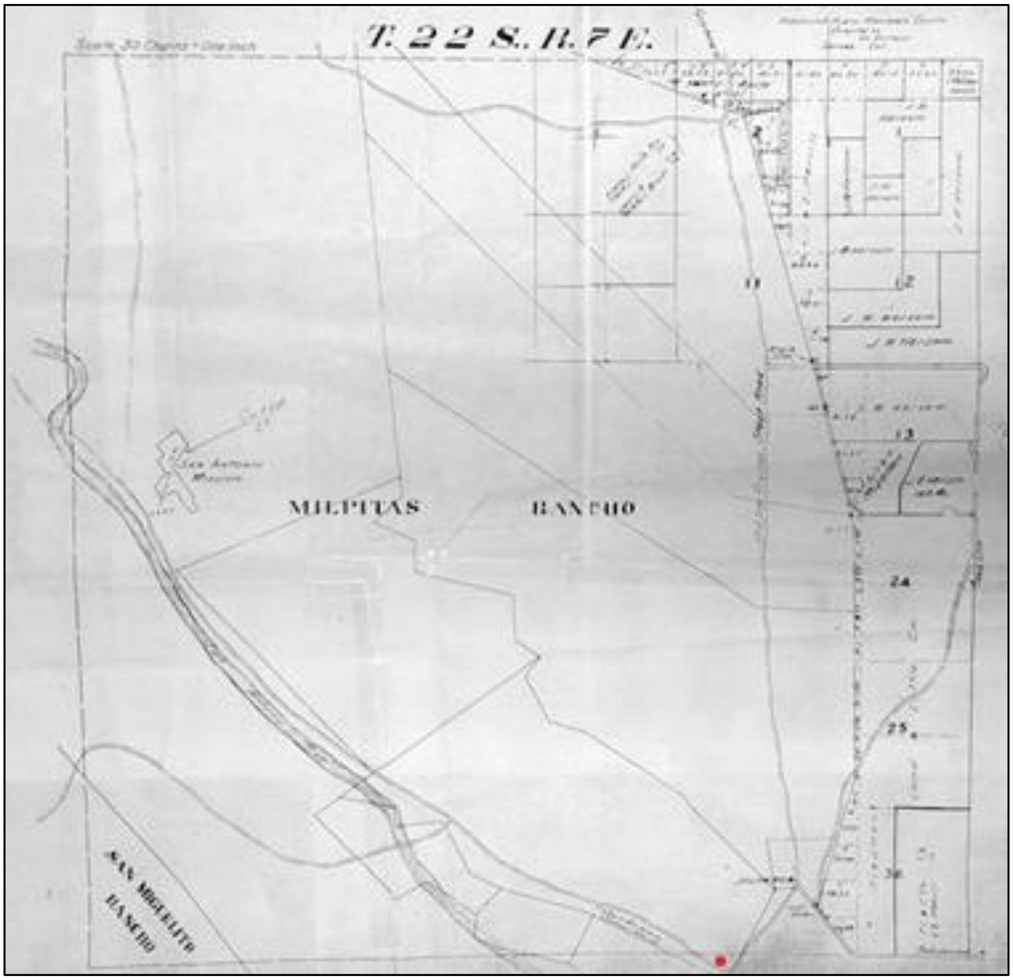
María Gil, allowing him to keep his adobe house and the surrounding land that made up his ranch.[32]

Figure 19. Historic map showing the ranchos of Monterey Country, no date. (*Ranchos of Monterey County*, Hunter Liggett Archive Room.)



32. Spanish and Mexican Land Grant Records, California Secretary of State, n.d., https://www.sos.ca.gov/archives/collections/ussg.

Figure 20. Historic map showing land that is part of the Milpitas Rancho. (Monterey County Assessor's Office.)



2.3.2 José María Gil

José María Gil was born in Madrid, Spain, in 1821. At the age of seven his family moved to Erongariquero, Mexico. He then moved to California in 1842 at the age of 21. Gil became a naturalized United States citizen on 5 June 1868.[33] Gil was living on the land that became his ranch well before he bought it in 1871. Because of this, the Gil family is one of the oldest pioneer families in the San Antonio Valley area and is credited with being one of the first Hispanic families to settle within the area. José María Gil was married twice and had a total of 17 children. He married his first wife, Juliana Gomez, in 1850. She died in 1857, leaving Gil with their three

33. Rolin C. Watkins, ed., *History of Monterey and Santa Cruz Counties, California* [. . .], Vol. II (Chicago: S.J. Clarke Publishing Co., 1925), 32–33.

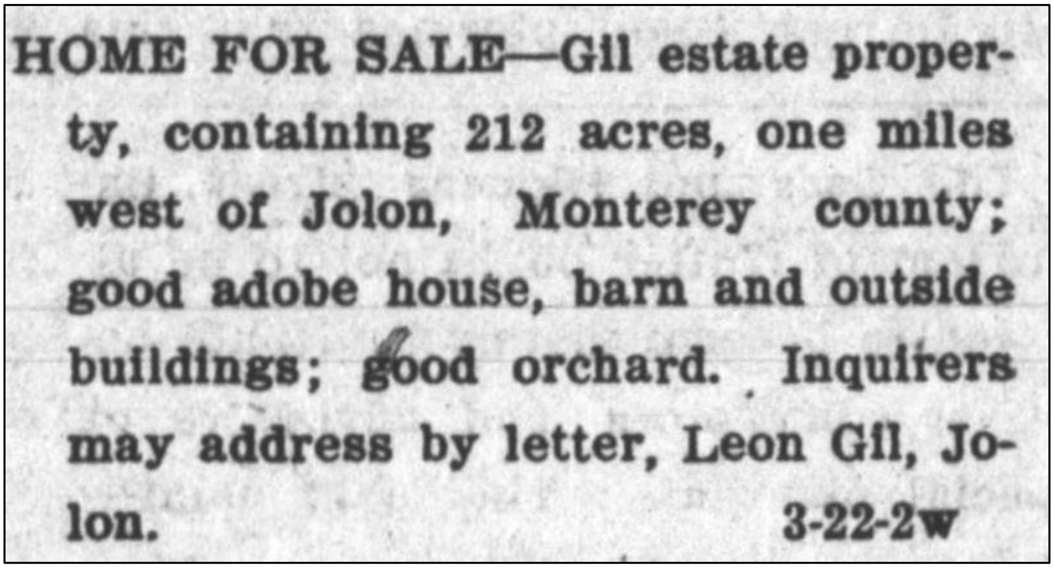
children. By 1860, Gil had remarried a woman named Maria Vallejo. Maria Vallejo and José María Gil had 14 children together.

The Gil family made many changes to the property during their long ownership. The first change occurred circa 1865, before José María Gil legally owned the land. This is when Gil constructed an adobe building that was used as a ranch house by his family and would later be known as the José María Gil Adobe. The exact date of construction is unknown. He also started a ranch using his surrounding lands. Gil's family was involved on his ranch and also in the Jolon community. Many of his children established residence in the area. Gil's thirteenth child, Henry, was born in 1876 and was known for opening a general store in Jolon. The store was located close to the where the Tidball store was located in Jolon, which also is no longer in business. The Tidball store building, however, still stands off of Lockwood-Jolon Road.

When José Gil died in 1892, he left his estate (which included the adobe house and ranch lands) to his wife, Maria Vallejo. After Maria's death in 1909, the family decided to sell the 212-acre plot of land.[34] In 1910, advertisements in the local newspaper promoted the sale of the property (below in Figure 21).

34. Allen and Sanchez, "Adaptive Reuse Study for the Jose Maria Gil Adobe Site."

Figure 21. Newspaper clipping from the *San Luis Obispo Daily Telegram*, March 22, 1910. (Public domain.)[35]



HOME FOR SALE—Gil estate property, containing 212 acres, one miles west of Jolon, Monterey county; good adobe house, barn and outside buildings; good orchard. Inquirers may address by letter, Leon Gil, Jolon. 3-22-2w

2.3.3 Peter K. Watters

In 1910, the Gil family sold the property to Dr. Peter K. Watters. Dr. Watters graduated from Iowa State University with a degree in medicine.[36] He practiced in Watsonville, where he and his wife, Louise, lived. Six years after purchasing the property, Watters purchased 21 purebred Holstein heifers and started a dairy operation. Due to his heavy involvement within the Watsonville community, Dr. Watters did not take up residence on the ranch. He did, however, visit the land frequently but ended up selling the land one year later to Philip Miller in 1917 (Figure 23). This sale included all of the land, stock, and farm implements.[37]

2.3.4 Philip Miller

After acquiring the 212-acre property in 1917, the Miller family became active members of their new Jolon community. Antonia Miller, Philip's wife, was an involved member in the Ladies Guild of St. Mark's Church. She even hosted meetings within the adobe house.[38]

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35. *San Luis Obispo Daily Telegram* 11, no. 23, March 22, 1910, California Digital Newspaper Collection, Center for Bibliographical Studies and Research, https://cdnc.ucr.edu/?a=d&d=SLODT19100322.2.35.1&e=-------en--20--1--txt-txIN--------1.

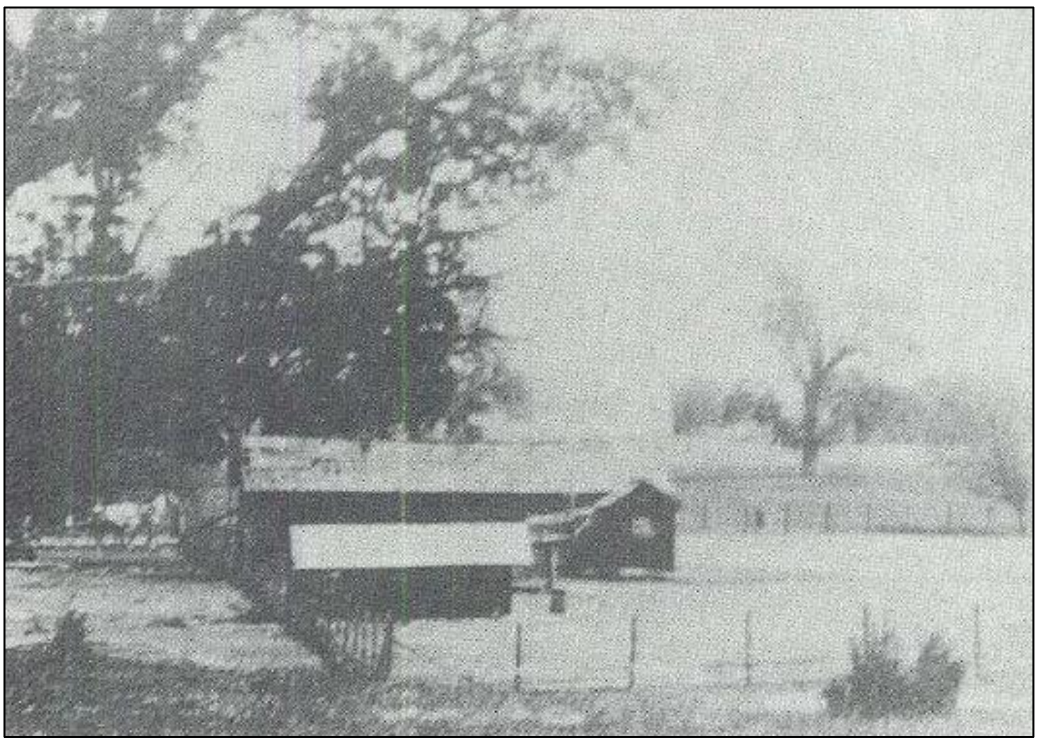
36. California, US, Occupational Licenses, Registers, and Directories, 1876–1969 [database on-line], California State Archives, Ancestry.com Operations, Inc., 2015.

37. Allen and Sanchez, "Adaptive Reuse Study for the Jose Maria Gil Adobe Site."

38. Allen and Sanchez, "Adaptive Reuse Study for the Jose Maria Gil Adobe Site."

In June of 1922, a fire destroyed all the buildings on the property and the supplies within them. Thankfully, the Miller family, with the help of their neighbors, was able to extinguish the fire before it reached the adobe house. An outbuilding that was destroyed in the fire can be seen in Figure 22. In total, eight cows and 80 tons of alfalfa were lost during the fire. Between the years of 1922 to 1925, the old barn that had burned down in the fire was replaced with a new barn by the Miller family and surrounding neighbors. The new barn measured 50 × 100 ft, and the floor was made of concrete.[39] The Millers lived on this land until the late 1920s, when all of the ranch lands were purchased by the Piedmont Cattle Company under William Randolph Hearst's ownership.[40]

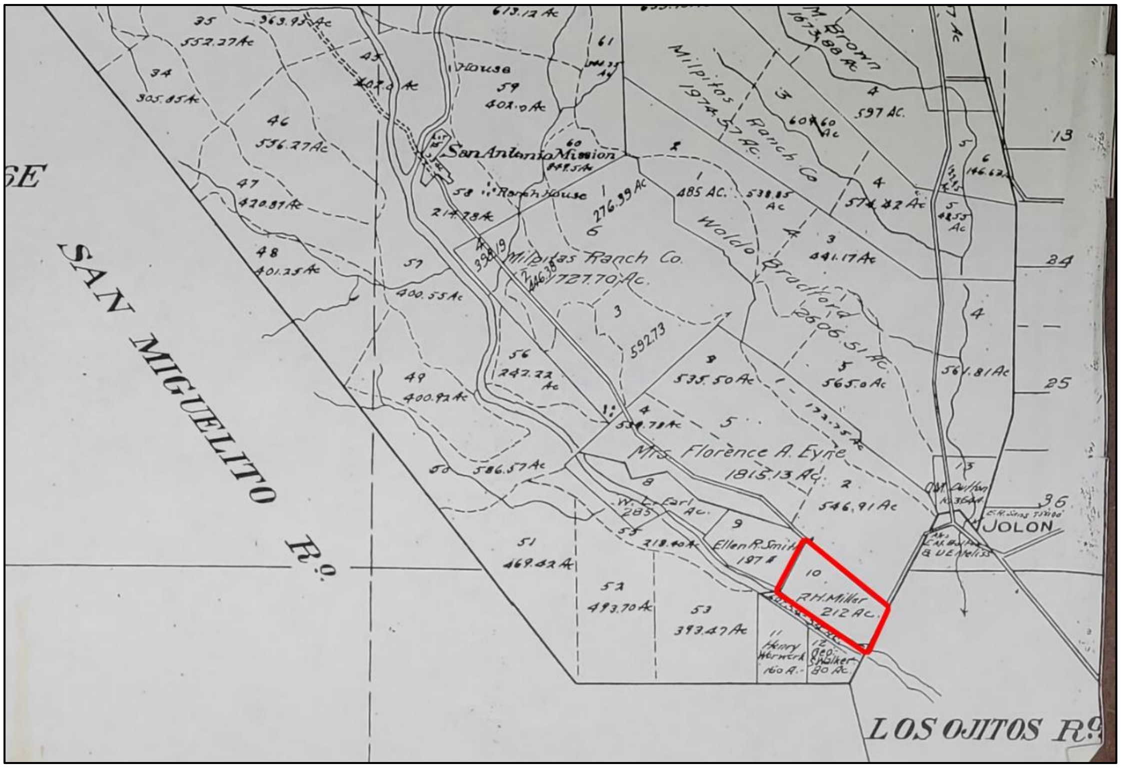
Figure 22. Outbuilding that once stood east of the José María Gil Adobe, unknown date (pre-1922). (Image reproduced with permission from San Antonio Mission Archives.)



39. The date of the new dairy barn construction has conflicting records. The "Adaptive Reuse" report contradicts other reports by stating that the barn construction took place in 1922. However, in *Images of America: San Antonio Valley*, a firsthand account recalls that the barn was constructed around 1925. Allen and Sanchez, "Adaptive Reuse Study for the Jose Maria Gil Adobe Site," 1995; Susan Raycraft and Ann Keenan Beckett, *Images of America: San Antonio Valley* (Mount Pleasant, SC: Arcadia Publishing, 2006).

40. Brenda L. Tippin, "The California Morgans of William Randolph Hearst," History Lesson, *The Morgan Horse*, 2 July 2013, https://www.morganhorse.com/upload/photos/904TMH_July2013_HearstMorgans.pdf.

Figure 23. A 1914 map showing the 212-acre Miller property outlined in *red*, 1916. (Hunter Liggett Archive Room.)



2.3.5 William Randolph Hearst

Once William Randolph Hearst acquired the property, it, along with all of the surrounding properties, was used as ranch land under his family's Sunical Corporation. While Hearst owned and operated this land, all of the existing buildings served as housing for the ranch hands. What is now known as the José María Gil Adobe was one of these many buildings.[41]

2.3.6 The Army

William Hearst's ranch property was bought by the US Army in September of 1940 for $6,000.00. The Army originally used the property as a maneuver area and artillery range in preparation for World War II. After acquisition, the Army destroyed many buildings in order to salvage and reuse anything they could.[42] If a building was not used for supplies, it was used as an artillery target. The José María Gil Adobe was spared and, under the Army's care, repurposed as an eight-person bachelor

41. Allen and Sanchez, "Adaptive Reuse Study for the Jose Maria Gil Adobe Site."
42. Allen and Sanchez, "Adaptive Reuse Study for the Jose Maria Gil Adobe Site."

officer's quarters (BOQ).[43] Changes were made to the original building in order to increase functionality for its new use. Wooden partition walls were added to form kitchen and bathroom spaces. Plumbing was added to the house, including a water heater, toilets, showers, water tanks, and a kitchen sink. During this renovation the building's roof was clad with green asphalt shingles.[44]

In April of 1968, the post engineer at Fort Hunter Liggett stated that the building had declined into a state that was beyond economical reparation. By November, an order was sent to demolish the building, but it was postponed due to public outcry. Ultimately to avoid public backlash officials decided not to demolish the building. However, upkeep was not done, and the building condition declined into further disrepair. (Figure 25). The Monterey County Historical Advisory Committee nominated the building to be listed on the NRHP in 1973. On 7 June 1974, the José María Gil Adobe was placed on the NRHP.[45]

Since the building's listing on the NRHP, the Army has not used the José María Gil Adobe. The Army placed a tarp over the building in 1976 as a temporary roof and posted signs that restricted trespassing onto the site and into the building. A year later in 1977, a more durable temporary roof constructed of salvaged materials was placed over the adobe. This is the cap-like roof that is currently the top layer, visible on the south wing of the building. In 1979, the Army boarded the adobe's doors and windows to protect the building from vandalism.[46] See the Army's exterior renovations in later images dated 1993 in Figure 26, Figure 27, and Figure 28, showing the green asphalt shingles as well as the multiple roof layers on the south wing.

In 1993, a building study was conducted by the Sanchez firm in consultation with the US Army Corps of Engineers, Sacramento District. Following the advice of the study, the Army "mothballed" much of the property. Such activities included the installation of a composition roof over the José María Gil Adobe and the cold storage building. A chain-link fence was also installed along the perimeter of the immediate site. The doors and windows were again boarded up to protect the interior of the

43. Raycraft and Beckett, Images of America: San Antonio Valley, 114–16.

44. Allen and Sanchez, "Adaptive Reuse Study for the Jose Maria Gil Adobe Site."

45. Allen and Sanchez, "Adaptive Reuse Study for the Jose Maria Gil Adobe Site."

46. Allen and Sanchez, "Adaptive Reuse Study for the Jose Maria Gil Adobe Site."

building.[47] See the José María Gil Adobe following the mothballing activities in Figure 29. In 1994, a “Adaptive Reuse Study for the José María Gil Adobe Site” was written for the adobe. The plan included restoration of the building for a public educational program, but the recommended changes never happened.[48]

The dairy barn described in Section 2.3.4 once stood north of the site of the José María Gil Adobe. It was constructed between 1922 and 1925 and remained on the Gil property throughout the early portion of the Army’s ownership. The barn no longer stands. The aerial seen in Figure 24 is dated 1972; therefore, the barn was removed sometime after 1972.

Figure 24. Aerial showing the Gil property and the large dairy barn, 1972. (Hunter Liggett Archive Room.)

47. Allen and Sanchez, “Adaptive Reuse Study for the Jose Maria Gil Adobe Site.”

48. Raycraft and Beckett, Images of America: San Antonio Valley, 114–16.

Figure 25. Historic image looking at south side of the José María Gil Adobe, 1969. (San Antonio Valley Historical Association [SAVHA].)

Figure 26. Looking northwest at green asphalt shingle roof on the José María Gil Adobe, 1993. (FHL real property file record.)

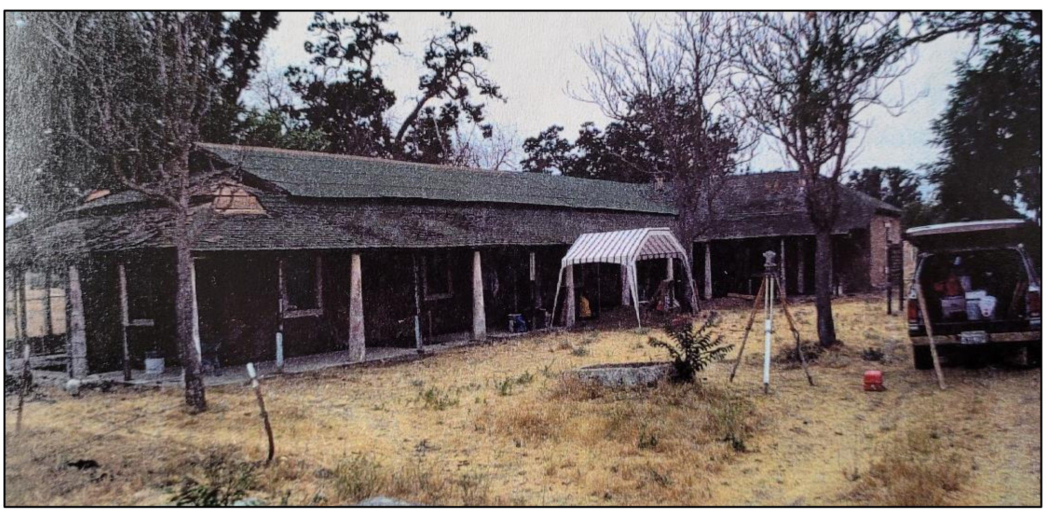


Figure 27. NRHP sign on the east side of the site of the José María Gil Adobe, 1993. (FHL real property file record.)

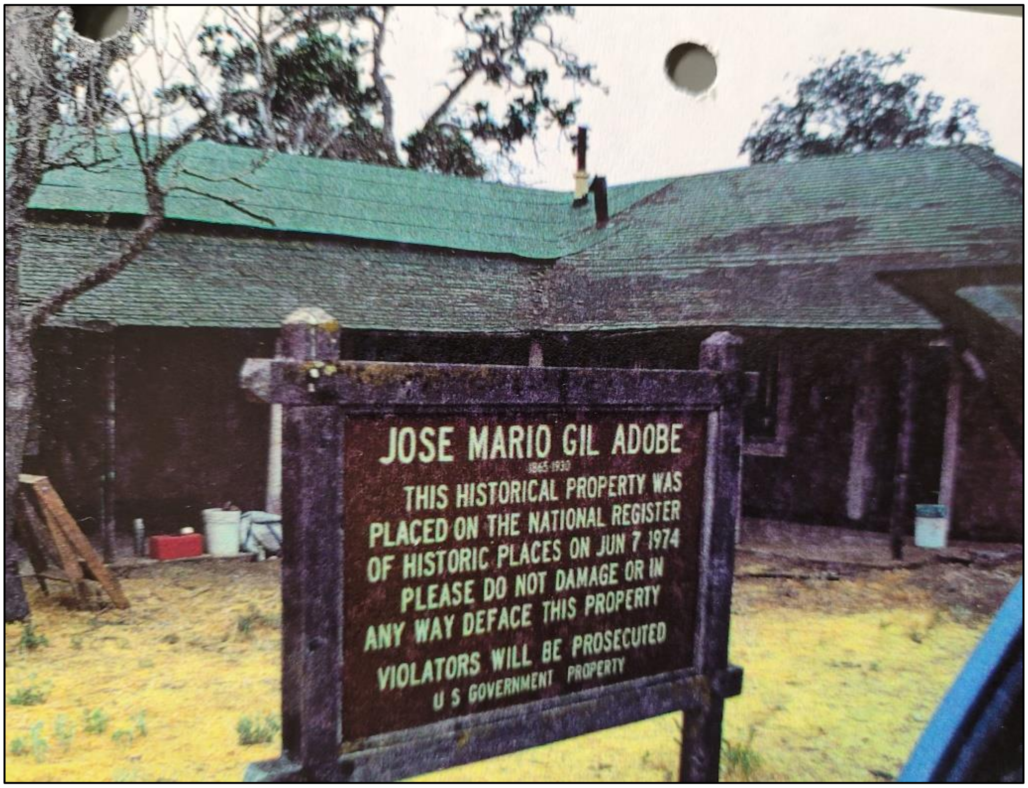


Figure 28. Major limbs and overgrowth on the east side of the José María Gil Adobe, 1993. (FHL real property file record.)

Figure 29. José María Gil Adobe in its present condition and how it was left in 1993, 2021. (ERDC-CERL.)

2.4 National Register of Historic Places Nomination[49]

PH0037257

Form 10-300 (July 1969)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES
INVENTORY – NOMINATION FORM

(Type all entries – complete applicable sections)

STATE: California
COUNTY: Monterey

FOR NPS USE ONLY

ENTRY NUMBER	DATE
JUN 7 1974	

SEE INSTRUCTIONS

1. NAME

COMMON: Jose Mario Gil Adobe

AND/OR HISTORIC: Same

2. LOCATION

STREET AND NUMBER: Hunter Liggett Military Reservation

CITY OR TOWN: ~~Monterey County~~, Jolon

STATE	CODE	COUNTY:	CODE
California	06	Monterey	053

3. CLASSIFICATION

CATEGORY (Check One)	OWNERSHIP		STATUS	ACCESSIBLE TO THE PUBLIC
☐ District ☒ Building ☐ Site ☐ Structure ☐ Object	☒ Public ☐ Private ☐ Both	Public Acquisition: ☐ In Process ☐ Being Considered	☐ Occupied ☒ Unoccupied ☐ Preservation work in progress	Yes: ☒ Restricted ☐ Unrestricted ☐ No

PRESENT USE *(Check One or More as Appropriate)*

☐ Agricultural	☐ Government	☐ Park	☐ Transportation	☐ Comments
☐ Commercial	☐ Industrial	☐ Private Residence	☐ Other *(Specify)*	
☐ Educational	☒ Military	☐ Religious		
☐ Entertainment	☐ Museum	☐ Scientific		

4. OWNER OF PROPERTY

OWNER'S NAME: U.S. Government, Dept. of the Army

STREET AND NUMBER: c/o Director of Facilities Engineering

CITY OR TOWN:	STATE:	CODE
Fort Ord, Monterey County	Calif.	06

STATE: California

5. LOCATION OF LEGAL DESCRIPTION

COURTHOUSE, REGISTRY OF DEEDS, ETC: Monterey County Courthouse

STREET AND NUMBER: West Alisal Street

CITY OR TOWN:	STATE	CODE
Salinas	Calif, 93901	06

COUNTY: Monterey

6. REPRESENTATION IN EXISTING SURVEYS

TITLE OF SURVEY:

DATE OF SURVEY: ☐ Federal ☐ State ☒ County ☐ Local

DEPOSITORY FOR SURVEY RECORDS:

STREET AND NUMBER:

CITY OR TOWN: STATE: CODE

RECEIVED NOV 27 1973 NATIONAL REGISTER

FOR NPS USE ONLY — ENTRY NUMBER: JUN 7 1974 — DATE

49. The following section reproduces Gary Messinger, "Jose Mario Gil Adobe," 7 June 1974, National Register of Historic Places Inventory Nomination Form, California Historic Commission, Monterey, California. https://npgallery.nps.gov/NRHP/GetAsset/NRHP/74000537_text. Public domain.

7. DESCRIPTION

CONDITION	(Check One)		
	☐ Excellent ☐ Good ☐ Fair ☒ Deteriorated ☐ Ruins ☐ Unexposed		
	(Check One) ☒ Altered ☐ Unaltered	(Check One) ☐ Moved ☒ Original Site	

DESCRIBE THE PRESENT AND ORIGINAL *(if known)* PHYSICAL APPEARANCE

The Jose Mario Gil Adobe is located near a General Store and the intersection of two country roads in the dry, grassy, scrub oak landscape of Jolon in southwest Monterey County, California.

The Adobe is a single story building, low, rambling, approximately 1200 square feet, in an "L" shape, with wooden porches on 3 sides. The roof is made of shingles. Walls are of adobe brick, 3 feet thick. Parts of the present floor are wood, but the original was of packed dirt. The building has 7 rooms and 2 indoor fireplaces.

Next to the Adobe is a small family cemetery containing remains of Jose Mario Gil, his second wife, Maria, and many children (see "Significance").

The building was constructed in 1865 as a ranch house, during the days when cattle ranching and dry farming were still the basis of Monterey County agriculture, and had not yet been replaced by high-yield vegetable farming dependent upon irrigation.

Through the early 1900's the Gil adobe was also noted for the attractively landscaped grounds surrounding it. Both the grounds and the building, however, were allowed to deteriorate from about 1930 onward. At the present time, most of the basic core of the adobe is well preserved and easily restorable, but the surrounding grounds are very shabby. In addition, restoration of the structure would require removal of some of the fittings (sinks, toilets, partitions, pipes, wires) added when the U. S. Army used the Adobe as a barracks in the Second World War.

RECEIVED NOV 27 1973 NATIONAL REGISTER

SEE INSTRUCTIONS

8. SIGNIFICANCE

PERIOD *(Check One or More as Appropriate)*

[ ] Pre-Columbian	[ ] 16th Century	[ ] 18th Century	[x] 20th Century
[ ] 15th Century	[ ] 17th Century	[x] 19th Century	

SPECIFIC DATE(S) *(If Applicable and Known)*

AREAS OF SIGNIFICANCE *(Check One or More as Appropriate)*

Aboriginal	[ ] Education	[ ] Political	[ ] Urban Planning
[ ] Prehistoric	[ ] Engineering	[ ] Religion/Philosophy	[ ] Other *(Specify)*
[ ] Historic	[ ] Industry	[ ] Science	
[x] Agriculture	[ ] Invention	[ ] Sculpture	
[x] Architecture	[ ] Landscape Architecture	[ ] Social/Humanitarian	
[ ] Art	[ ] Literature	[ ] Theater	
[ ] Commerce	[ ] Military	[ ] Transportation	
[ ] Communications	[ ] Music		
[ ] Conservation			

STATEMENT OF SIGNIFICANCE

The Gil Adobe is one of the few adobes in Monterey County that has not been incorporated into a private home, which makes it an unusually fine example of the ranch adobes that once peppered the Salinas Valley (an area of over 1,000 square miles, the home of John Steinbeck, and one of the major farming regions of the world). The Adobe is an excellent physical reminder of the Cattle Ranching Era that preceded the coming of irrigation, as well as an excellent example of the architecture common at that time.

(See Summary attached)

SEE INSTRUCTIONS

9. MAJOR BIBLIOGRAPHICAL REFERENCES

1. Interviews with local residents 2. Articles and notes in possession of Monterey County Archeological Society 3. Incidental articles in King City Rustler and Salinas Californian (newspapers) 4. Padres and People of Old Mission San Antonio (at local Mission), by Beatrice Casey (n.d.) 5. Personal knowledge, Mrs. Rachel Gillett, Lockwood, Calif.

10. GEOGRAPHICAL DATA

LATITUDE AND LONGITUDE COORDINATES DEFINING A RECTANGLE LOCATING THE PROPERTY			OR	LATITUDE AND LONGITUDE COORDINATES DEFINING THE CENTER POINT OF A PROPERTY OF LESS THAN TEN ACRES	
CORNER	LATITUDE (Degrees Minutes Seconds)	LONGITUDE (Degrees Minutes Seconds)		LATITUDE (Degrees Minutes Seconds)	LONGITUDE (Degrees Minutes Seconds)
NW	° ' "	° ' "		121° 11' ~~12~~ 22"	35° 57' 42"
NE	° ' "	° ' "			
SE	° ' "	° ' "			
SW	° ' "	° ' "			

APPROXIMATE ACREAGE OF NOMINATED PROPERTY: ½ acre

LIST ALL STATES AND COUNTIES FOR PROPERTIES OVERLAPPING STATE OR COUNTY BOUNDARIES

STATE:	CODE	COUNTY	CODE
STATE:	CODE	COUNTY:	CODE
STATE:	CODE	COUNTY:	CODE
STATE:	CODE	COUNTY:	CODE

RECEIVED NOV 27 1973 NATIONAL REGISTER

11. FORM PREPARED BY

NAME AND TITLE: Dr. Gary Messinger, Consultant

ORGANIZATION: Monterey County Historical Advisory Committee

DATE: April 18, 1973

STREET AND NUMBER: Box 1208 Monterey County Courthouse

CITY OR TOWN: Salinas

STATE: California

CODE: 053

12. STATE LIAISON OFFICER CERTIFICATION

As the designated State Liaison Officer for the National Historic Preservation Act of 1966 (Public Law 89-665), I hereby nominate this property for inclusion in the National Register and certify that it has been evaluated according to the criteria and procedures set forth by the National Park Service. The recommended level of significance of this nomination is:

National ☐ State ☐ Local ☒

Name [signature]

Title: State Historic Preservation Officer

Date: July 17, 1973

NATIONAL REGISTER VERIFICATION

I hereby certify that this property is included in the National Register.

[signature] Ernest Allen Connally

Associate Director, Professional Services

Date: JUN 7 1974

ATTEST:

[signature]

Acting Keeper of The National Register

Date: 6-4-74

SEE INSTRUCTIONS

Form 10-300a
(July 1969)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES
INVENTORY - NOMINATION FORM

(Continuation Sheet)

STATE	
California	
COUNTY	
Monterey	
FOR NPS USE ONLY	
ENTRY NUMBER	DATE
JUN 7 1974	

(Number all entries)

NATIONAL REGISTER FORM
Attachment

THE JOSE MARIO GIL ADOBE

Jose Mario Gil was born in Madrid, Spain, in 1821. At the age of 7 he came to the New World, settling in Mexico. At age 21 he migrated to California. When the Gold Rush began in 1849, he was attracted by stories of gold in the Santa Lucia Mountains, and came to the mines near Jolon.

When riches were not forthcoming, he found work as a farm hand on the Milpitas Ranch (formed out of the old Land Grant), and also worked for a Mr. Earl. In 1850 he became a U. S. citizen, while his earnings soon enabled him to buy the land near Jolon where he built his adobe ranch house in 1865.

Gil married twice. In 1850 he married Senorita Juliana Gomez, who died in 1857, leaving 3 sons: Mariano, Miguel, and Augustine. In 1860 he married Maria Vallejo, and they had 9 sons and 5 daughters. Many members of the family are buried in the small cemetery that adjoined Gil's adobe at Jolon.

Gil owned 260 acres. This gave him the economic base to support his large family, most of whom remained on the ranch, as well as to give employment to the needy and to help pioneer in establishment of California's school system.

One of Gil's daughters, Louisa, married James Rios, a direct descendant of Petronillo Rios, one of those who had come to California with Father Junipero Serra and helped build the first missions.

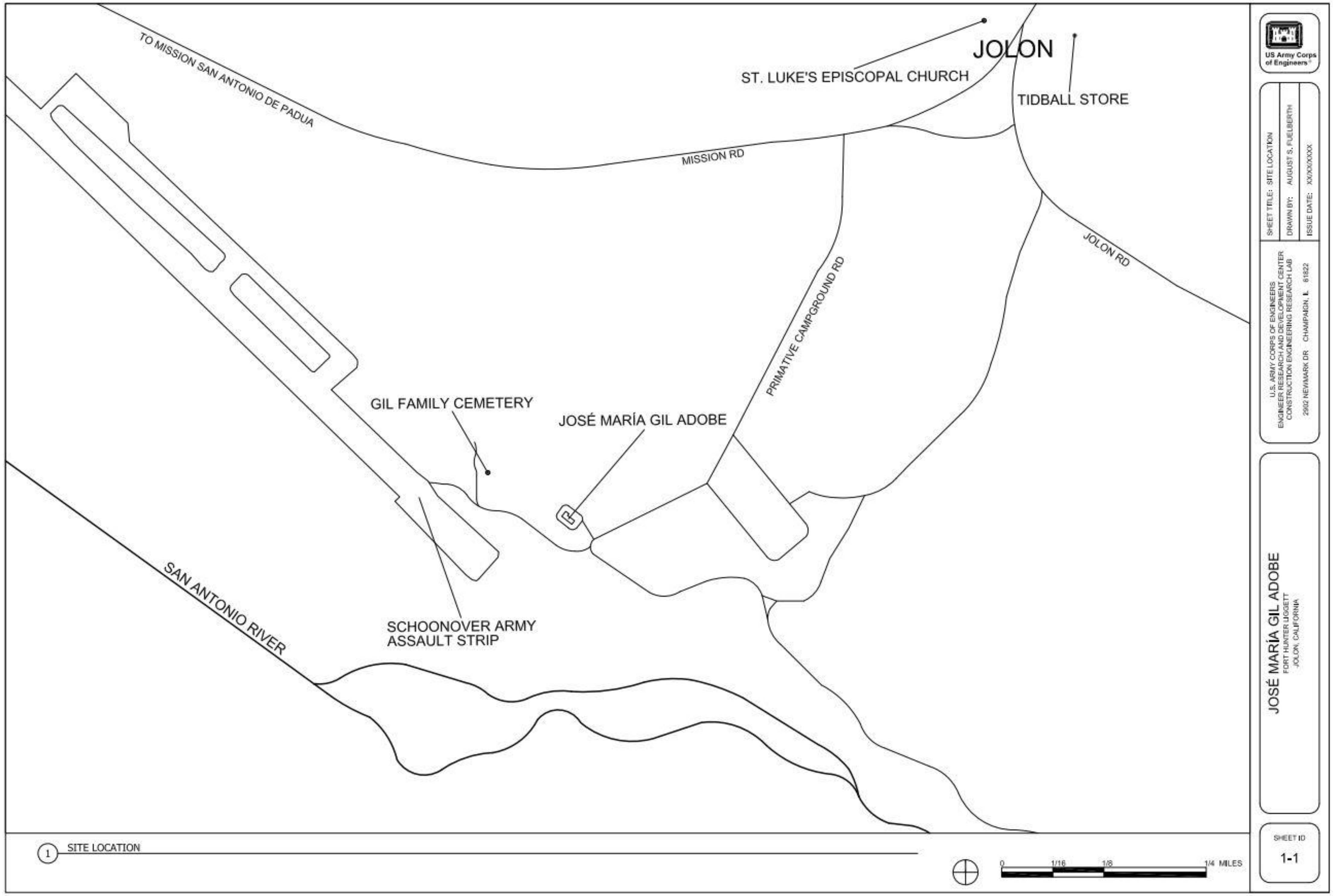
Some time after 1900, the Gil Adobe was sold to a Dr. Miller, so that the structure is still known to some as the "Miller Adobe".

In the period between the two World Wars, the Gil-Miller Adobe, along with most of the Milpitas Grant of which it was a part, was purchased by William Randolph Hearst, who built a Neo-Spanish mansion here which he used as a change of pace from his estate at San Simeon, further south. Patriotism and economic calculation prompted Hearst to deed the property to the U. S. Army during the Second World War. The Army is now the legal owner of the Gil Adobe and grounds.

3 Stage II: Site Location, Site Information, and Architectural Description

The José María Gil Adobe site is located on Fort Hunter Liggett in Jolon, California. To the west of the site is the Schoonover Army Assault Strip, which extends into the northwest. To the north is the Fort Hunter Liggett Campground. To the northeast is St. Luke's Episcopal Church, a Carpenter Gothic structure that is another notable building in this area, and the Tidball store located near the intersection of Mission Road and Jolon Road. South of the site is the San Antonio River and riverine that consists of various freshwater forested and shrub wetlands as well as freshwater emergent wetlands lying to the southeast. See site location map in Figure 30.

Figure 30. Existing building site location map of the José María Gil Adobe, 2022. (Drawn by ERDC-CERL.)



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3.1 Immediate site context

The immediate site context is devoid of buildings. The closest buildings are about 700 ft northeast of the site. Looping around the west side and extending along the south side of the José María Gil Adobe is a dried arroyo that now appears as an empty ditch (Figure 32). To the west of the site is a fenced corral, which used to be part of the ranch (Figure 33). South of the José María Gil Adobe is a cold storage building that is described in Section 3.1.2. A gravel drive circles around the building's fence line (Figure 34). The site of the José María Gil Adobe consists of various objects that are discussed in Sections 7.1, 8.1, and 9.1 of this report. See the existing site plan in Figure 31.

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Figure 31. Existing building site plan of the José María Gil Adobe, 2022. (Drawn by ERDC-CERL.)

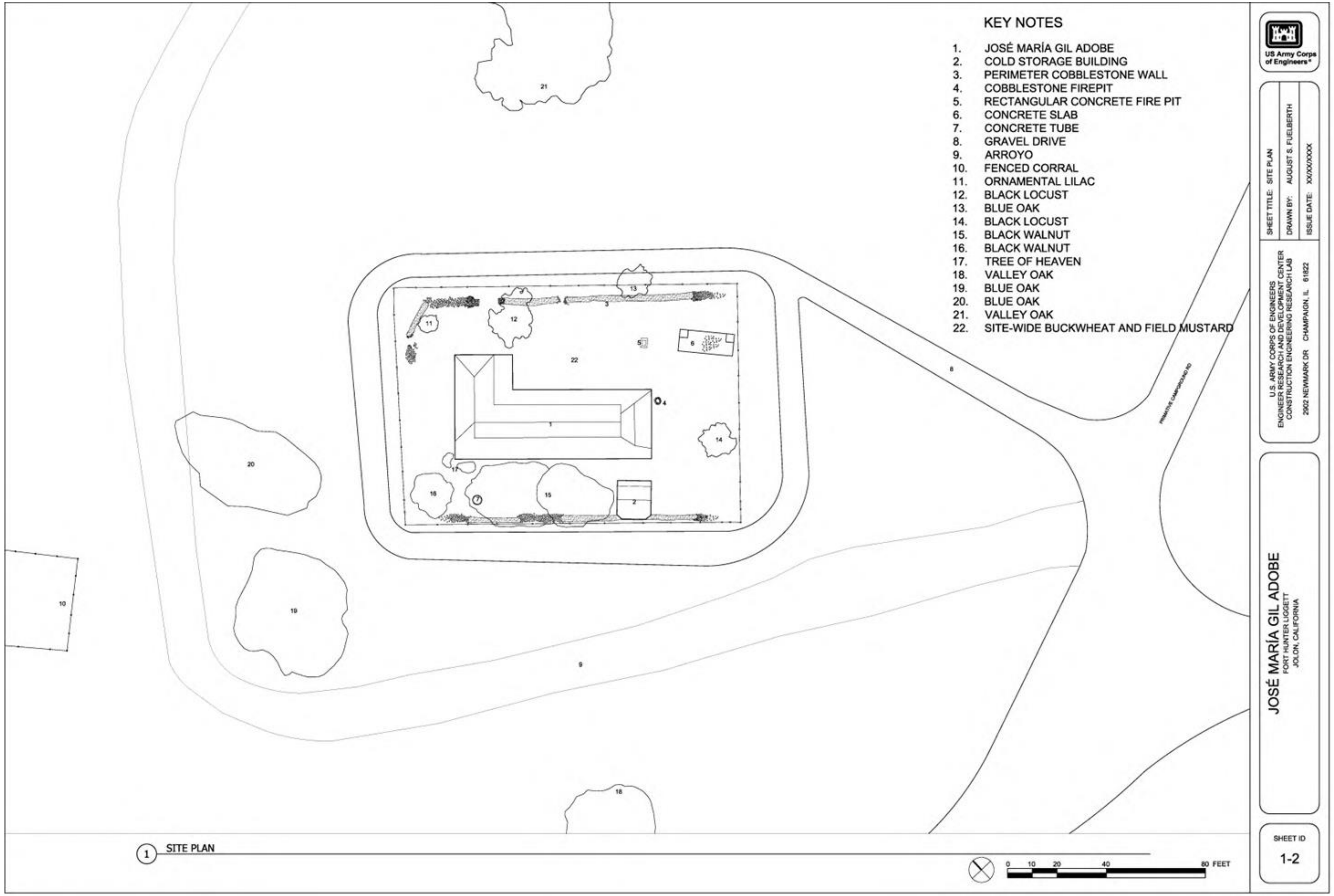

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Figure 32. Arroyo that loops around the west and south side of the site of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 33. Looking west toward fenced corral on the west side of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 34. Gravel drive that lines the fence line of the José María Gil Adobe, 2021. (ERDC-CERL.)

3.1.1 Vegetation

Throughout the site of the José María Gil Adobe are field mustard and buckwheat that were identified by field biologists at the CRM office at Fort Hunter Liggett (Figure 35, Figure 36, and Figure 37).

Figure 35. Field mustard growing in various locations near the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 36. Close-up image of blooming field mustard growing in various locations near the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 37. Buckwheat growing in various locations near the José María Gil Adobe, 2021. (ERDC-CERL.)

3.1.2 Outbuilding

The outbuilding, or cold storage building is the only other building that remains on the fenced-in site of the José María Gil Adobe (Figure 38 and Figure 39). The building is believed to have been constructed during Philip Miller's or William Randolph Hearst's ownership of the property. The 10 × 12 ft structure was constructed from rammed earth (known for its insulating qualities) and once served as a cool house for those that lived in the adobe residence. In 1996, there were some repairs done to prevent wall failure and a rodent infestation. During this restoration, vinyl and Plexiglas were added in the door and window openings to protect the interior of the building (Figure 40 and Figure 41).[50] In 1993, a temporary roof was placed over the original roof (Figure 42).[51] Today, the cold storage building remains near the south corner of the residence next to the cobblestone wall. A rating system has been developed that looks at the condition of material using terms such as "POOR" and "GOOD," referring to the action of giving attention to or leaving as is.

50. Appendix F of "Ongoing Maintenance Activities for the Gil Family Adobe," Integrated Cultural Resources Management Plan, Fort Hunter Liggett, California.

51. Allen and Sanchez, "Adaptive Reuse Study for the Jose Maria Gil Adobe Site."

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Figure 38. Cold storage building existing floor plan, roof plan, and elevations, located south of the José María Gil Adobe, 2022. (Drawn by ERDC-CERL.)

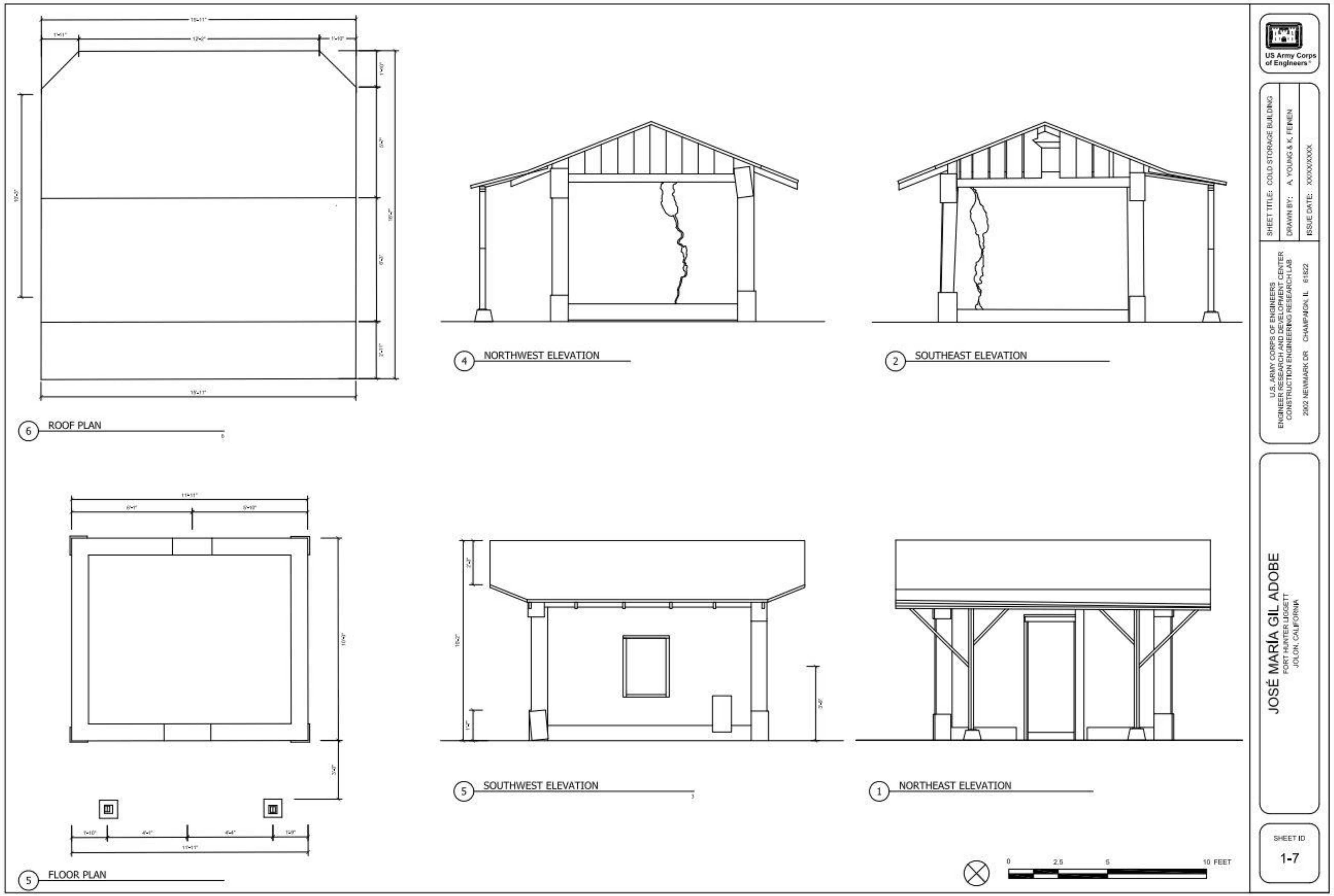

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Figure 39. Looking west at cold storage building located near the south corner of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 40. Plexiglass in the door opening on the northeast side of the cold storage building, 2021. (ERDC-CERL.)

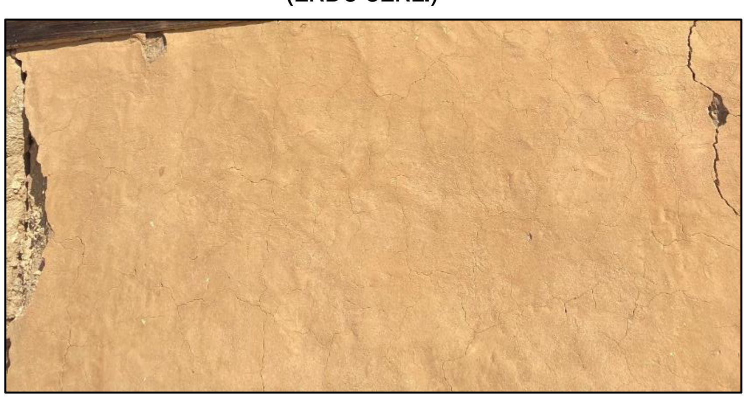
Figure 41. Plexiglass in the window opening on the southwest side of the cold storage building, 2021. (ERDC-CERL.)

Figure 42. Brown asphalt paper on the roof of the cold storage building, 2021. (ERDC-CERL.)

The rammed earth material seen in Figure 43 has been exposed due to a large crack on the southeast side of the cold storage building. The crack was most likely caused by a past earthquake and can be fully seen in Figure 48. The remainder of the rammed earth structure is coated in a plaster that was added during the same time period and of the same kind as the José María Gil Adobe (Figure 44).

Figure 43. Rammed earth material exposed in crack on the southeast side of the cold storage building, 2021. (ERDC-CERL.)

Figure 44. Plaster coating on the cold storage building, 2021. (ERDC-CERL.)



Some wooden elements remain on the exterior of the cold storage building. All wooden elements are in “POOR” condition. In the north and south gable openings there are 1 × 10 in. wooden boards vertically placed (Figure 45). The rammed earth walls do not extend up to the peak of the roof. Under the 22 in. overhang along all but the northeast side are wooden soffits (Figure 46). The northeast side consists of the door opening and a wooden veranda that extends outward 46 in., supported by two wooden posts. The two posts are strengthened by angled brace members in a Y shape that extend in either direction of the posts toward the roof’s middle and edge (Figure 47). The posts are resting on concrete blocks. There are approximately 1 × 10 in. wooden trim boards that line the top and base of the rammed earth structure as well as the vertical corner edges (Figure 48). Some of the wooden trim boards have split, which causes them to appear narrower in some areas. The window on the southwest side of the building has 2 to 3 in. wooden trim boards and sill boards (Figure 49). The door opening on the southwest side of the building has missing and deteriorating wood trim (Figure 47). See Section 10 for the analysis of the outbuilding materials.

Figure 45. Vertically placed boards cladding the gable opening on the north and south sides of the cold storage building, 2021. (ERDC-CERL.)

Figure 46. Wooden soffits under the roof overhang of the cold storage building, 2021. (ERDC-CERL.)

Figure 47. Wooden posts supporting front veranda of the cold storage building, 2021. (ERDC-CERL.)

Figure 48. Wooden trim boards along base and corners of the cold storage building, 2021. (ERDC-CERL.)

Figure 49. Wooden window trim and sill boards on the cold storage building, 2021. (ERDC-CERL.)

3.1.3 Gil Family Cemetery

Northwest of the José María Gil Adobe is the Gil Family Cemetery (Figure 50).

Figure 50. Gil Family Cemetery northwest of the José María Gil Adobe, 2019. (Public domain. Courtesy of Hunter Liggett CRM.)

Buried in the Gil Family Cemetery are four members of the Gil family (Figure 51–Figure 53). Estevan Gil, the son of José María Gil, is not pictured.

3.1.3.1 José María Gil (1821–1892)

Figure 51. Gravesite of José María Gil in the Gil Family Cemetery northwest of the José María Gil Adobe, 2004. (Courtesy of Hunter Liggett CRM. Public domain.)

3.1.3.2 Maria Antonia Avila-Linares Gil (1841–1909)

Figure 52. Gravesite of Maria Gil. (wife of José María Gil) in the Gil Family Cemetery northwest of the José María Gil Adobe, 2004. (Courtesy of Hunter Liggett CRM. Public domain.)

3.1.3.3 Eliza Gil (1861–1876)

Figure 53. Gravesite of Eliza Gil in the Gil Family Cemetery northwest of the José María Gil Adobe, 2004. (Courtesy of Hunter Liggett CRM. Public domain.)

3.2 José María Gil Adobe architectural description

3.2.1 Exterior description

The José María Gil Adobe is a one-story structure constructed with an L-shaped footprint with a hip-and-valley roof that has multiple layers (Figure 54). Originally clad in wood shingles, the Army covered the original roof with green asphalt shingles, then with a cap-like roof clad in green asphalt shingles, then with tarps and temporary brown asphalt paper for protection (Figure 55 and Figure 56). The structural system of the roof is made of wooden members that have been added to and strengthened throughout time with many ages of lumber. A veranda extends around all but the northwest side of the building, originally supported by wooden posts (Figure 57), but now with concrete columns and wooden braces (Figure 58). The veranda floor is made up of 2 × 2 ft concrete pavers, many of which are missing (Figure 59).

Figure 54. Oblique looking west at the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 55. Multiple roof layers showing green asphalt shingles and brown asphalt paper on the south corner of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 56. Multiple layers of roofs on the south end of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 57. Looking northeast along the veranda and at wooden structural components on the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 58. Concrete columns and wooden braces supporting the veranda of the José María Gil Adobe, 2021. (ERDC-CERL.)

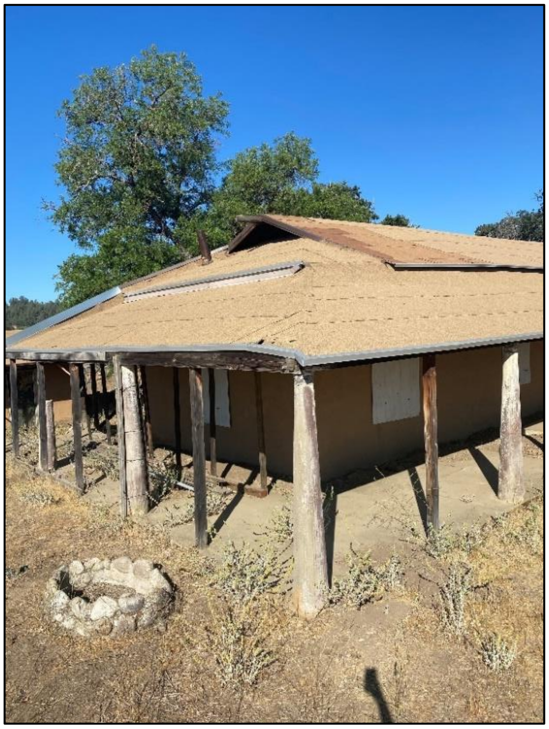


Figure 59. Looking northwest at the concrete veranda floor on the east side of the José María Gil Adobe, 2021. (ERDC-CERL.)

The building is constructed of adobe bricks currently coated in brown plaster (Figure 60). There are many areas on all elevations that the plaster has deteriorated, which has exposed the adobe bricks. The walls were created by hand, resulting in unique and uneven surfaces, a strong characteristic of vernacular architecture (Figure 61).

Figure 60. Plaster coating and exposed adobe brick on the north wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

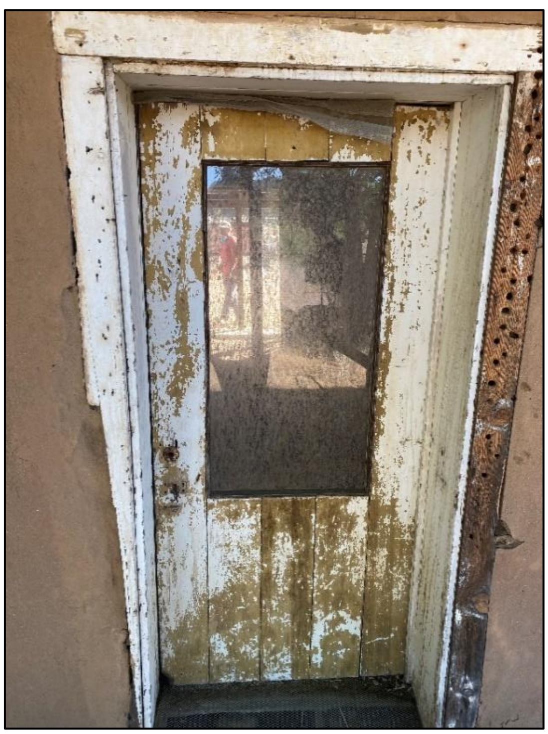
Figure 61. Uneven surface and flare of adobe wall at the base on the north corner of the José María Gil Adobe, 2021. (ERDC-CERL.)

Each elevation has windows and doors that are not the same heights. Most of the window and door openings are approximately the same size; however, different sizes of wooden trim make up the edges of the openings. This is due to breakage over time or the availability of variously sized wooden members throughout the construction process. Originally, the building had six-over-six, wood-sash, double-hung windows, but today, many of the wooden window components are either broken or missing (Figure 62). There are two door types that appear on the José María Gil Adobe, one constructed of vertical boards with an X-shaped frame on the interior and one of vertical boards with a window opening in the center (Figure 63 and Figure 64). All window openings have wooden headers and sills of some form, and all wooden doors have wooden headers and thresholds.

Figure 62. Example of a six-over-six, wood-sash, double-hung wood window that is missing muntins on the east side of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 63. Exterior door type with vertical boards on the southwest side of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 64. Exterior door type with vertical boards and a window on the northwest side of the José María Gil Adobe, 2021. (ERDC-CERL.)



3.2.2 Interior description

The José María Gil Adobe's interior consists of plaster walls with rooms containing various details. Each room appears unique (Figure 65). Rooms either have dirt floors, wood floors, or wood floors heavily coated in dirt and guano appearing as a dirt floor (Figure 66 and Figure 67). Some of the interior walls have wainscoting (beadboard or various board sizes), a chair rail, and paint colors (Figure 68). The north wing of the building has interior additions that were added post 1940 after the Army gained ownership of the property. Wooden partition walls were added to frame a kitchen and bathroom area, as well as shower, toilet, and sink fixtures (Figure 69, Figure 70, and Figure 71). Small electrical sockets can be seen throughout the interior ceiling spaces in various locations (Figure 72). Stovepipe and chimney pipe connections can be seen protruding from both wall and ceiling surfaces (Figure 73).

Figure 65. Looking through a doorway showing two rooms with differing details in the south wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 66. Wooden floor with extensive dirt and guano in the south wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 67. Floor that appears to be dirt due to excessive coverage of dirt and guano in the north wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 68. Wainscoting in the north wing of the José María Gil Adobe, 2021.
(ERDC-CERL.)

Figure 69. Wooden partition walls in the north wing of the José María Gil Adobe, 2021.
(ERDC-CERL.)

Figure 70. Kitchen components in the north wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 71. Shower floor and toilet plumbing connection in the north wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

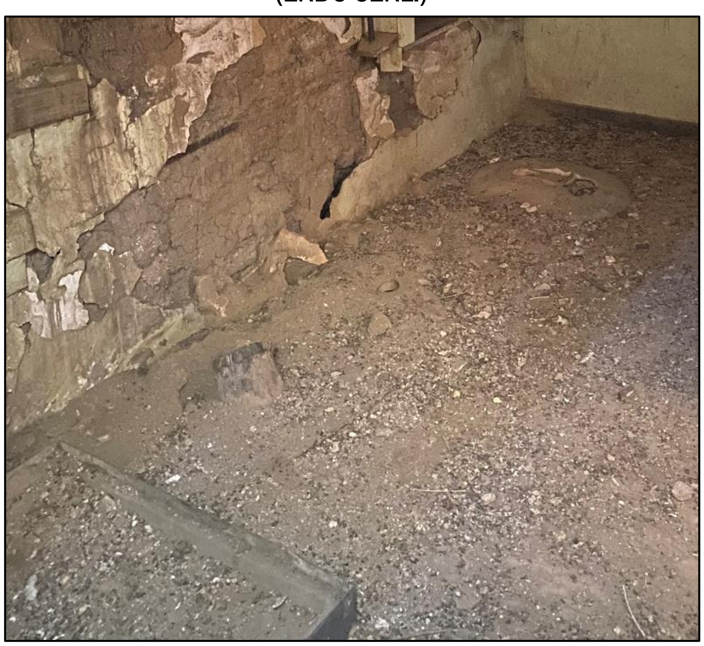


Figure 72. Electrical sockets on ceilings of various rooms of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 73. Existing stovepipe connection protruding from inner ceiling edge in the José María Gil Adobe, 2021. (ERDC-CERL.)

3.3 Current condition drawings

The following AutoCAD drawings were created from 3D-point clouds taken in 2020 (Figure 74–Figure 77).

Figure 74. Existing building floor plan of the José María Gil Adobe, 2022. (Drawn by ERDC-CERL.)

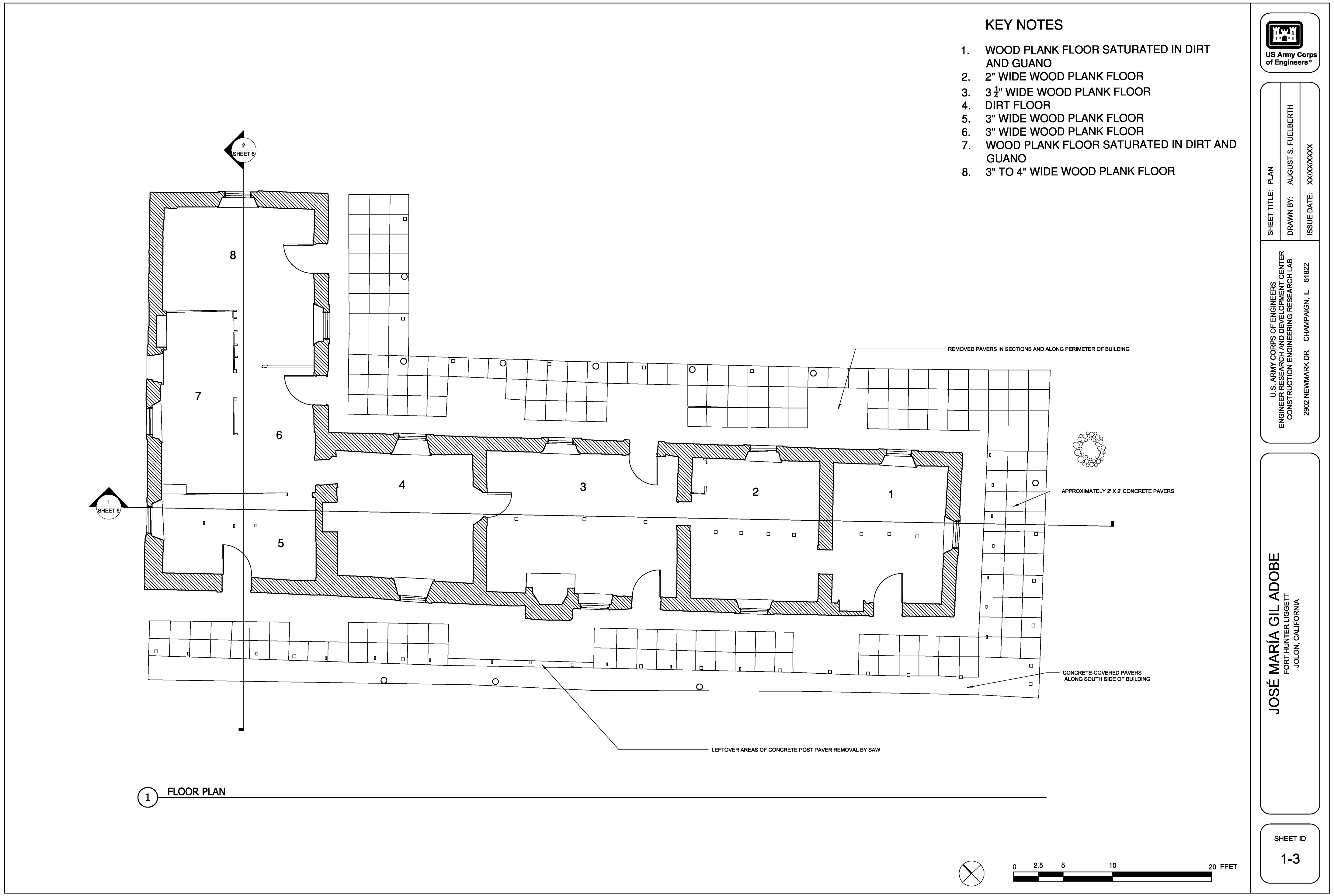
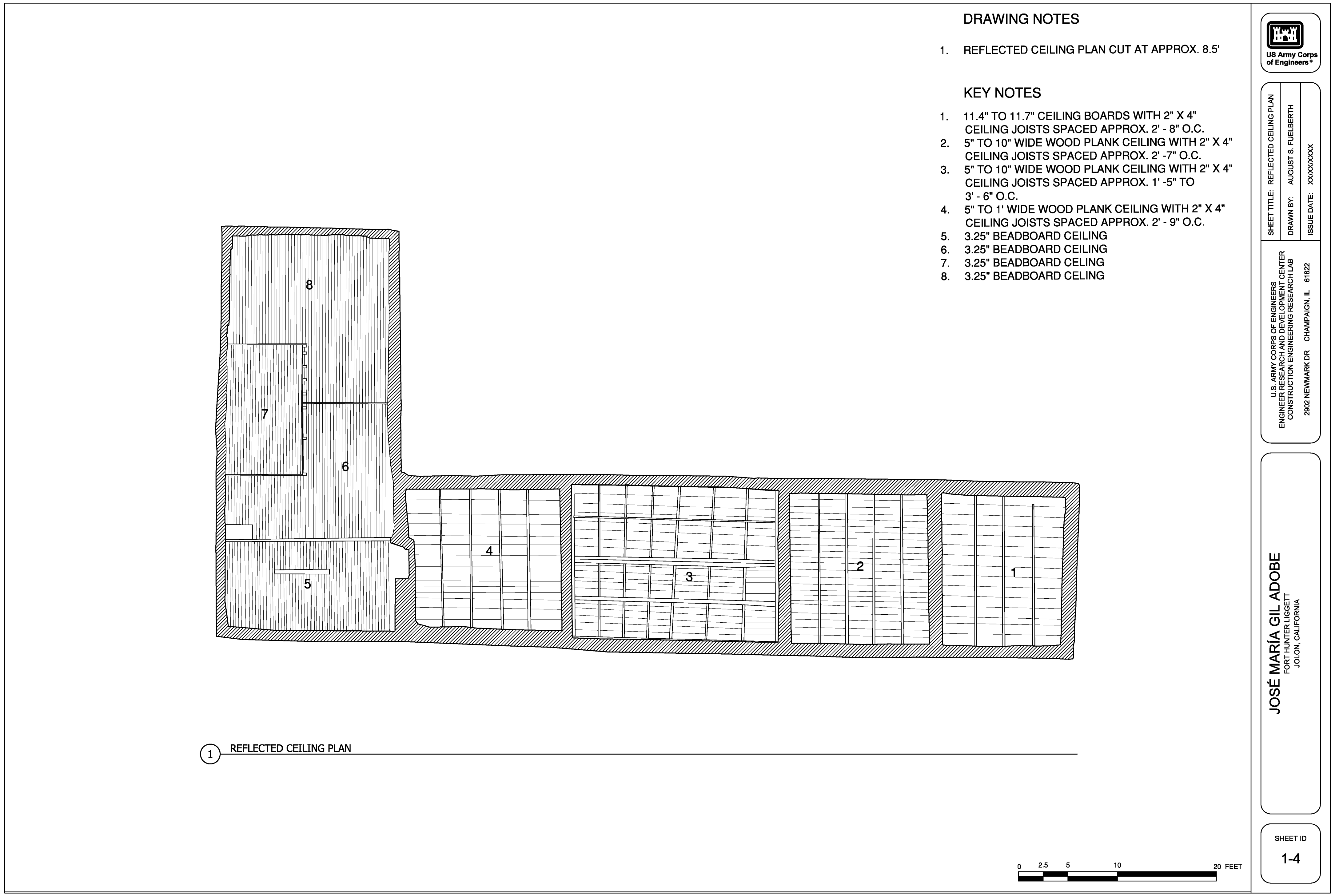


Figure 75. Existing building elevations of the José María Gil Adobe, 2022. (Drawn by ERDC-CERL.)

Figure 76. Existing building sections of the José María Gil Adobe, 2022. (Drawn by ERDC-CERL.)

Figure 77. Existing building reflected ceiling plan of the José María Gil Adobe, 2022. (Drawn by ERDC-CERL.)



3.4 Archeological study acknowledgement

An archaeological investigation was prepared by Rebecca Allen of BioSystems Analysis Inc. of Santa Cruz, California, in January of 1995. The purpose of the study was to provide insight into the construction of the adobe. Researchers were able to locate information on the José María Gil Adobe's foundation and porch that suggested when certain additions may have been constructed.[52]

There were also artifacts found on the site that give us insight into the lives of early settlers of the area or potentially the lives of the Gil family. Many bottles and broken pottery were found within the excavation units proving that the site was used during the early 1800s.

3.5 Construction stages

It is common for historic adobes to have been built in stages that included many additions or changes. Considering the age of the José María Gil Adobe, documenting the construction stages teaches us about the methods and materials used. In the earliest documentation of the José María Gil Adobe, we know that José María Gil lived in an adobe structure on the land that is now Fort Hunter Liggett. There are two theories: one, that a small adobe structure existed when José María Gil acquired the land, and two, that José María Gil constructed the small adobe structure. This structure was not constructed in the same L-shaped footprint that we see today.

Through illustration, these stages visually present what the building may have looked like in each stage of its life.

3.5.1 Stage 1

A floor plan of the José María Gil Adobe was developed based on 3D scan data. This floor plan captures multiple wall thicknesses, which is one indication of multiple construction stages. Seen in Figure 78, the highlighted portion of the floor plan has thicker walls, measuring

52. Daryl Allen, Rebecca Allen, and Gil Sanchez, "Adaptive Reuse Study for the Jose Maria Gil Adobe Site," January 1995, Records of the Cultural Resources Management Office (CRM), Fort Hunter Liggett Military Installation, California.

approximately 2 ft thick. The remainder of the building's walls measure approximately 16 in.

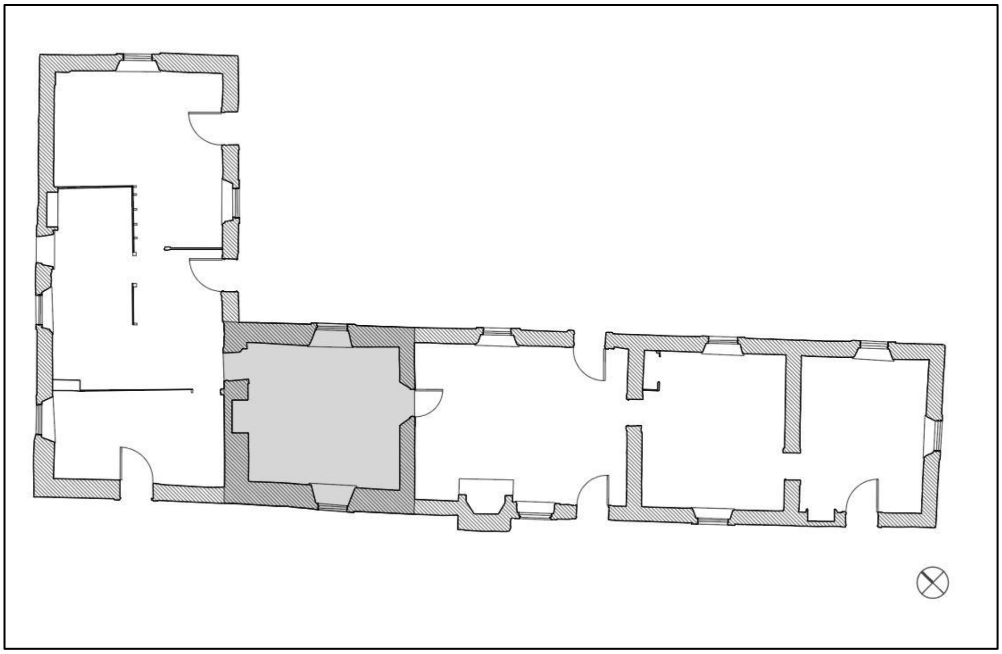
An interior fireplace is located in what is thought to be the original room of the José María Gil Adobe. Around 1850, interior fireplaces were introduced into small adobe residences in Monterey County. The fireplace is approximately 3 × 3 ft thick. Previously discussed in Section 2.2.2, the José Eusebio Boronda Adobe also has an interior fireplace that measures approximately 2 ½ × 3 ft. This consistency in size is valuable information because both adobes are documented as having been built around the same time that interior fireplaces were introduced in Monterey County.

The height of the windows (facing northeast and southwest) in what is thought to be the original room differs from the remainder of the windows throughout the building. It is likely that this room originally had a dirt floor, so the window openings were constructed based on the grade. The rooms constructed at a later date have wooden floors, so the window heights were likely based on the floor heights.

The floor plan of what may be the original room shows the approximately 2 ft thick walls on all three walls but the southern wall. The southern wall matches the approximate 16 in. wall thickness that is seen in the rooms added at a later date. There is evidence of adobe brick placed to interlock the new room to the preexisting structure.[53]

53. Allen and Sanchez, "Adaptive Reuse Study for the Jose Maria Gil Adobe Site."

Figure 78. Illustration highlighting what could be the original room of the José María Gil Adobe based on its wall thickness. (Drawn by ERDC-CERL, 2022.)



3.5.2 Stage 2

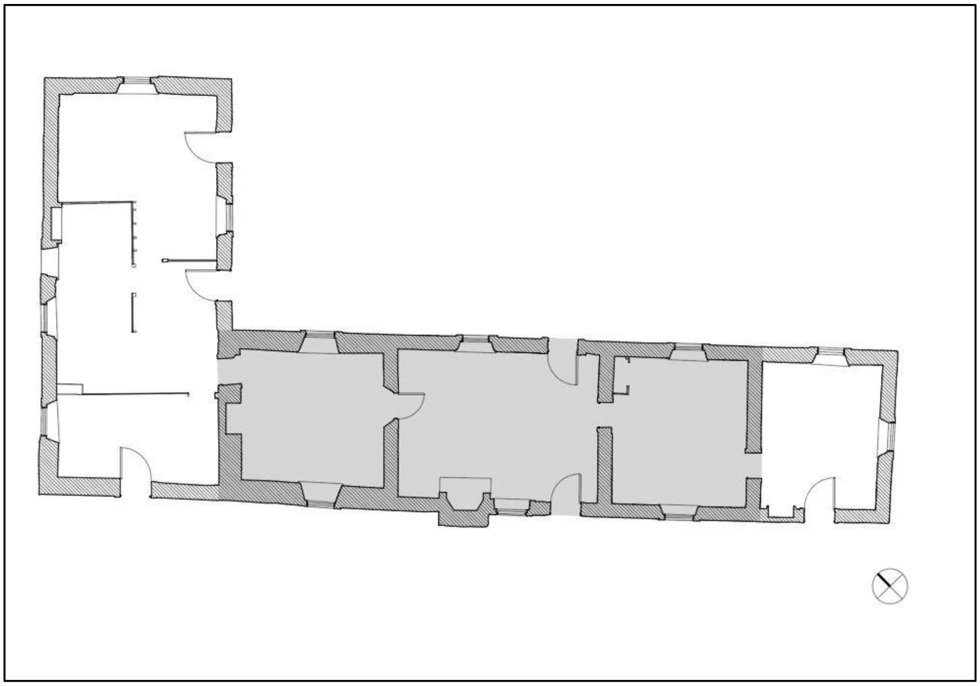
It is unknown when the second addition of the José María Gil Adobe was constructed, but it is likely that José María Gil constructed it as his family expanded (Figure 79).

In addition to a smaller wall thickness, two key pieces of evidence suggesting this are that the floor is lower and the window openings are higher.

It is unknown if the chimney on the southwest wall was added at the same time as this addition.

The nail types discovered were used to determine when this addition was constructed. A common type of nail that was used in the late 1800s construction was *cut nails*. This name derives from how the nails were made, as they were cut from rolled pieces of iron. Cut nails were found in this addition, suggesting that this room was constructed in the late 1800s. In the southernmost room of this addition, there is wainscoting assembled with the use of cut nails.[54] It is likely that José María Gil constructed this addition sometime before his death in 1892.

Figure 79. Illustration highlighting what could be the second addition (also showing original room) of the José María Gil Adobe based on its wall thickness, floor and window height, foundation, and other findings. (Drawn by ERDC-CERL, 2022.)



3.5.3 Stage 3

It is unknown when the third stage of construction took place, but it likely occurred during José María Gil's ownership of the adobe before his death in 1892 (Figure 80). The construction of this addition would have taken place shortly or soon after the previous addition was constructed.

The wall thickness, door size, and window sizes match those of stage 2.

A common feature of all of the rooms that have been constructed up to this point is a cobblestone foundation; however, in this addition, the foundation was made up of two courses of stone, making the elevation about 2 ½ in. lower than the other rooms. This suggests that this room was constructed at a later date than the previous rooms.

54. Allen and Sanchez, "Adaptive Reuse Study for the Jose Maria Gil Adobe Site."

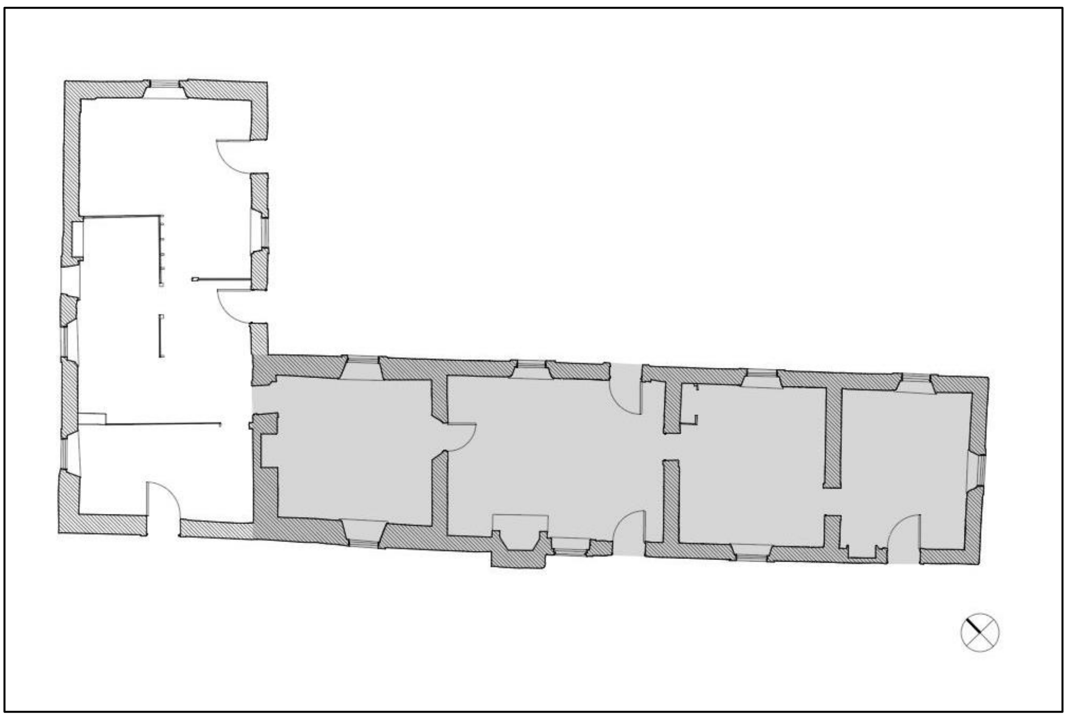
There is also evidence of a cold joint (or a joint that shows an addition) that connects the south room of stage 2 and the room in stage 3, which also suggests that it was an addition.

The flooring also suggests that the room was constructed at a different time, as the flooring runs east to west rather than the north to south flooring like in the other rooms constructed at a previous date.

The room also contains an early rim knob lock that could date to around 1865.[55]

The four rooms constructed up to this point are believed to be the rooms constructed while José María Gil owned the adobe.

Figure 80. Illustration highlighting what could be the third addition. (as well as previous additions) of the José María Gil Adobe based on its wall thickness, floor height, and foundation, 2021. (Drawn by ERDC-CERL.)



55. Allen and Sanchez, "Adaptive Reuse Study for the Jose Maria Gil Adobe Site."

3.5.4 Stage 4

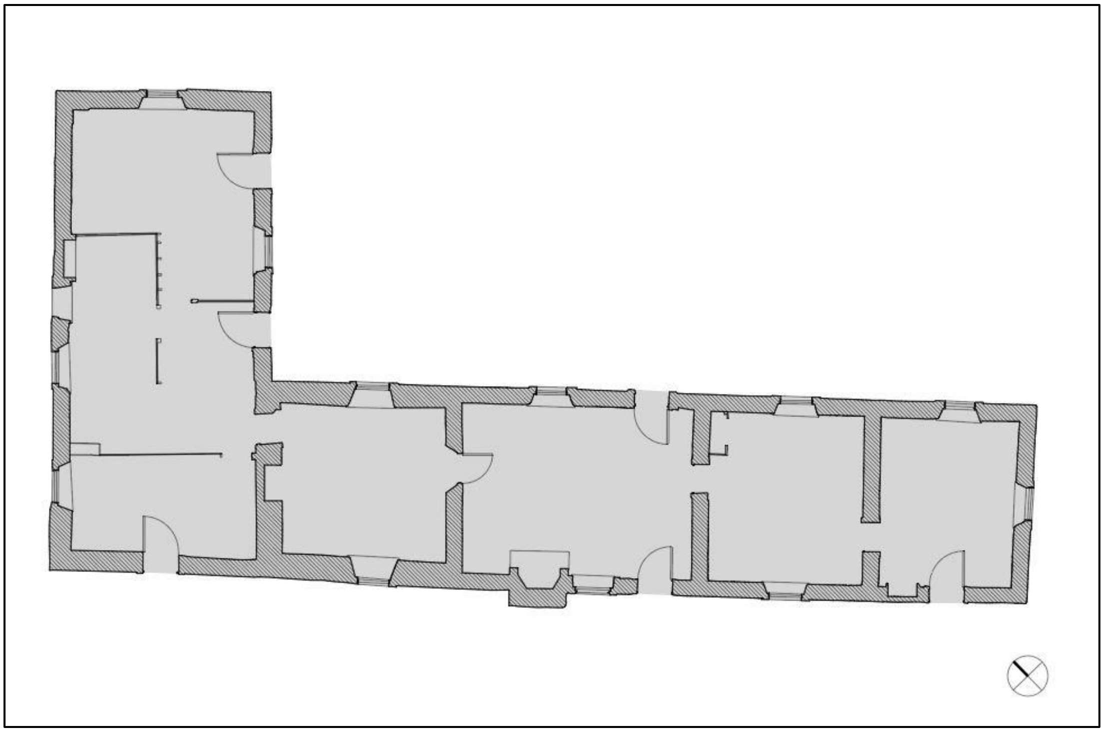
Stage 4, which is referred to as the north wing, is the last addition that makes up the L-shaped building footprint that we see today (Figure 81). Similar to the other additions, the exact construction date is unknown.

A key difference between this wing and the south wing is that this addition has a wooden foundation. The south wing has a cobblestone foundation. This addition rests on 1 in. thick board which can be seen in Figure 103 in Section 6.1. This major change in foundation type suggests a later construction date. Cobblestones were used as a foundation as their use was a Spanish tradition. Since this wing has a wooden foundation, this suggests that the north wing was added after the Gil family sold the adobe and the property.

It is likely that the north wing was constructed during the early 1900s when Dr. Peter K. Watters or Philip Miller owned the adobe, before William Randolph Hearst acquired the ranch in the late 1920s. It is highly unlikely that Hearst would have constructed an addition of this size, as he mainly used the buildings that were left on the land to house ranch hands.[56]

56. Refer back to Section 2.3.5 for more information.

Figure 81. Illustration highlighting what could be the fourth addition. (as well as previous additions) of the José María Gil Adobe based on its wall thickness, floor height, and foundation, 2021. (Drawn by ERDC-CERL.)

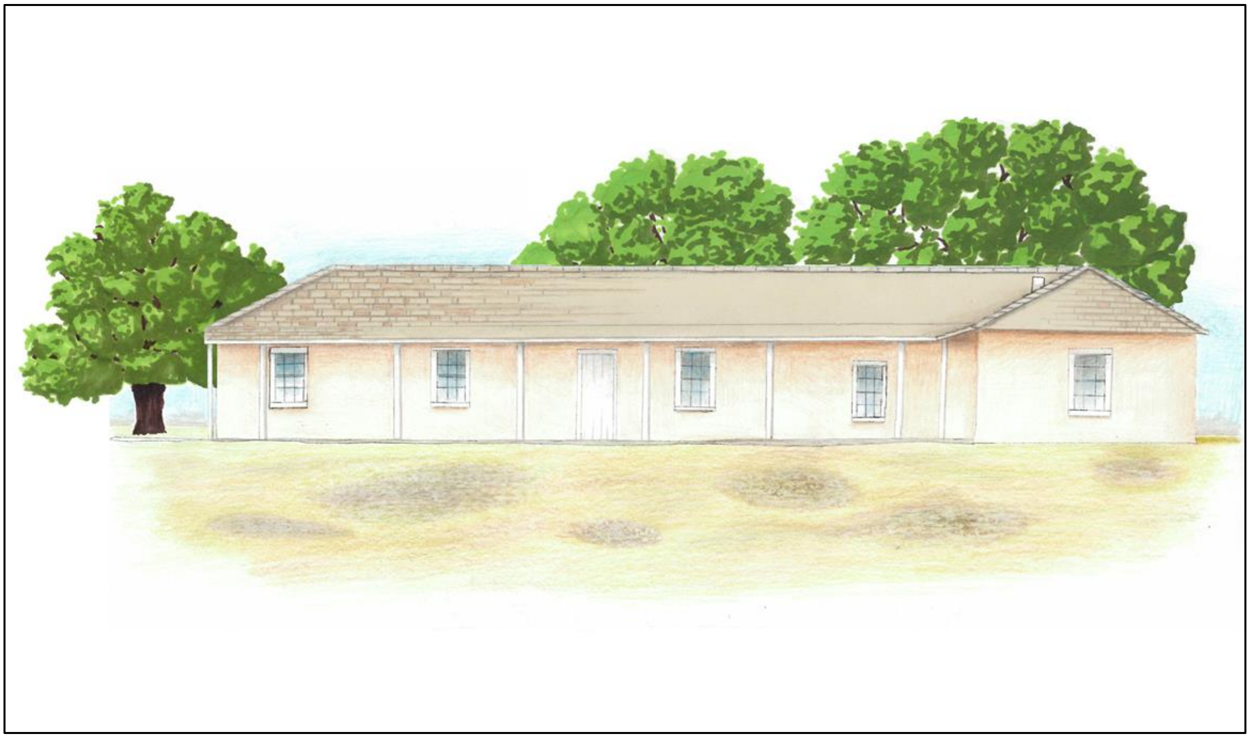


3.5.5 Stage 5

Once the José María Gil Adobe's footprint reached an L-shape, no other major additions were constructed. Archeological evidence suggests that the porch was originally located (in an L-shape) on only the northeast, southeast, and southwest elevations of the adobe and extended out 4 ft (Figure 82). The original porch had redwood joists that ran from the southeast to the northeast that were found under the concrete pavers that remain. They are similar to the joists that are found under the room south of the original room, so the porch was likely constructed near the end of the 19th century.[57]

57. Allen and Sanchez, "Adaptive Reuse Study for the Jose Maria Gil Adobe Site."

Figure 82. Elevation rendering of the José María Gil Adobe showing what the building may have looked like before the Army purchased the land in 1940, 2021. (Illustrated by ERDC-CERL.)



3.5.6 Stage 6

For the last century, the building has survived but has undergone many changes, such as an altered veranda, replacement columns, porch additions, and multiple layers of roofing. Before the Army acquired the building in 1940, the building most likely had its shorter veranda, redwood shingle-clad roof, and wooden veranda posts (Figure 82). The date of the wooden posts' replacement is unknown.

As discussed previously in Section 2.3.6, the Army modified the José María Gil Adobe for use as a BOQ. It is unclear whether or not the new concrete porch was poured or the porch veranda was extended before or after this period. The Army also clad the roof in green asphalt shingles (Figure 83 and Figure 84).

Figure 83. Elevation rendering of the José María Gil Adobe showing what the building may have looked like after the Army purchased the land in 1940, 2021. (Illustrated by ERDC-CERL.)

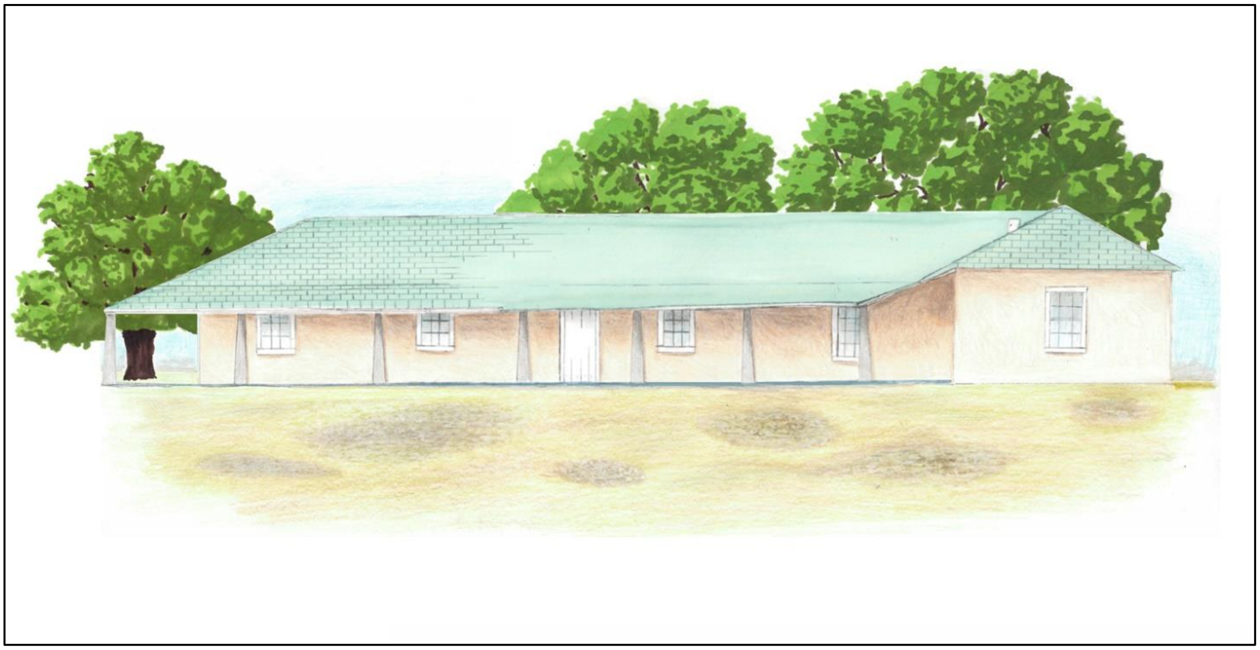


Figure 84. Perspective rendering of the José María Gil Adobe showing what the building may have looked like after the Army purchased the land in 1940, 2021. (Illustrated by ERDC-CERL.)

Once the Army made these changes soon after purchasing the José María Gil Adobe, the building slowly started to deteriorate. Refer back to the stabilization and mothballing activities discussed in Section 2.3.6.

4 Stage III: Building Zones

Building zones establish the framework for planning the operation, maintenance, and rehabilitation of an individual building by dividing the building into logical areas consistent with their use, original design, public access, and integrity. The concept of zoning, while establishing a logical framework, is also consistent with techniques of original architectural programming, design, and construction.

The zoning of the building seeks to identify the differences between more and less architecturally and historically significant interior and exterior building areas and assigns a numerical rating, or level, to each zone. The zone ratings establish management and treatment requirements for each zone (i.e., highly significant public spaces may be in a “preservation zone” where maintenance is tightly controlled, and replacements are restricted). At the other end of the spectrum, larger, more private work areas may be subject to normal maintenance and open to a much broader range of architectural modification. The treatment guidelines for each level convey the general principles of preservation to be applied within the zone.

The six zones are as follows:

- Level 1—Preservation Zone (Red)
- Level 2—Preservation Zone (Yellow)
- Level 3—Rehabilitation Zone (Green)
- Level 4—Free Zone (White)
- Level 5—Rehabilitation Zone (Green)
- Level 6—Impact Zone (Red Stripes)

The José María Gil Adobe has two zones.

4.1 Level 1—Preservation zone

This zone describes areas that exhibit distinguishing qualities or original materials and features or that represent examples of skilled craftsmanship. Throughout the José María Gil Adobe, there are features that are original. Such features include original adobe bricks and wooden elements within the building as well as elements that have been added throughout the construction stages. These materials represent significant practices of historic Californian adobe construction.

GUIDELINE: Preservation should be considered to ensure the José María Gil Adobe's integrity.

4.2 Level 3—Rehabilitation zone

This zone includes rehabilitation information to allow for certain materials throughout the José María Gil Adobe to be repaired in-kind to a certain stage of the building's life. Significant stages are described in Section 3.5.

GUIDELINE: Rehabilitation is encouraged to bring back the qualities, aesthetics, and functions of certain characteristics and materials within the José María Gil Adobe to allow for a representation of Californian adobe construction.

5 Stage IV: Adobe and Plaster Coatings

5.1 Exterior adobe and plaster coatings

Adobe as a construction material is made entirely from natural elements. The José María Gil Adobe is constructed in adobe bricks of various sizes, some appearing smaller due to breakage. Because the adobe bricks are coated in plaster as a protective layer, the bricks were not laid based on aesthetics. Due to neglect, there are areas of the building where plaster has deteriorated, exposing adobe brick (Figure 85, Figure 86, and Figure 87).

Figure 85. Exposed adobe bricks and mortar on the José María Gil Adobe, 2021. (ERDC-CERL.)

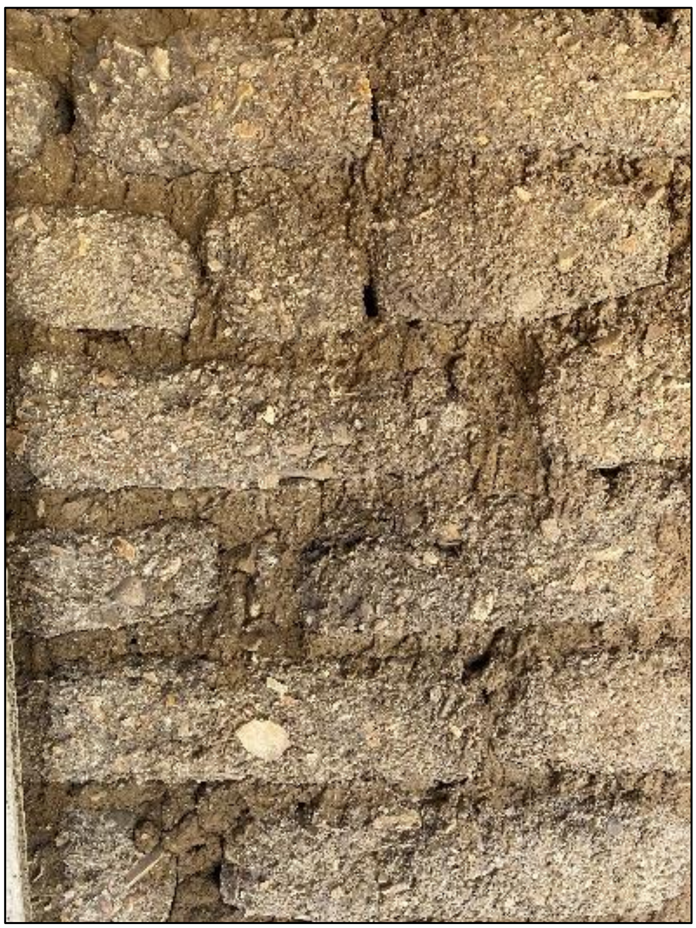


Figure 86. Large section of adobe brick between a door and window on the southeast side of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 87. Large section of adobe brick around two windows on the northwest side of the José María Gil Adobe, 2021. (ERDC-CERL.)

The current brown, exterior plaster was added at an unknown date (Figure 88).

Figure 88. Exterior, brown plaster on the northwest side of the José María Gil Adobe, 2021. (ERDC-CERL.)

5.2 Interior adobe and plaster coatings

The José María Gil Adobe has interior plaster that coats the adobe brick. Much of the plaster has been painted a pale green. The plaster and paint are in "POOR" condition. The paint and plaster are cracked and peeling in many locations, exposing interior adobe and wooden features (Figure 89 and Figure 90). Some plaster walls are still intact on the interior and are exposed by peeling paint (Figure 91).

Figure 89. Cracked plaster and paint exposing adobe brick in the south wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 90. Cracked plaster and paint exposing wooden elements in the south wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 91. Intact plaster with peeling paint in the south wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

5.3 Treatment measures

The following images and documents offer treatment measures for exterior and interior adobe brick and plaster surfaces that are in "POOR" condition. The sources include information from the National Park Service and *Adobe Conservation: A Preservation Handbook*.

5.3.1 Preservation Brief 5, *Preservation of Historic Adobe Buildings*, 1978[58]

5 PRESERVATION BRIEFS

Preservation of Historic Adobe Buildings

U.S. Department of the Interior
National Park Service
Cultural Resources
Heritage Preservation Services

Whether built in the 17th century or in the 20th century, adobe buildings share common problems of maintenance and deterioration. This brief discusses the traditional materials and construction of adobe buildings and the causes of adobe deterioration. It also makes recommendations for preserving historic adobe buildings. By its composition, adobe construction is inclined to deteriorate; however, the buildings can be made durable and renewable when properly maintained.

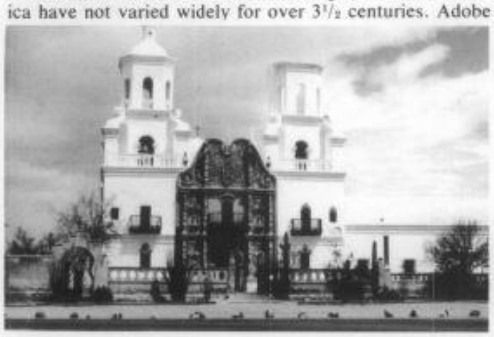
What is Adobe?

The adobe, or sun-dried brick, is one of the oldest and most common building materials known to man. Traditionally, adobe bricks were never kiln fired. Unbaked adobe bricks consisted of sand, sometimes gravel, clay, water, and often straw or grass mixed together by hand, formed in wooden molds, and dried by the sun. Today some commercially available adobe-like bricks are fired. These are similar in size to unbaked bricks, but have a different texture, color, and strength. Similarly some adobe bricks have been stabilized, containing cement, asphalt, and/or bituminous materials, but these also differ from traditional adobe in their appearance and strength.

Traditional adobe construction techniques in North America have not varied widely for over 3½ centuries. Adobe building methods employed in the Southwest in the 16th century are still used today. Because adobe bricks are not fired in a kiln as are clay bricks, they do not permanently harden, but remain unstable—they shrink and swell constantly with their changing water content. Their strength also fluctuates with their water content: the higher the water content, the lower the strength.

Adobe will not permanently bond with metal, wood, or stone because it exhibits much greater movement than these other materials, either separating, cracking, or twisting where they interface. Yet, many of these more stable building materials such as fired brick, wood, and lime and cement mortars are nonetheless used in adobe construction. For example, stone may be used for a building's foundation, and wood may be used for its roof or its lintels and doorways. In the adobe building, these materials are generally held in place by their own weight or by the compressive weight of the wall above them. Adobe construction possibilities and variations in design have therefore been somewhat limited by the physical constraints of the material.

Preserving and rehabilitating a deteriorated adobe building is most successful when the techniques and methods used for restoration and repairs are as similar as possible to the techniques used in the original construction.



SAN XAVIER DEL BAC, TUCSON VICINITY, ARIZONA. *Built entirely of adobe construction (1783–1797), this is one of the finest Spanish Colonial churches in the United States, having an elaborate frontispiece of molded, carved, and painted brick imitating stone. (National Park Service)*

Adobe Construction Techniques

The Brick: The adobe brick is molded from sand and clay mixed with water to a plastic consistency. Commonly, straw or grass is included as a binder. Although they do not help reinforce the bricks or give them added long-term strength, straw and grass do help the bricks shrink more uniformly while they dry. More important for durability, however, is the inherent clay-to-sand ratio found in native soil. The prepared mud is placed in wooden forms, tamped, and leveled by hand. The bricks are then "turned-out" of the mold to dry on a level surface covered with straw or grass so that the bricks will not stick. After several days of drying, the adobe bricks are ready for air-curing. This consists of standing the bricks on end for a period of 4 weeks or longer.

Mortar: Historically, most adobe walls were composed of adobe bricks laid with mud mortar. Such mortar exhibited the same properties as the bricks: relatively weak and susceptible to the same rate of hygroscopic (moisture absorptive) swelling and shrinking, thermal expansion and contrac-

58. This section reproduces de Teel Patterson Tiller and David W. Look, *Preservation of Historic Adobe Buildings,* Preservation Brief 5 (Washington, DC: National Park Service, 1978), https://www.nps.gov/orgs/1739/upload/preservation-brief-05-adobe.pdf. Public domain.

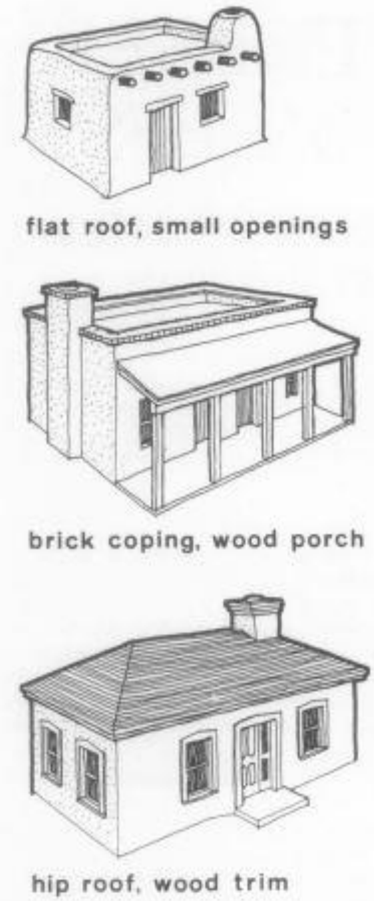
tion, and deterioration. Consequently, no other material has been as successful in bonding adobe bricks. Today, cement and lime mortars are commonly used with stabilized adobe bricks, but cement mortars are incompatible with unstabilized adobe because the two have different thermal expansion and contraction rates. Cement mortars thereby accelerate the deterioration of adobe bricks since the mortars are stronger than the adobe.

Building Foundations: Early adobe building foundations varied because of the difference in local building practices and availability of materials. Many foundations were large and substantially constructed, but others were almost nonexistent. Most often, adobe building foundations were constructed of bricks, fieldstones, or cavity walls (double) infilled with rubble stone, tile fragments, or seashells. Adobe buildings were rarely constructed over basements or crawlspaces.

Walls: Since adobe construction was load-bearing with low structural strength, adobe walls tended to be massive, and seldom rose over 2 stories. In fact, the maximum height of adobe mission churches in the Southwest was approximately 35 feet. Often buttresses braced exterior walls for added stability.

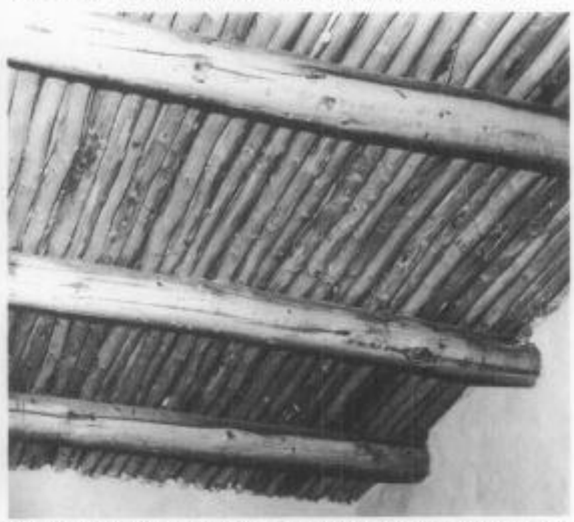
In some parts of the Southwest, it was common to place a long wooden timber within the last courses of adobe bricks. This timber provided a long horizontal bearing plate for the roof thereby distributing the weight of the roof along the wall.

Roofs: Early Southwest adobe roofs (17th–mid–19th centuries) tended to be flat with low parapet walls. These roofs consisted of logs which supported wooden poles, and which in turn supported wooden lathing or layers of twigs covered with packed adobe earth. The wood was aspen, mesquite, cedar, or whatever was available. Roughly dressed logs (called "*vigas*") or shaped squared timbers were spaced on close (2–3 feet or less) centers resting either on the horizontal wooden member which topped the adobe wall, or on decorated cantilevered blocks, called "corbels," which were set into the adobe wall. Traditionally, these *vigas* often projected through the wall facades creating the typical adobe



Evolution of Roof Forms. *The roofs of early adobe buildings were flat, made with mud, with low parapets. Later, brick copings were placed on top of parapets and chimneys to protect them from erosion, and shed roof porches were added to shelter doors and windows. After the railroad reached the Southwest, hip roofs and wooden trim began to appear as sawn lumber, shingles, tile, and sheet metal became available. (Drawing by Albert N. Hopper)*

Roof Bearing. *A roof bearing timber placed within the adobe walls provides even support for the weight of the roof. (Farm Security Administration Collection, Library of Congress)*



Roof Framing. *Viga logs and savinos are seen in the interior of the adobe building. Often the wooden materials that compose the traditional flat adobe roof create interesting and pleasing patterns on the ceilings of the interior rooms. (Photo by Russell Lee, Farm Security Administration Collection, Library of Congress)* construction detail copied in the 20th-century revival styles. Wooden poles about 2 inches in diameter (called "*latias*") were then laid across the top of the *vigas*. Handsplit planks (called "*cedros*" if cedar and "*savinos*" if cypress) instead of poles were used when available. In some areas, these were laid in a herringbone pattern. In the west Texas and Tucson areas, *saguaro* (cactus) ribs were used to span between *vigas*. After railroad transportation arrived in most areas, sawn boards and planks, much like roof sheathing, became available and was often used in late-19th- and early-20th-century buildings or for repairs to earlier ones.

Next cedar twigs, plant fibers, or fabric were placed on top of the poles or planks. These served as a lathing on which the 6 or more inches of adobe earth was compacted. If planks were used, twigs were not necessary. A coating of adobe mud was then applied overall. The flat roofs were sloped somewhat toward drains of hollowed logs (called "*canales*," or "*gargolas*"), tile, or sheet metal that projected through the parapet walls.

Gable and hipped roofs became increasingly popular in adobe buildings in the 19th and 20th centuries. "Territorial" styles and preferences for certain materials developed. For example, roof tiles were widely used in southern California. Although the railroad brought in some wooden shingles and some terra-cotta, sheet metal roofing was the prevalent material for roofs in New Mexico.

Floors: Historically, flooring materials were placed directly on the ground with little or no subflooring preparation. Flooring materials in adobe buildings have varied from earth to adobe brick, fired brick, tile, or flagstone (called "*lajas*"), to conventional wooden floors.

Traditional Surface Coatings

Adobe surfaces are notoriously fragile and need frequent maintenance. To protect the exterior and interior surfaces of new adobe walls, surface coatings such as mud plaster, lime plaster, whitewash, and stucco have been used. Such coatings applied to the exterior of adobe construction have retarded surface deterioration by offering a renewable surface to the adobe wall. In the past, these methods have been inexpensive and readily available to the adobe owner as a solution to periodic maintenance and visual improvement. However, recent increases in labor costs and changes in cultural and socio-economic values have caused many adobe building owners to seek more lasting materials as alternatives to these traditional and once-inexpensive surface coatings.

Mud Plaster: Mud plaster has long been used as a surface coating. Like adobe, mud plaster is composed of clay, sand, water, and straw or grass, and therefore exhibits sympathetic properties to those of the original adobe. The mud plaster bonds to the adobe because the two are made of the same materials. Although applying mud plaster requires little skill, it is a time-consuming and laborious process. Once in place, the mud plaster must be smoothed. This is done by hand; sometimes deerskins, sheepskins, and small, slightly rounded stones are used to smooth the plaster to create a "polished" surface. In some areas, pink or ochre pigments are mixed into the final layer and "polished."

Whitewash: Whitewash has been used on earthen buildings since before recorded history. Consisting of ground gypsum rock, water, and clay, whitewash acts as a sealer, which can be either brushed on the adobe wall or applied with large pieces of coarse fabric such as burlap.

Initially, whitewash was considered inexpensive and easy to apply. But its impermanence and the cost of annually renewing it has made it less popular as a surface coating in recent years.

Lime Plaster: Lime plaster, widely used in the 19th century as both an exterior and interior coating, is much harder than mud plaster. It is, however, less flexible and cracks easily. It consists of lime, sand, and water and is applied in heavy coats with trowels or brushes. To make the lime plaster adhere to adobe, walls are often scored diagonally with hatchets, making grooves about 1½ inches deep. The grooves are filled with a mixture of lime mortar and small chips of stone or broken roof tiles. The wall is then covered heavily with the lime plaster.

Cement Stucco: In the United States, cement stucco came into use as an adobe surface coating in the early 20th century for the revival styles of Southwest adobe architecture. Cement stucco consists of cement, sand, and water and it is applied with a trowel in from 1 to 3 coats over a wire mesh nailed to the adobe surface. This material has been very popular because it requires little maintenance when applied over fired or stabilized adobe brick, and because it can be easily painted.

It should be noted however, that the cement stucco does not create a bond with unfired or unstabilized adobe; it relies on the wire mesh and nails to hold it in place. Since nails cannot bond with the adobe, a firm surface cannot be guaranteed. Even when very long nails are used, moisture within the adobe may cause the nails and the wire to rust, thus, losing contact with the adobe.

Other Traditional Surface Coatings: These have included items such as paints (oil base, resin, or emulsion), portland cement washes, coatings of plant extracts, and even coatings of fresh animal blood (mainly for adobe floors). Some of these coatings are inexpensive and easy to apply, provide temporary surface protection, and are still available to the adobe owner.

Adobe Deterioration

When preservation or rehabilitation is contemplated for a historic adobe building, it is generally because the walls or roof of the building have deteriorated in some fashion—walls may be cracked, eroded, pitted, bulging, or the roof may be sagging. In planning the stabilization and repair of an adobe building, it is necessary:

- To determine the nature of the deterioration
- To identify and correct the source of the problem causing the deterioration
- To develop rehabilitation and restoration plans that are sensitive to the integrity of the historic adobe building
- To develop a maintenance program once the rehabilitation or restoration is completed.

General Advice: There are several principles that when followed generally result in a relatively stable and permanent adobe resource.

1. Whenever possible, secure the services or advice of a professional architect or other preservationist proficient in adobe preservation and stabilization. Although this may be more costly than to "do-it-yourself," it will probably be less expensive in the long run. Working with a deteriorated adobe building is a complex and difficult process. Irreversible damage may be done by well-meaning but inexperienced "restorationists." Moreover, professional assistance may be required to interpret local code requirements.
2. Never begin restoration or repairs until the problems that

Deteriorated Adobe Building. *By virtue of its fragile nature, the adobe building must be restored by thorough, systematic, and professional measures that will insure its future survival. (Technical Preservation Services Division)*

Structural Damage and Cracking. *Sagging, bulging, and cracking of walls and roofs are signs of serious problems in the adobe building. It is always advisable to secure professional services in the repair of such problems. (National Park Service)*

have been causing the deterioration of the adobe have been found, analyzed, and solved. For instance, sagging or bulging walls may be the result of a problem called "rising damp" and/or excessive roof loads. Because adobe deterioration is almost always the end product of a combination of problems, it takes a trained professional to analyze the deterioration, identify the source or sources of deterioration, and halt the deterioration before full restoration begins.

3. Repair or replace adobe building materials with the same types of materials used originally and use the same construction techniques. Usually the best and the safest procedure is to use traditional building materials. Repair or replace deteriorated adobe bricks with similar adobe bricks. Repair or replace rotted wooden lintels with similar wooden lintels. The problems created by introducing dissimilar replacement materials may cause problems far exceeding those which deteriorated the adobe in the first place.

Sources of Deterioration

The following are some common signs and sources of adobe deterioration and some common solutions. It should be cautioned again, however, that adobe deterioration is often the end-product of more than one of these problems. The remedying of only one of these will not necessarily arrest deterioration if others are left untreated.

Structural Damage: There are several common structural problems in adobe buildings, and while the results of these problems are easy to see, their causes are not. Many of these problems originate from improper design or construction, insufficient foundations, weak or inadequate materials, or the effects of external forces such as wind, water, snow, or earthquakes. In any case the services of a soils engineer and/or structural engineer knowledgeable in adobe construction may be necessary to evaluate these problems. Solutions may involve repairing foundations, realigning leaning and bulging walls, buttressing walls, inserting new window and door lintels, and repairing or replacing badly deteriorated roof structures.

There are many tell-tale signs of structural problems in adobe buildings, the most common being cracks in walls, foundations, and roofs. In adobe, cracks are generally quite visible, but their causes may be difficult to diagnose. Some cracking is normal, such as the short hairline cracks that are caused as the adobe shrinks and continues to dry out. More extensive cracking, however, usually indicates serious structural problems. In any case, cracks, like all structural problems, should be examined by a professional who can make recommendations for their repair.

Water Related Problems: Generally, adobe buildings deteriorate because of moisture, either excessive rainwater or ground water. Successful stabilization, restoration, and the ultimate survival of an adobe building depends upon how effectively a structure sheds water. The importance in keeping an adobe building free from excessive moisture cannot be overestimated. The erosive action of rainwater and the subsequent drying out of adobe roofs, parapet walls, and wall surfaces can cause furrows, cracks, deep fissures, and pitted surfaces to form. Rain saturated adobe loses its cohesive strength and sloughs off forming rounded corners and parapets. If left unattended, rainwater damage can eventually destroy adobe walls and roofs, causing their continued deterioration and ultimate collapse. Standing rainwater that accumulates at foundation level and rain splash may cause "coving" (the hollowing-out of the wall just above grade level).

Ground water (water below ground level) might be present because of a spring, a high water table, improper drainage, seasonal water fluctuations, excessive plant watering, or changes in grade on either side of the wall. Ground water rises through capillary action into the wall and causes the adobe to erode, bulge, and cove. Coving is also caused by spalling during the freeze-thaw cycles. As water rises from the ground into the wall, the bond between the clay particles in the adobe brick breaks down. In addition, dissolved minerals or salts brought up from the soil by the water can be deposited on or near the surface of the wall as the moisture evaporates. If these deposits become heavily concentrated, they too can deteriorate the adobe fabric. As the adobe dries out, shrinkage cracks usually appear; loose sections of adobe bricks and mud plaster may crumble.

A water-tight roof with proper drainage is the best protection against rainfall erosion. Adobe wall and roof surfaces properly maintained with traditional tiles or surface coatings generally resist the destructive effects of rainwater. Roof drains should be in good repair and sufficient to carry rainwater run-off from the roof. In an effort to halt the destructive effects of rainwater, 19th-century builders often capped parapet walls with fired bricks. These bricks were harder and better suited to weather the erosive action of rainwater; however, the addition of a brick cap to an existing parapet wall creates a drastic change in a structure's appearance and fabric. The use of traditional lime mortar with the fired brick is advised because it is more water-tight and compatible with the harder brick.

Rainwater that has accumulated at adobe foundations should be diverted away from the building. This may be done by regrading, by building gravel-filled trenches or brick, tile, or stone drip gutters, or by any technique that will effectively remove the standing rainwater. Regrading is perhaps the best solution because defective gutters and trenches may in effect collect and hold water at the base of the wall or foundation.

In repairing "coving," the damage caused by rain splash, adobe bricks stabilized with soil cement might be considered. On the other hand, concrete patches, cement stucco, and curb-like buttresses against the coving usually have a negative effect because moisture may be attracted and trapped behind the concrete.

Cement stucco and cement patches have the potential for specific kinds of water related adobe deterioration. The thermal expansion coefficient of cement stucco is 3 to 10 times greater than that of adobe resulting in cracking of the stucco. Cracks allow both liquid water and vapor to penetrate the adobe beneath, and the stucco prevents the wall from drying.

As the moisture content of the adobe increases, there is a point at which the adobe will become soft like putty. When the wall becomes totally saturated, the adobe mud will flow as a liquid. This varies with the sand, clay, and silt content of the adobe.

If the adobe becomes so wet that the clay reaches its plastic limit, or if the adobe is exposed to a freeze-thaw action, serious damage can result. Under the weight of the roof, the wet adobe may deform or bulge. Since the deterioration is hidden from view by the cement stucco, damage may go undetected for some time. Traditional adobe construction techniques and materials should therefore, be used to repair or rebuild parts of the walls.

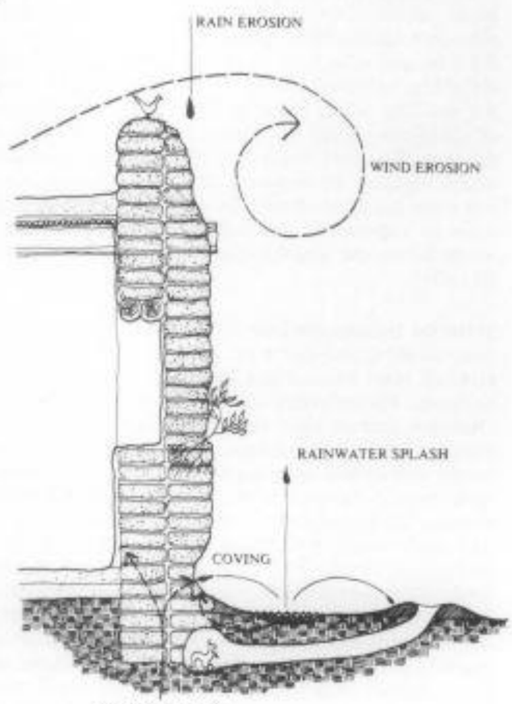
The destructive effects of moisture on adobe buildings may be substantially halted by several remedies.

1. Shrubs, trees, and other foundation plantings may be causing physical damage. Their roots may be growing into the adobe, and/or they may be trapping excessive moisture in their roots and conducting it into walls. Their removal might be considered to halt this process.
2. Level ground immediately adjacent to the walls may be causing poor drainage. Regrading could be considered so that the ground slopes away from the building, eliminating rainwater pools.
3. The installation of footing drains may be considered. Trenches about 2 to 2½ feet wide and several feet deep are dug around the adobe building at the base of the walls or at the foundation if there is any. If the soil is weak, it may be necessary to slope the sides of the trench to prevent cave-in of the trench and subsequent damage to the wall. The walls and bottom of the trench should be lined with a polyethylene vapor barrier to prevent the collected water from saturating the surrounding soil and adobe wall. Clay tile, or plastic pipe, which drain to a sump or to an open gutter, are then laid in the bottom of the trench. The trench is filled with gravel to within 6 inches of grade. The remaining excavation is then filled to grade with porous soil.

A Word of Caution: *Plant removal, regrading, or trenching may be potentially destructive to archeological remains associated with historic adobe building sites. Any disturbance of the ground should, therefore, be undertaken with prudence and careful planning.*

Once any one or all of these solutions has effectively minimized the problems of rising ground water, the coving and deterioration of the walls can be corrected by patching the area with new adobe mud and by applying traditional surface coatings. It should be remembered, however, that unless the capillary action is stopped effectively, this erosive condition will certainly continue. Most important, surface coatings and patching only repair the effects of ground water and wind erosion, they cannot cure the cause.

Coving. *Salts deposited by rising ground water can evaporate and cause spalling of the adobe bricks at the base of the wall, a serious condition called "coving." Coving can also be caused and/or exacerbated by the erosion of rain splash. (National Park Service)*



Water, Wind, Animal, Insect, and Vegetation Damage. *Most deterioration of adobe buildings can be directly correlated with the presence of either excessive rainwater, groundwater, or both. Successful adobe stabilization and restoration depends upon keeping the adobe building moisture free, repaired, and well maintained. (Drawing by David W. Look, AIA, based on sketches by Albert N. Hopper)*

Wind Erosion: Wind-blown sand has often been cited as a factor in adobe fabric erosion. Evidence of wind erosion is often difficult to isolate because the results are similar to water erosion; however, furrowing caused by wind is usually more obvious at the upper half of the wall and at the corners, while coving from rainsplash and ground water is usually at the lower third of the wall.

Maintenance is the key to mitigating the destructive effects of wind erosion. Wind damage on adobe walls and roof surfaces should be repaired with new adobe mud. Any traditional surface coating may be applied to protect against any possible future destructive effects. If high wind is a continuing problem, a wind screen or breaker might be built, using fencing or trees. Care should be taken to plant trees far enough away from the structure so that the roots will not destroy the foundation or trap moisture.

Vegetation, Insects, and Vermin: Vegetation and pests are natural phenomena that can accelerate adobe deterioration. Seeds deposited by the wind or by animals may germinate in adobe walls or roofs as they would in any soil. The action of roots may break down adobe bricks or cause moisture retention which will harm the structure. Animals, birds, and insects often live in adobe structures, burrowing and nesting in walls or in foundations. These pests undermine and destroy the structural soundness of the adobe building. The possibility of termite infestation should not be overlooked since termites can travel through adobe walls as they do through natural soil. Wood members (lintels, floors, window and door shutters, and roof members) are all vulnerable to termite attack and destruction.

It is important to rid adobe structures immediately of all plant, animal, and insect pests and to take preventive measures against their return. Seedlings should be removed from the adobe as soon as they are discovered. Large plants should be removed carefully so that their root systems will not dislodge adobe material. Pest control involving the use of chemicals should be examined carefully in order to assess the immediate and longlasting effects of the chemicals on the adobe building. Professional advice in this area is important not only because chemicals may be transported into the walls by capillary action and have a damaging effect on the adobe fabric, but also for reasons of human and environmental safety.

Material Incompatibilities: As adobe buildings are continually swelling and shrinking, it is likely that repair work has already been carried out sometime during the life of the building. Philosophies regarding adobe preservation have changed, and so have restoration and rehabilitation techniques. Techniques acceptable only 10 years ago are no longer considered appropriate. Until recently, adobe bricks have been repointed with portland cement; deteriorated wooden lintels and doors have been replaced with steel ones; and adobe walls have been sprayed with plastic or latex surface coatings. The hygroscopic nature of adobe has rendered these techniques ineffective and, most important, destructive. The high strength of portland cement mortar and stucco has caused the weaker adobe brick to crack and crumble during the differential expansion of these incompatible materials. Steel lintels are much more rigid than adobe. When the building expands, the adobe walls twist because they are more flexible than the steel. Plastic and latex wall coatings have been used to seal the surface, keeping it from expanding with the rest of the brick. Portions of the wall have consequently broken off. In some instances, incompatible materials can be removed from the building without subsequently damaging the structure. Other times, this is not possible. Professional advice is therefore recommended.

Repairing and Maintaining the Historic Adobe Building

Once the adobe deterioration and any resulting structural damage is repaired, the restoration of the adobe building can proceed. Careful attention should be given to replace, repair, and/or reproduce all damaged materials with traditional or original materials.

Patching and Repairing Adobe Brick: In patching and replacing adobe brick, every reasonable effort should be made to find clay with a texture and color similar to the original fabric. When an individual adobe brick has partially disintegrated, it may be patched in place. The deteriorated material may be scraped out and replaced with appropriate adobe mud. Often fragments of the original adobe brick have been ground up, mixed with water, and reused to patch the eroded area. However, some professionals advise against the reuse of material which has spalled off because it frequently contains a high concentration of salts.

If a substantial amount of the brick has been destroyed or spalled, commercially made adobe bricks and half-bricks can be obtained, or they may be made at the site or nearby. Generally these are 3 or 4 inches thick, and ideally they are composed of unstabilized adobe (that is, without any chemical additives). The deteriorated adobe bricks should be scraped out to insert the new bricks. If most of the brick is not deteriorated, then the deteriorated portion may be replaced with a half-brick. It may be necessary to cut back into undeteriorated portions of the brick to achieve a flush fit of the new or half-bricks. Spray (do not soak) the new brick and surrounding area lightly with water to facilitate a better bond. Too much moisture can cause swelling. Always use traditional adobe mud mortar.

When entire bricks or sections of the brick walls have to be replaced, caution should be exercised when buying ready-made bricks. Many are now manufactured using stabilizing agents (portland cement, lime, or emulsified asphalt) in their composition. While the inclusion of these agents in new adobe bricks is a technical advancement in their durability, they will prove incompatible with the fabric of the historic

Cement Mortar Incompatibility. *The stronger and less flexible cement mortar has caused the softer adobe bricks to crumble thus leaving a "honeycomb" of cement mortar joints.* (National Park Service) adobe building. Concrete blocks and cinderblocks are likewise tempting solutions to extensive adobe brick replacement; but, like commercially stabilized adobe bricks, they are not compatible with older and more unstable adobe bricks. However, concrete blocks have been used for interior partitions successfully.

Patching and Replacing Mortar: In repairing loose and deteriorated adobe mortar, care should also be taken to match the original material, color, and texture. Most important, never replace adobe mud mortar with lime mortar or portland cement mortar. It is a common error to assume that mortar hardness or strength is a measure of its suitability in adobe repair or reconstruction. Mortars composed of portland cement or lime do not have the same thermal expansion rate as adobe brick. With the continual thermal expansion and contraction of adobe bricks, portland cement or lime mortars will cause the bricks—the weaker material—to crack, crumble, and eventually disintegrate.

It is recognized, however, that some late historic adobe buildings have always had portland cement or lime mortars used in their initial construction. The removal and replacement of these mortars with mud mortar is not advised because their removal is usually destructive to the adobe bricks.

In repairing adobe cracks, a procedure similar to repointing masonry joints may be used. It is necessary to rake out the cracks to a depth of 2 or 3 times the width of a mortar joint to obtain a good "key" (mechanical bond) of the mortar to the adobe bricks. The bricks should be sprayed lightly with water to increase the cohesive bond. A trowel or a large grout gun with new adobe mud mortar may then be used to fill the cracks.

Repairing and Replacing Wooden Members: Rotted or termite infested wood members such as *vigas, savinos,* lintels, wall braces, or flooring should be repaired or replaced. Wood should always be replaced with wood. For carved corbels, however, specially formulated low-strength epoxy consolidants and patching compounds may be used to make repairs, thus saving original craftsmanship. Tests, however, should be made prior to repairs to check on desired results since they usually are not reversible. This is an area of building repair that ought not be attempted by the amateur. For further information, see *Epoxies for Wood Repairs in Historic Buildings*, cited in the reading list of this brief.

Patching and Replacing Surface Coatings: Historically, almost every adobe building surface was coated. When these coatings deteriorate, they need to be replaced. Every effort should be made to recoat the surface with the same material that originally coated the surface.

When the coating has been mud plaster, the process requires that the deteriorated mud plaster be scraped off and replaced with like materials and similar techniques, attempting in all cases to match the repair work as closely as possible to the original. It is always better to cover adobe with mud plaster even though the mud plaster must be renewed more frequently.

The process is not so simple where lime plaster and portland cement stuccos are involved. As much of the deteriorated surface coating as possible should be removed without damaging the adobe brick fabric underneath. Never put another coat of lime plaster or portland cement stucco over a deteriorated surface coating. If serious deterioration does exist on the surface, then it is likely that far greater deterioration exists below. Generally this problem is related to water, in which case it is advisable to consult a professional.

If extensive recoatings in lime plaster or portland cement stucco are necessary, the owner of an adobe building might consider furring out the walls with lathing, then plastering over, thus creating a moisture barrier. Always patch with the same material that is being replaced. Although lime plaster and portland cement stucco are less satisfactory as a surface coating, many adobe buildings have always had them as a surface coating. Their complete removal is inadvisable as the process may prove to be more damaging than the natural deterioration.

Roofs: Flat adobe roofs should be restored and maintained with their original form and materials; however, it may not be feasible or prudent to restore or reconstruct a flat adobe roof on a building if the roof has previously been modified to a gable roof with sheet metal, tiles, or wood shingles.

If an existing flat adobe roof is restored with a fresh layer of adobe mud over an existing mud roof, care should be taken to temporarily support the roof during the work because adobe mud is heavier wet than after it has cured. If not supported, the roof may collapse or deflect. If the wooden roof supports are allowed to sag during such work, the wood may take a permanent deflection, resulting in inadequate drainage and/or "ponding" at low points. Ponding is especially damaging to adobe roofs since standing water will eventually soak through the mud and cause the wooden roof members to rot.

On an adobe building, it is not advisable to construct a new roof that is heavier than the roof it is replacing. If the walls below have uncorrected moisture problems, the added weight of a new roof may cause the walls to bulge (a deformation caused while the adobe mud is in a plastic state). If the walls are dry but severely deteriorated, the added weight may cause the walls to crack or crumble (compression failure).

Floors, Windows, Doors, Etc.: Windows, doors, floors, and other original details of the older adobe building should be retained whenever feasible. It is, however, understandable when the demands of modern living make it necessary to change some of these features: thermal windows and doors, easily maintained floors, etc. But every reasonable effort should be made to retain original interior and exterior details.

Maintenance

Cyclical maintenance has always been the key to successful adobe building survival. As soon as rehabilitation or restoration has been completed, some program of continuing maintenance should be initiated. Changes in the building should particularly be noted. The early stages of cracking, sagging, or bulging in adobe walls should be monitored regularly. All water damage should be noted and remedied at its earliest possible stages. Plant, animal, and insect damage should be halted before it becomes substantial. The roof should be inspected periodically. Surface coatings must be inspected frequently and repaired or replaced as the need indicates.

Mechanical systems should be monitored for break-down. For instance, leaking water pipes and condensation can be potentially more damaging to the adobe building than to a brick, stone, or frame structure. Observing adobe buildings for subtle changes and performing maintenance on a regular basis is a policy which cannot be over emphasized. It is the nature of adobe buildings to deteriorate, but cyclical maintenance can substantially deter this process, thus producing a relatively stable historic adobe building.

Summary

In conclusion, to attempt the preservation of an adobe building is almost a contradiction. Adobe is a formed-earth material, a little stronger perhaps than the soil itself, but a material whose nature is to deteriorate. The preservation of historic adobe buildings, then, is a broader and more complex problem than most people realize. The propensity of adobe to deteriorate is a natural, on-going process. While it would be desirable to arrest that process in order to safeguard the building, no satisfactory method has yet been developed. Competent preservation and maintenance of historic adobe buildings in the American Southwest must (1) accept the adobe material and its natural deterioration, (2) understand the building as a system, and (3) understand the forces of nature which seek to return the building to its original state.

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Many individuals have contributed to the direction, the content and the final form of this Preservation Brief. The text and illustration materials were prepared by de Teel Patterson Tiller, Architectural Historian, and David W. Look, AIA, Technical Preservation Services Division. Much of the technical information was based upon an unpublished report prepared under contract for this office by Ralph H. Comey, Robert C. Giebner, and Albert N. Hopper, College of Architecture, University of Arizona, Tucson. Valuable suggestions and comments were made by architects Eugene George, Austin, Texas; John P. Conron, Santa Fe; and David G. Battle, Santa Fe. Other staff members who provided editorial assistance include H. Ward Jandl, and Kay D. Weeks.

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. **August 1978.**

Renewing the Surface Coating. *Traditionally, adobe surface coatings that protected the fragile adobe building fabric were renewed every few years. Recently however, high labor costs have made this a relatively expensive process. Women are seen here recoating an adobe wall with mud plaster mixed with straw at Chamisal, New Mexico.* (Photo by Russell Lee, *Farm Security Administration Collection, Library of Congress*)

5.3.2 *Adobe Conservation: A Preservation Handbook, "Reconstructing Adobe Walls*," 2006[59]

RECONSTRUCTING ADOBE WALLS

When it is impossible to repair the adobe wall because of excessive structural damage, it is then necessary to reconstruct the wall. The following section gives a step-by-step pictorial narrative for the reconstruction process.

TOOLS AND MATERIALS REQUIRED

59. This section reprints with permission from Cornerstones Community Partnerships, "Reconstructing Adobe Walls," in *Adobe Conservation: A Preservation Handbook*, illustrated by Contreras Francisco Uviña (Santa Fe, NM: Sunstone Press, 2006), 111–115.

Soil

Screen

Square

Water (potable)

Wheel barrow

1. Shore up roof prior to work (see Part One, *Emergency Shoring*).

2. Remove fallen wall material.

3. Rebuild the footing following the existing pattern or consult a structural engineer for a new design. In high water table situations there are a variety of methods to alleviate the water table problem. In this particular case the engineer chose to use a concrete and block footing. Traditional stone footings (below), however, are recommended for use whenever possible (see Part Three, *Installing a Subsurface Drainage System* for more suggestions regarding high water table damage).

No footing

River cobble footing

Sandstone laid in mud mortar footing

Traditional stone footings

4. Gravel Footing. Dig a trench 12 inches in depth and the width of the wall. Evenly spread the river cobbles over the floor of the trench. Cover the cobbles with one to two inches of gravel. The first mortar joint should be laid directly on top of the gravel with no moisture barrier between. This gravel bed is an effective capillary break for ground water as well as a conduit to the permeable soils below for any water entering from above. This method can *only* be used where good drainage conditions exist on the site.

5. Determine the pattern of adobes to be laid. Match the existing pattern.

An example of adobe bricks with alternating joints

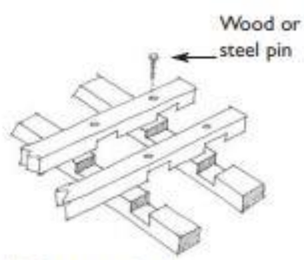
6. Pour the mud mortar and level by hand or with a trowel a half to one-inch thick. Lay adobes so that the joints alternate from course to course.

7. A maximum of three to four courses can be laid every two to three days, depending on weather conditions. Allow ample time for the mud mortar joints to dry. Adding too many courses in a short period of time may cause the adobes to shift.

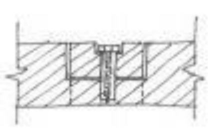
8. Determine how to best key in the new wall with the existing wall. For best results always key back to the existing wall.

9. Replace wooden lateral and corner ties if they exist in the original construction. Fill in with full size adobes or custom cut adobes.

10. Use half-lap and cross-lap joints to tie in lateral ties at corner. Loosely pin them together. They should be able to move and settle with the wall.



Half lap joint detail



Section of half-lap joint with loose lag bolt fastener.

11. After placing the wooden bond beam (rough beam) to match the existing wooden bond beam if it is being replaced, reinstall the existing corbels using jacks or a pulley system to lift the *vigas*. Set the bond beam to the lowest measurement from the *viga* to allow the corbels to fit beneath the *viga* and rest on the bond beam. Insert shims between the corbels and the bond beam for any that do not meet the corresponding *viga*. Moving the roof could cause problems.

12. Replace *vigas* that cannot be spliced or repaired with new ones to match the existing. Slide the *viga* through one side of the building to the other then set the *viga* on the corbel (see Part Three, *Repairing Vigas and Corbels*).

13. Infill between the corbels and *vigas* with adobe bricks and mud mortar.

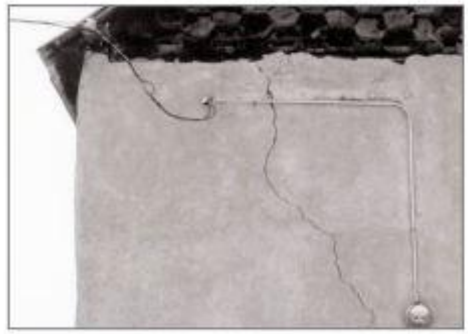
14. Apply a mud plaster when the wall has been completed (see *Mud Plastering* below).

NOTE: In historic adobe building construction, bond beams should be wood.

5.3.3 *Adobe Conservation: A Preservation Handbook*, "Removing Cement Plaster," 2006[60]

REMOVING CEMENT PLASTER

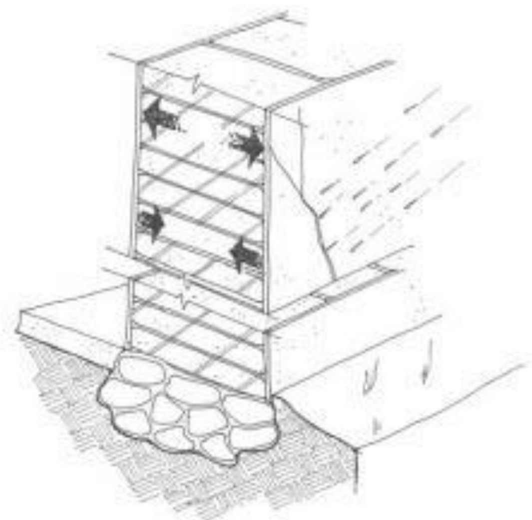
Early in the 20th century, plaster began to replace traditional mud and lime plaster to a large extent. Cement is less permeable than "softer" plaster materials and tends to trap moisture within adobe walls. As moisture rising from the ground and through the foundation is trapped, the moisture content increases and the wall loses strength. Eventually it will slump (see Part Two, *Moisture Testing in Adobe Walls* for more information).



TOOLS AND MATERIALS REQUIRED

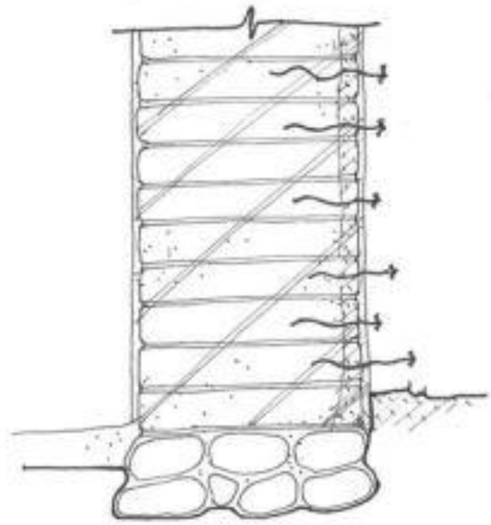
60. This section reprints with permission from Cornerstones Community Partnerships, "Removing Cement Plaster," in *Adobe Conservation: A Preservation Handbook*, illustrated by Contreras Francisco Uviña (Santa Fe, NM: Sunstone Press, 2006), 91–93.

CEMENT PLASTERS



When a rigid cement plaster is applied to an adobe wall there is a high probability the plaster will crack from the thermal expansion of the wall mass. The incompatible plaster will create cracks where water can penetrate. Cement plaster moves at a different rate than does adobe when the temperature changes. This differential is a major cause of cracks in cement plaster.

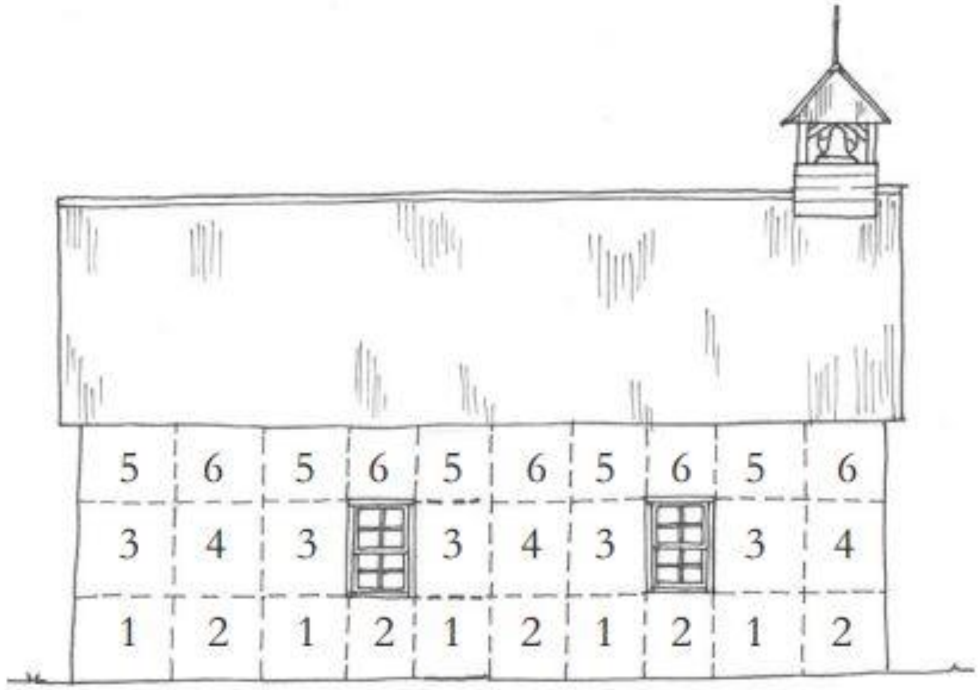
MUD AND LIME PLASTERS



Mud and lime are more compatible with the thermal qualities of adobe. Mud and lime plasters, conversely, are permeable materials that allow the adobe walls to dry when wet.

After the cement stucco has been cut into small (two- to three-foot) square sections, the plaster can usually be removed easily by using a wrecking bar to pull the plaster and wire lath away from the wall. If the adobe walls are wet, safety precautions should be taken.

NOTE: Use protective eyewear and a mask to protect against dust and flying particles.



A small (3 feet by 3 feet maximum) cement plaster section at the base of the adobe wall should be cut and removed to determine the wall conditions. If the walls are either very wet or have lost more than 30% of their thickness at the base, safety shoring should be erected to carry the weight of the roof before removing any additional plaster from the walls (see Part Two, *Emergency Shoring* and *Repairing and Restoring Adobe Walls*). When shoring is in place, alternating sections of plaster can be removed. This will protect workers if there is a large delamination of material from above. These areas need time to dry before removing the remaining the plaster at this level. Reconstruct any deteriorated areas and replace adobes from the ground up. Place additional wall shoring along the vertical plane as needed.

Strong, hard plaster may need to be cut into manageable sections with a circular saw and diamond-toothed masonry blades. The first priority is to remove the cement without damaging the adobe building!

Sections of the wall plaster can be safely removed only after the basal repairs (including removal of the *contra pared*) are accomplished. When removing cement plaster from a wet wall, carefully remove it in two feet by two feet or three feet by three feet sections. The sections should be randomly spaced according to the diagram shown above. Work from bottom to top.

Allow each section to dry for one to two weeks if it is wet before continuing the process. If the walls are wet and all the plaster is removed, the walls may tend to shift while drying and the adobe wall might structurally fail.

5.3.4 *Adobe Conservation: A Preservation Handbook*, "Mud Plastering," 2006[61]

MUD PLASTERING

Throughout history, many materials have been used as natural additives to protect earthen buildings. Among the most common were lye soap, alum, pine needles, cactus, straw, dung, rice fibers, animal blood, egg yolks, oil, stones, ceramic tile, lime, cement, asphalt emulsion and chemicals. In New Mexico, by in the 1930s, many adobe buildings had been plastered with cement. The use of this material was thought to be an economical and permanent solution to the regular cycle of mud plastering.

The reality is that cement plaster does not allow the adobe wall to breathe. Walls that breathe act as a heat exchanger, warming incoming air before it enters the living space. This porous membrane also keeps indoor air safer. Earthen walls regulate interior temperatures, absorbing vapor in high humidity and moistening the environment in drier air. Because the expansion of the earthen plaster is the same as the adobe wall in damp weather, it is far more pliable than cement. The accumulation of moisture trapped by cement plaster has destroyed some buildings and threatened many of the others it was intended to protect.

The use of non-natural additives to "stabilize" mud plaster should also be avoided when using mud as a coating on historic adobe buildings. Such additives are usually cement, acrylic, or petroleum products. They are historically inappropriate and functionally incompatible with natural adobes. Such additives trap moisture within the walls.

It is an oft-heard saying among the old *adoberos* of New Mexico that, *"Un adobe sin paja es un adobe sin alma"* (an adobe without straw is an adobe without soul). In other words, this was a method of saying "use straw" in the mud mix without explaining why. It is understood that straw performs certain functions, including balancing the soil mix in adobes. Straw helps the sand and clay particles dry evenly. Omitting straw will lead to excessive cracking as the adobes dry.

The greatest threat to an unprotected adobe wall in the Southwest is erosion by water. Summertime convection storms may unleash violent torrents that, though of short duration, are intense mechanisms of destruction. Water flowing down a vertical surface, unless it is deflected from a straight path, will rapidly cut a channel in the mud plaster and expose the adobe fabric beneath. The exterior mud plaster is what is caledl a "sacrificial" coating

61. This section reprints with permission from Cornerstones Community Partnerships, "Removing Cement Plaster," in *Adobe Conservation: A Preservation Handbook*, illustrated by Contreras Francisco Uviña (Santa Fe, NM: Sunstone Press, 2006), 127–133.

NOTE: Select the right soil (see *Adobe Material Selection and Testing* above).
(1) A thin, 1/4 inch "binder" coat applied to the original material is critical to the successful adhesion of successive layers.
(2) The first "scratch" coat applied to the final binder coat should crack because of a higher percentage of clay.
(3) Brown or "leveling" coats will usually have less cracking because sand is added to the mud mixture if needed.
(4) The final or "finish" mud coat should not crack if a balanced mixture of clay, straw, and sand has been used (see "Shake Jar" Testing above).

A FEW FINAL WORDS: Experiment! Apply and observe plaster test panels. Select the best recipes to suit particular situations based upon your tests.

TOOLS AND MATERIALS REQUIRED

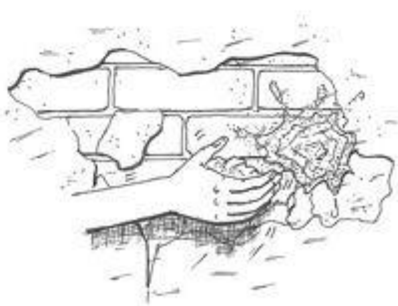
1. Set up scaffolding and equipment.

2. Screen the soil. Do not screen the soil if wet. (See *Building a Screen* at the end of this section.)

3. Judiciously scrape the walls and remove any loose or "friable" adobe material and brush off dust. Dampen an area of the wall with water using a dash brush, a large cup of water, or a fine, soft hose spray or sprayer. The very first binder coat should contain straw and should be applied in a uniform 1/4- to 3/8-inch thickness. The binder coat will follow the contour of the original fabric after the walls have been scraped and dampened. It is critical that this binder coat adheres, or all successive coats risk failure. Once the initial binder coat has dried and adhesion is verified, thin leveling coats may be applied to the binder coat to bring the pitted or concave wall areas out to plane.

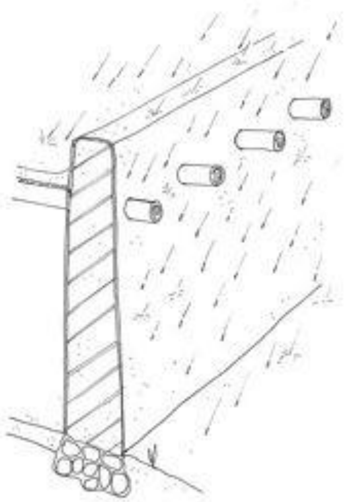
4. When the wall has been brought out to a flat plane, the recipe for the next mud layer should be mixed fairly rich (more clay) so that it cracks slightly. Slight cracking will allow the subsequent coat(s) of mud to penetrate this plaster layer for better adherence. Add straw (not hay or alfalfa) to the plaster layer applied to the binder coat. See *Methods for Cutting Straw* at the end of this section.

NOTE: Excessive cracking may cause the mud plaster to lose its adhesion to the previous layer. Excessive cracking indicates more sand is needed and that the mix is too rich in clay.

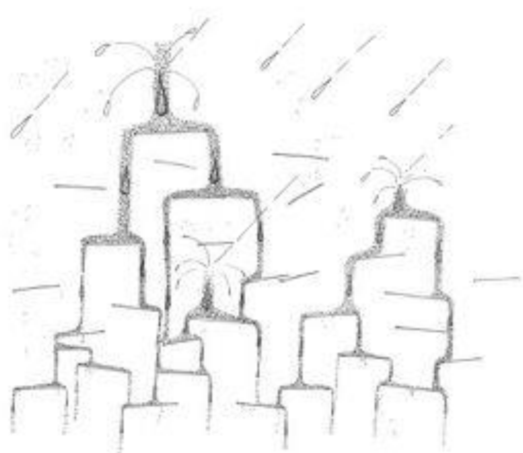


5. If no mud plaster exists, throw the mud onto the wet adobe wall surface by hand or hurl with a brick trowel. Scrape the excess mud and re-throw, filling the concave areas and following the contours of the wall. Always apply thin (never greater than 5/8-inch thick) coats to ensure adhesion. When a large void under four inches deep is encountered, fill it by hand with mud in successive layers of 5/8 of an inch or less. Be patient. Build out with several passes, allowing each layer to dry in between passes. Do not try to build up low areas with a single application of mud. If the void is deeper than four inches, new adobes will have to be inserted.

6. Using the heel of the hand or side of a trowel, work upwards in a low arching motion away from the body. The print should be that of a half rainbow. The straw will align horizontally or nearly so.



7. Water flowing down a vertical surface, unless it is deflected from a straight path, will rapidly cut a channel in the mud plaster and expose the adobe fabric beneath.



8. The rivulet beginning at parapet height encounters a straw barrier across its path and is diverted. The downward velocity is broken and erosion reduced. Straw causes water to spread out or "sheet" over the surface of the wall.



9. Apply the scratch coat approximately one- to one and a half-inches thick with a brick trowel or by hand. Allow the mud plaster to completely dry and crack one to two days before continuing. A plaster trowel may be used if mud plaster exists. Before each application wet surface of wall immediately before plastering.

10. Add straw to the second or "brown" coat mix. This coat should be 3/4-inch thick and have few or no cracks. Allow the brown coat to dry one to two days before continuing. A plaster trowel can be used to apply this coat.

11. The third or "finish" coat should be 1/4-inch thick. Straw is essential to this stage. Mix the mud plaster for the finish coat with pieces of straw that are no more than one-`inch long. Apply the finish coat so that the majority of straw pieces on the surface are aligned horizontally (parallel to the ground).

12. Wet the surface of plaster with a damp sheepskin or sponge and smooth over any small cracks that have appeared. This process can also be used for a sand-floated finish.

5.3.5 *Adobe Conservation: A Preservation Handbook*, "Interpreting Sources, Processes, and Effects of Deterioration" and "Emergency Stabilization and Shoring," 2006[62]

INTERPRETING SOURCES, PROCESSES AND EFFECTS OF DETERIORATION

Before beginning the process of repairing an historic building or site, it is important to identify the sources of deterioration and create an outline for future conservation, preservation, and restoration work. When assessing an historic building it is critical to examine the landscape or urban environment in which the structure was originally built. The cultural and architectural landscape surrounding a structure may give clues as to how the restoration may proceed most appropriately.

This section illustrates some of the ways in which various elements damage adobe structures. In almost every example, the problem was identified and repaired using the methods and materials described in this handbook.

Adobe structures, when properly maintained, can last for hundreds of years. Water is the most common source of deterioration in earthen buildings because it can invade an adobe wall or other parts of a building. Adobe is clay and sand, mixed with straw and water, and formed into sun-dried bricks. If sufficient moisture is added, adobe bricks revert to mud.

In many cases where the base of an adobe wall is in contact with damp earth, moisture can travel up into the wall. Moisture can enter an adobe building through roof leaks, failed flashing at roof penetrations (chimneys, vents, sky lights), poorly sealed doors and windows, and large cracks in the plaster. Components made of concrete, such as sidewalks, buttresses or concrete aprons, trap moisture and increase damage to the base. In all these cases, capillary action will suck moisture upward like a sponge. In other cases, when the protective surface coating – originally mud or lime plaster – deteriorates, rain water and snow erode the exposed adobe bricks.

In the early part of the 20th century, cement plaster began to replace mud and lime plaster on many churches and other adobe buildings. Cement inhibits the evaporation of water and therefore traps moisture within the structure.

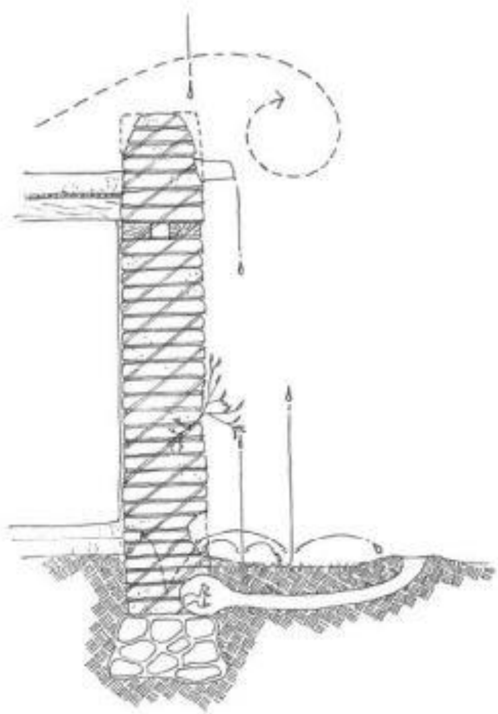
62. This section reprints with permission from Cornerstones Community Partnerships, "Interpreting Sources, Processes, and Effects of Deterioration" and "Emergency Stabilization and Shoring," in *Adobe Conservation: A Preservation Handbook*, illustrated by Contreras Francisco Uviña (Santa Fe, NM: Sunstone Press, 2006), 50–61.

If water penetrates into the wall behind the plaster by capillary action or through cracks or a broken flashing, it cannot escape and the adobe bricks become saturated. The basic problem with using cement on earthen buildings is its incompatibility: cement is hard, while earth is soft. Each behaves in an entirely different mannner during environmental cycles. Another measure intended to repair damage to damp walls is the addition of a protective concrete collar around the base of the wall, called a *contra pared*. This too tends to trap moisture in the wall and becomes another 'remedy' that causes more damage than it prevents. Cement plaster is a problem not only because it retains moisture, but also because it hides wall damage. An important advantage of earthen or lime plasters is that they reveal damage immediately.

COMMON SOURCES AND CAUSES OF DETERIORATION

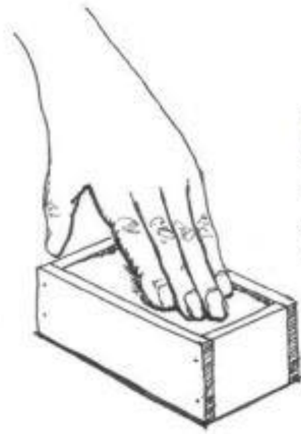
Identifying the source of deterioration is the first step toward repair. The following list outlines both natural and man-made sources.

Fire – arson or natural
Erosion – wind, rain, snow, sleet, or hail may cause erosion of plaster, adobe, and wood
Rot – wood deterioration
Vegetation – plants near the base of adobe walls moisten earthen plaster, cause basal erosion and structural failure
Pests
Rodents
Broken downspouts
Leaking plumbing
Negative site drainage
Bad interventions – additions of cement plasters, concrete *contra paredes*, sidewalks, and buttresses
Short eaves
Rise in water table
Vandalism
Seismic activity
Faulty roofs
Missing or damaged fenestration (doors, windows)

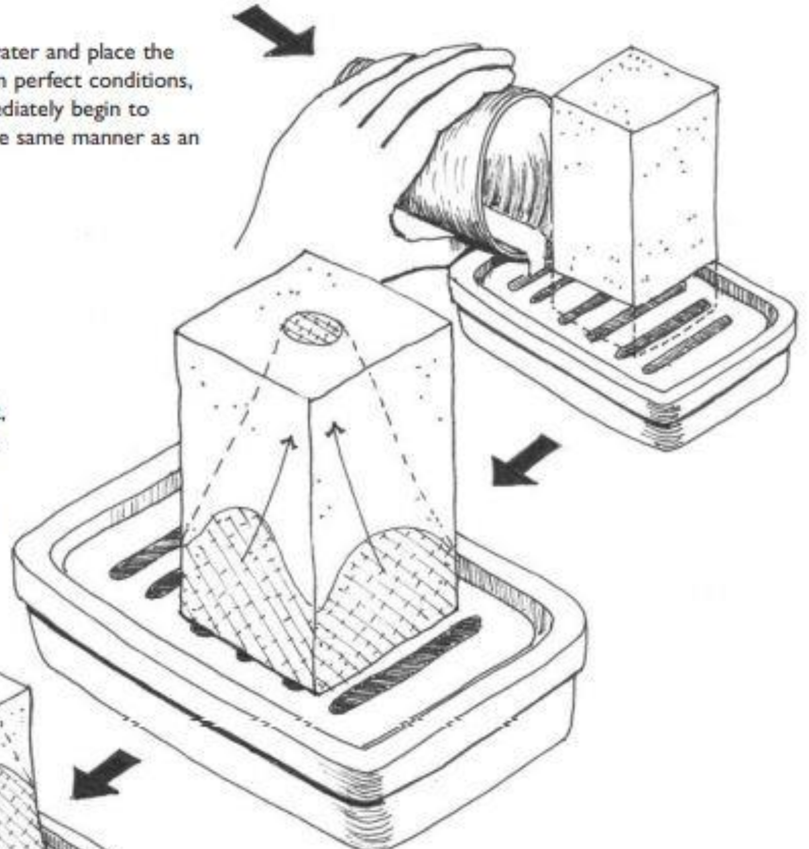


PERFORMING A CAPILLARITY TEST

This test illustrates the movement of water from the base of an adobe brick up to its center as a result of capillary action. Cement additions prevent moisture from otherwise escaping to the surface through a breathable mud or lime plaster.

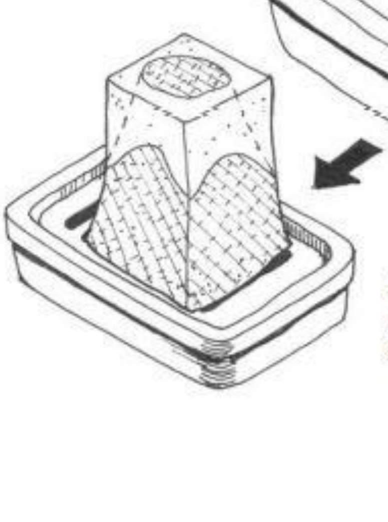


1. Make a small adobe brick following the instructions given in the succeeding sections of this manual.



2. Fill a soap dish with water and place the adobe brick in the dish. In perfect conditions, the adobe brick will immediately begin to absorb the moisture in the same manner as an adobe wall.

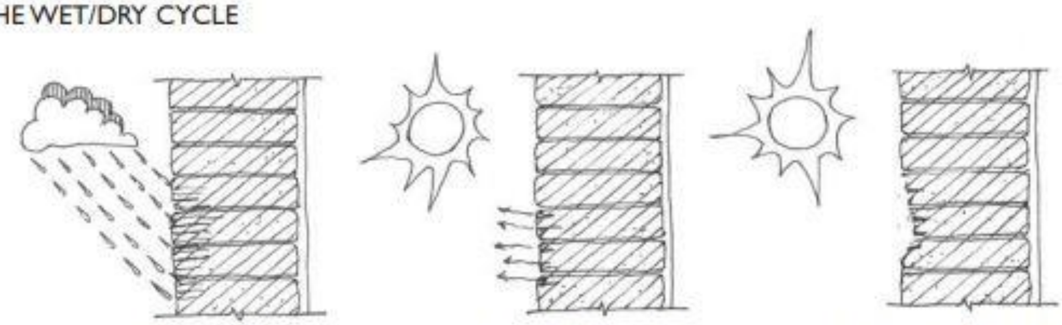
3. When the capillary movement of the water shows signs of dampness on top of the adobe brick, the adobe brick will begin to slump exactly as an adobe wall that has moisture trapped behind cement plaster or a concrete *contra pared*.



At this point, the brick is saturated with its maximum amount of moisture, and gravity prevents the water from rising higher up the adobe brick.

COMMON PROCESSES OF DETERIORATION

THE WET/DRY CYCLE

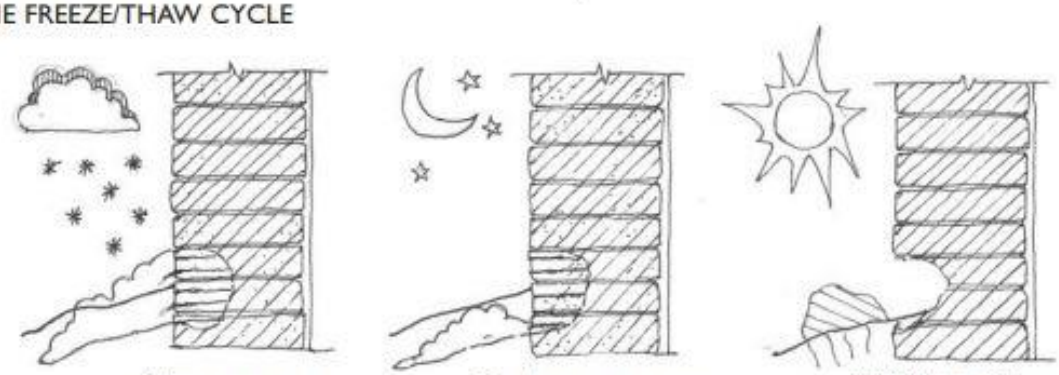


Water saturates wall.

Dissolved soluble salts migrate to wall surface as wall dries and water evaporates.

Salts crystallize on the wall surface and accelerate erosion.

THE FREEZE/THAW CYCLE

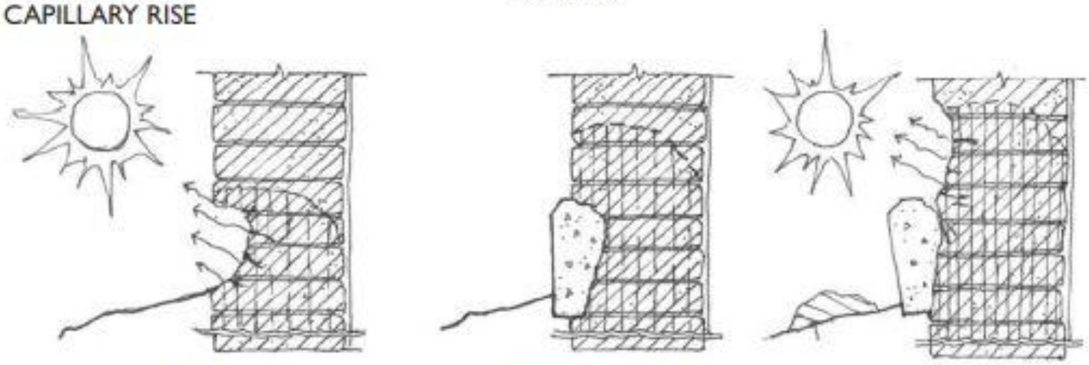


Water saturates wall.

Freezing temperature results in water crystal expansion.

Wall thaws with loss of integrity.

CAPILLARY RISE

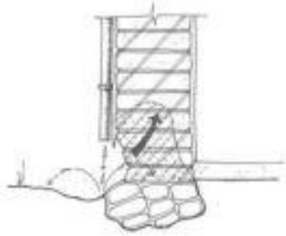


Rising damp results in basal erosion.

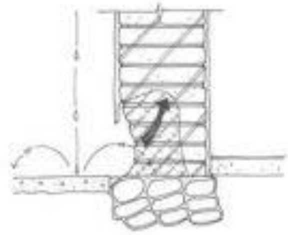
If basal erosion is repaired with portland cement, damp rises even higher.

New erosion occurs above portland cement repair.

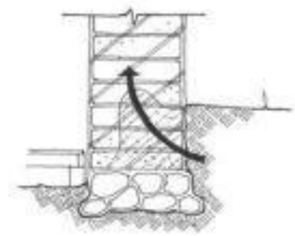
FACTORS THAT CONTRIBUTE TO CAPILLARY RISE



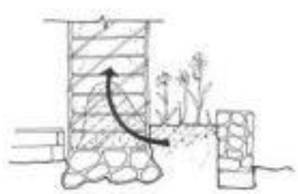
Damaged and improperly maintained downspouts cause deterioration at the base of a wall and increase capillary rise ...



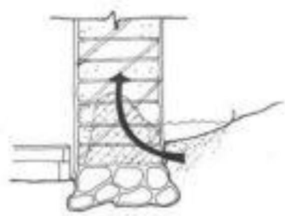
... as do leaking gutters or *canales*. Hard surfaces like concrete sidewalks next to a wall increase the force and velocity of the "splash back" against the wall and speed up the deterioration process.



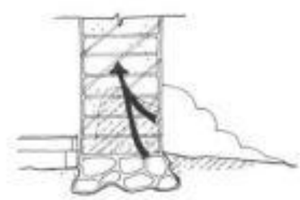
When the exterior grade is too high, capillary rise moves higher up the interior of the wall ...



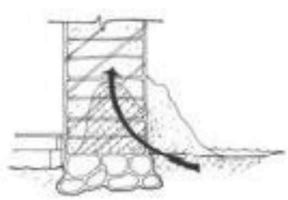
... the same thing can happen when a planter is constructed next to a wall. If the plants require frequent watering, the problem becomes even worse.



An exterior grade that slopes toward the building causes water to pool against it and increases the amount of capillary rise ...

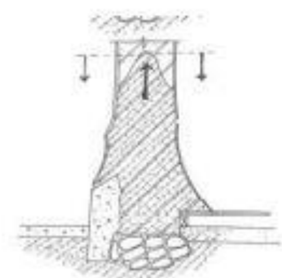


... snow that is allowed to drift around the base of the building has the same effect.



In fact any type of debris that is allowed to pile up against an adobe wall traps moisure in it and contributes to capillary rise.

An impervious surface, such a concrete sidewalk or slab floor, or even plastic landscaping cloth placed too close to the building, inhibits natural evaporation in the ground around the foundation, concentrates water at the base of the building and contributes to capillary rise.



Water trapped in a wall causes the loss of structual integrity. Evenually gravity will cause the wall to "slump" and finally collapse.

After identifying the sources of deterioration, it is important to prevent further deterioration from taking place. Repairs include stopping roof and other leaks, providing good site drainage, installing subsurface drainage systems, and replacing cement plaster with permeable coatings such as mud and/or lime plasters. These coatings allow moisture to escape from adobe walls before they become saturated and lose their ability to bear weight. The following sections of this manual will show you how to identify and correct specific moisture problems.

A SPECIAL NOTE ON SEISMIC ZONES

If you are restoring a building within a seismic (earthquake) zone, it is important to observe how the original builders created stability for the building. In many cases, it is the use of incompatible materials and the addition of recent modifications that make adobe buildings more susceptible to damage during an earthquake.

There are many ways to improve a building's stability in the face of potential seismic activity. Encouraging horizontal continuity in the building through the use of wooden bond beams, nylon straps, and wood plates is one way to decrease the chance of a critical separation. The use of concrete ties or concrete bond beams creates a far too rigid environment, increasing the potential for damage. Window and door openings should remain in the center of walls, and no new openings should be made near wall or roof joints. In addition, window and door lintels should be significantly longer than those used outside earthquake zones.

Single story structures are inherently more horizontally stable and are less likely to separate during an earthquake. If the building must have more than one story, the second level should be made of *bajareque*, or waddle and daub, which is inherently more flexible because of its vertical and horizontal woven structure.

There is a wealth of information on earthen structures in earthquake zones. For more detail, refer to the Getty Conservation Institute's Getty Seismic Adobe Project (GSAP) at:

www.getty.edu/conservation/science/seismic/index.html

EMERGENCY STABILIZATION AND SHORING

Immediate action is called for when a wall or a portion of a wall is near collapse, or when necessary repairs will put the wall in danger of collapse. A collapsing wall is usually caused by deterioration at its base due to trapped moisture within, or when the wall is not appropriately attached to the rest of the walls in the building. Signs of this condition include bulging at the base and the appearance of horizontal or diagonal cracks at the corners. For other possible sources of deterioration and erosion, such as coving at the base see the preceding chapter, *Interpreting Sources, Processes, and Effects of Deterioration.*

Walls that are out of plumb may indicate they are saturated at the base or that lateral loads are pushing on the wall. On the other hand, some massive adobe walls have been out of plumb from the time of their original construction. Because an adobe wall is out of plumb does not necessarily mean it is ready to collapse. Too often it is assumed that a wall out of plumb is in danger of falling over, and attempts to correct the out-of-plumb condition cause further damage. Such attempts include building buttresses against walls that trap moisture and installing cables or tie rods at the top of walls that damage the walls by introducing tension. Buttresses often pull a wall out of plumb because they are built as later additions with incompatible materials. Buttresses or cables and tie rods should never be introduced without first gathering evidence that the walls are indeed moving or in danger of slumping.

When a wall is beginning to slump downward or outward, the immediate need is to prevent the roof from collapsing as well. Methods of emergency shoring for roof *vigas* and a system for more long-term shoring are illustrated below. Long-term shoring can remain in place until the adobe wall is rebuilt or repaired.

Sandbags may also be used to stabilize the corner and base of a wall until permanent repairs can be made or better shoring is installed. This procedure is detailed on the following page.

After emergency shoring is installed, the cause of deterioration and failure should be identified. Installing emergency shoring should provide the necessary time for stabilization and restoration of the structure.

NOTE: It is always recommended to consult a qualified structural engineer before installing long-term shoring. Very high-tech shoring units are also available if desired.

TOOLS AND MATERIALS REQUIRED

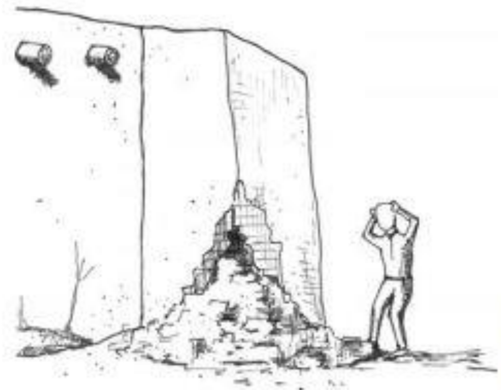

Shoring jack


Plywood

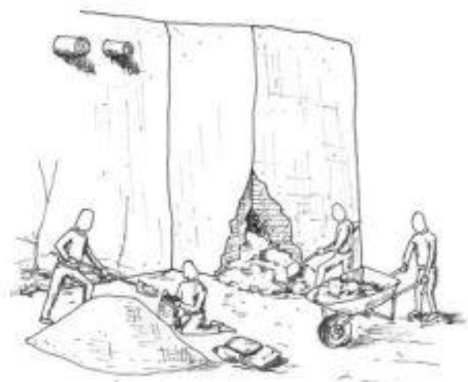

Lumber


Duplex scaffolding nail

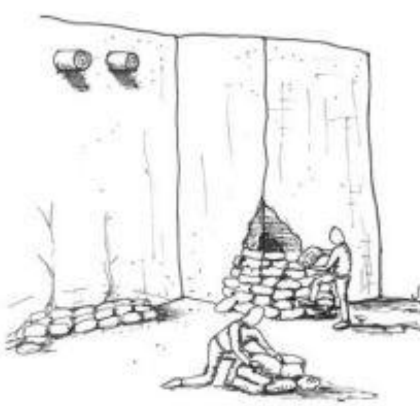
EMERGENCY SANDBAG STABILIZATION



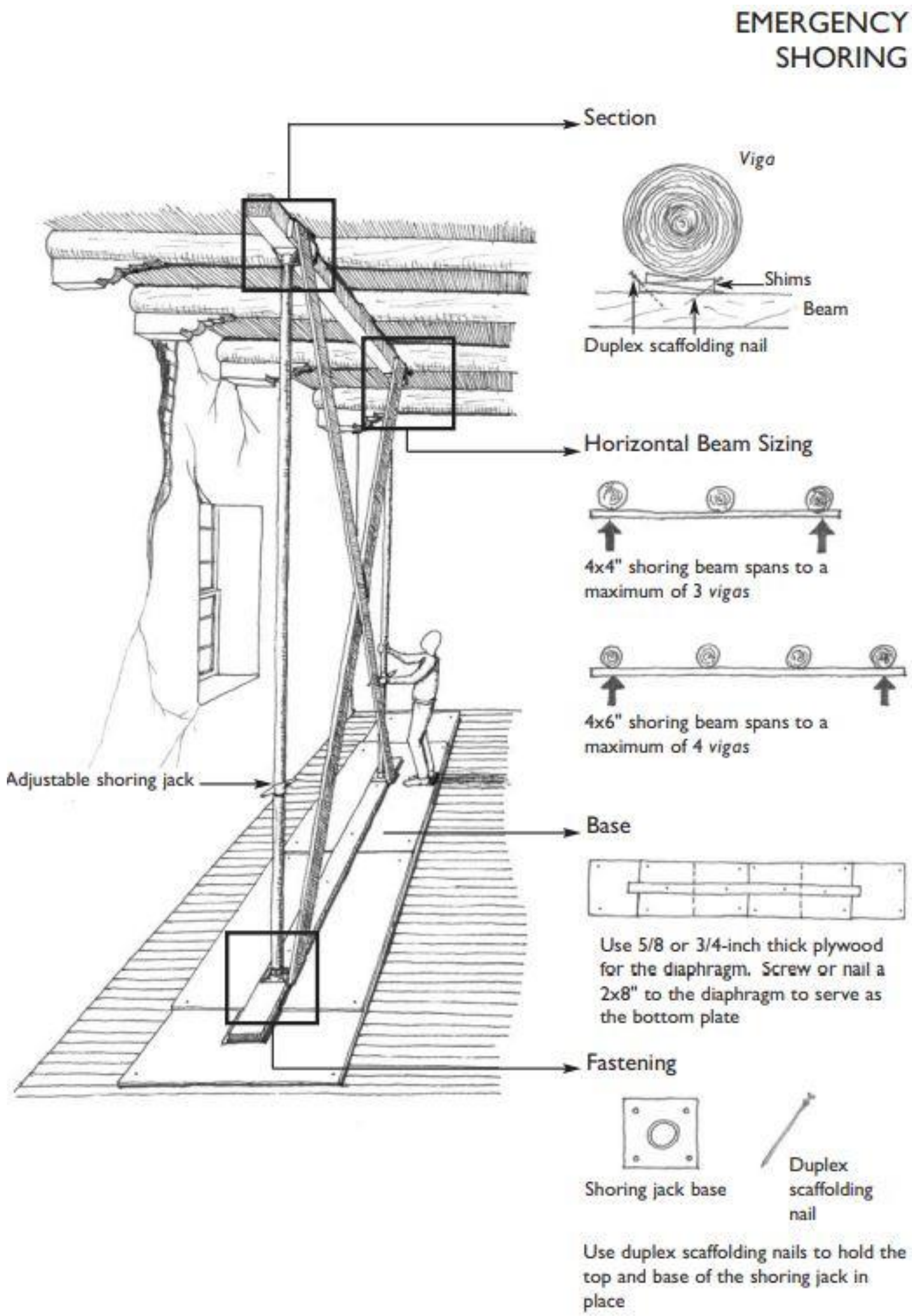
1. Corner collapse. First review the preceeding chapter on the *Sources, Processes and Effects of Deterioration* to make sure you understand the forces that caused the collapse.



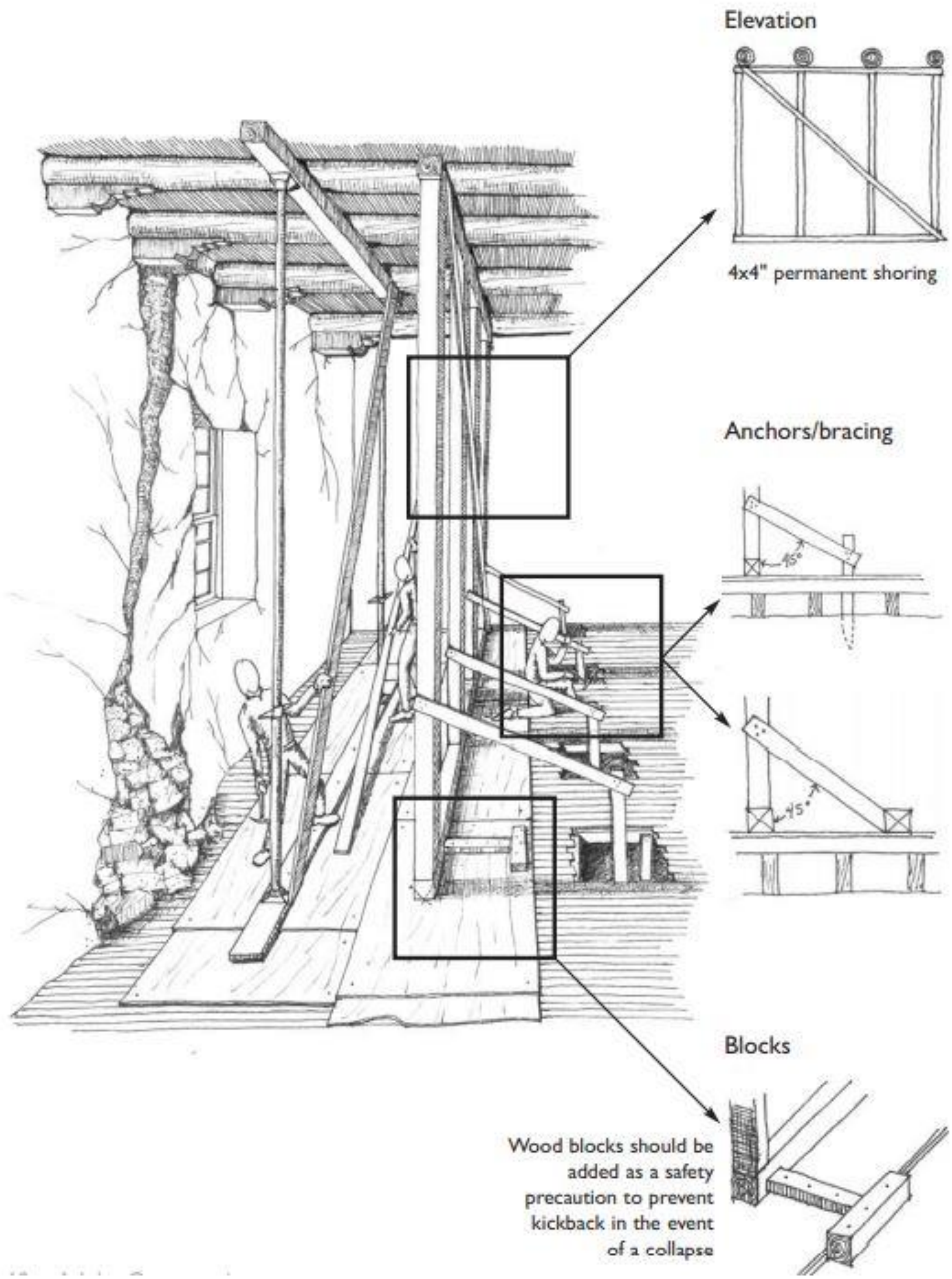
2. Prevent further damage by removing the rubble that retains moisture. Fill burlap or grain bags with sand or fine gravel and tie securely.



3. Pack the collapsed wall sections with sandbags to provide temporary support to the upper wall. To provide additional support, stack the sandbags outside the void into a buttress. Make sure the opening is not too large to work around it, since further collapse may occur and a different system should then be utilized. See the section on diagonal bracing on the following page for additonal detail.


EMERGENCY
SHORING
Section
Viga
Shims
Beam
Duplex scaffolding nail
Horizontal Beam Sizing
4x4" shoring beam spans to a maximum of 3 vigas
4x6" shoring beam spans to a maximum of 4 vigas
Adjustable shoring jack
Base
Use 5/8 or 3/4-inch thick plywood for the diaphragm. Screw or nail a 2x8" to the diaphragm to serve as the bottom plate
Fastening
Shoring jack base
Duplex scaffolding nail
Use duplex scaffolding nails to hold the top and base of the shoring jack in place

PERMANENT SHORING



5.4 Adobe soil materials analysis

This section provides the specifications needed to match the adobe soil used in the construction of the José María Gil Adobe. These specifications are intended to allow the owner the means to closely match the adobe soil used in the various phases of construction and renovation over the course of the house's lifetime. In addition to the specifications, the methodology and a brief background needed to the understand the methodology are presented in this section.

The reader should note that the methods used herein were constrained by the small sample size of the adobe soil. That is to say, because of the historic status of the structure, the sample size was limited to reduce damage to the structure. Thus, the methods used to identify the adobe soil and develop the specifications are novel and are particularly applicable to soil-based construction of historic buildings.

5.4.1 Sieve and hydrometer analysis

A sieve analysis is performed using a set of sieves to separate the soil particles into different size ranges. While the particular sieves used for a sieve analysis may vary based on the requirements of the project, American Society for Testing and Materials (ASTM) D6913 provides guidelines for a standard set with openings (i.e., particle sizes) ranging from greater than 75 mm (3 in.) to less than 75 µm (0.0030 in.);[63] Table 1 shows the standard sieve set. Once sieved, the weight of soil retained on each sieve is determined and the particle-size distribution is developed by plotting the percent retained (by mass) on each sieve versus the particle size.

A hydrometer analysis is used to estimate the particle-size distribution of the soil that passes the no. 200 sieve (which are termed "fines"). A hydrometer analysis estimates the size of soil particles by the rate at which they settle out of suspension. To perform a hydrometer analysis (ASTM D7928), a slurry of soil is thoroughly mixed to ensure that all the particles are in suspension.[64] Then, as time passes, the hydrometer is used to

63. ASTM (American Society for Testing and Materials), *Standard Test Methods for Particle-Size Distribution of Soils Using Sieve Analysis*, D6913/6913M–17 (West Conshohocken, PA: American Society for Testing and Material, 2017).

64. ASTM, *Standard Test Methods for Particle Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis*, D7928-21 (West Conshohocken, PA: American Society for Testing and Material, 2021).

measure the fluid density, which can then be correlated to the size of soil particles still held in suspension.

Table 1. Standard sieve set (after American Society for Testing and Materials [ASTM] D6913).

US Standard Sieve Designation	Metric Designation
Lid	Lid
3 in.	75 mm
2 in.	50 mm
1 1/2 in.	37.5 mm
1 in.	25.0 mm
3/4 in.	19.0 mm
3/8 in.	9.5 mm
No. 4	4.75 mm
No. 10	2.00 mm
No. 20	850 µm
No. 40	425 µm
No. 60	250 µm
No. 100	150 µm
No. 140	106 µm
No. 200	75 µm
Pan	Pan

5.4.2 Atterberg limits

The Atterberg limits are moisture contents, ω, that correspond to the boundaries between different states and behaviors of soil. These boundaries, described from the driest to the wettest, are shrinkage limit (*SL*), plastic limit (*PL*), and liquid limit (*LL*). The *SL*, though not commonly used, is the ω at which any further reduction in water will not cause the soil to reduce in volume (i.e., shrink) when dried. In other words, soils with $\omega > SL$ will shrink when dried until reaching the *SL*. The *PL* and *LL*, per ASTM D4318, are the ω that mark the boundary between a soil's semisolid and plastic states, and the arbitrarily defined boundary between a soil's plastic and semiliquid states.[65] In practical terms, the *PL* can be conceptualized as the boundary that marks the ω below which soil loses its plasticity, whereas the *LL* is the ω that mark the boundary between soils in a plastic state or liquid state. Another important engineering property derived from the Atterberg limits is the plasticity

65. ASTM, *Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils*, D4318-17 (West Conshohocken, PA: American Society for Testing and Material, 2017).

index, PI, which is a range of ω in which a soil behaves plastically. Plasticity index is defined by the equation

$$PI = LL - PL. \quad (1)$$

5.4.3 Soil classification systems

While there are a number of soil classifications systems used in different professions and in different countries, there are three that are commonly encountered in geotechnical engineering (the engineering discipline from which the method herein is developed) and another used to qualitatively classify soil: (1) the Unified Soil Classification System (USCS), (2) the American Association of State Highway and Transportation Officials (AASHTO), (3) the US Department of Agriculture (USDA), and (4) a visual-manual procedure that does not use results from laboratory classification.

5.4.4 Unified Soil and American Association of State Highway and Transportation Officials (AASHTO) classification systems

The USCS (ASTM D2487) is commonly used for geotechnical engineering projects.[66] This classification system classifies soil into two major divisions, coarse grain (soils where more than 50% of the soil particles, by mass, are retained on the no. 200 sieve) and fine grain (soils where more than 50% of the soil particles, by mass, pass the no. 200 sieve), and then a number of subdivisions to fine tune the classification. The particle-size distribution and other basic engineering properties (e.g., LL; PI; coefficient of uniformity, C_u; and coefficient of curvature, C_c) are used to determine if a soil fits within a certain division or subdivision. The USCS process can be visualized using a chart (Table 2).

The AASHTO classification system (ASTM D3282) is typically used in transportation engineering.[67] While similar to the USCS in that the AASHTO system separates soil into granular (coarse-grain) and silt-clay (fine-grain) materials, the AASHTO system uses different boundaries to define the different soil types. Much like the USCS system, the AASHTO

66. ASTM, *Standard Test Methods for Classification of Soils for Engineering Purposes (Unified Soil Classification System)*, D2487-17 (West Conshohocken, PA: American Society for Testing and Material, 2017).

67. ASTM, *Standard Test Methods for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes*, D3282-15 (West Conshohocken, PA: American Society for Testing and Material, 2015).

uses the particle-size distribution in conjunction with the Atterberg limits to classify soil. AASHTO defines granular (coarse-grain) soil as one where 35% (by mass) of soil particles pass the no. 200 sieve, whereas a soil with more than 35% of soil particles (by mass) passing the no. 200 sieve is a silt-clay (fine-grain) soil. Table 3 and Table 4 present charts that visualize the classification process.

Table 2. Unified Soil Classification System (USCS) classification chart (after ASTM D2487).

				Soil Classification	
				Group Symbol*	Group Name
Coarse-grained soils (>50% retained on no. 200 sieve)	Gravels (>50% of coarse fraction retained on no. 4 sieve)	Clean gravels (<5% fines)	$C_u \geq 4.0$ and $1 \leq C_c \leq 3.0$	GW	Well-graded gravel
			$C_u < 4.0$ and/or $C_c < 1$ or $C_c > 3.0$	GP	Poorly graded gravel
		Gravels with fines (>12% fines)	Fines classify as ML or MH	GM	Silty gravel
			Fines classify as CL or CH	GC	Clayey gravel
	Sands (≥50% coarse fraction passes no. 4 sieve)	Clean sands (<5% fines)	$C_u \geq 6.0$ and $1.0 \leq C_c \leq 3.0$	SW	Well-graded sand
			$C_u < 6.0$ and/or $C_c < 1.0$ or $C_c > 3.0$	SP	Poorly graded sand
		Sands with fines (>12% fines)	Fines classify as ML or MH	SM	Silty sand
			Fines classify as CL or CH	SC	Clayey sand
Fine-grained soils (≥50% passes the no. 200 sieve)	Silts and clays (*LL* < 50)	Inorganic	*PI* > 7 and plots on or above "A" line	CL	Lean clay
			PI < 4 or plots below "A" line	ML	Silt
		Organic	$\frac{LL - \text{oven dried}}{LL - \text{not dried}} < 0.75$	OL	Organic clay
					Organic silt
	Silts and clays (*LL* ≥ 50)	Inorganic	*PI* plots on or above "A" line	CH	Fat clay
			PI plots below "A" line	MH	Elastic silt
		Organic	$\frac{LL - \text{oven dried}}{LL - \text{not dried}} < 0.75$	OH	Organic clay
					Organic silt
Highly organic soils	Primarily organic matter, dark in color, and organic odor			PT	Peat

* For a complete list of definitions for soil group symbols, see Natural Resources Conservation Service, "Engineering Classification of Earth Materials," in *National Engineering Handbook*, Part 631 (US Department of Agriculture, 2012), Table 3-9. https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=31847.wba.

Table 3. American Association of State Highway and Transportation Officials (AASHTO) classification of soils and soil-aggregate mixtures (after ASTM D3282).

General Classification	**Granular Materials ≤35% passing 75 µm (No. 200)**			**Silt-Clay Materials >35% passing 75 µm (No. 200)**			
Group Classification	A-1	A-3	A-2	A-4	A-5	A-6	A-7
Sieve analysis, % passing	—	—	—	—	—	—	—
2.00 mm (No. 10)	—	—	—	—	—	—	—
425 µm (No. 40)	50 max	51 min	—	—	—	—	—
75 µm (No. 200)	25 max	10 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing 425 µm (No. 40)	—	—	—	—	—	—	—
Liquid limit	—	—	[a]	40 max	41 min	40 max	41 min
Plastic limit	6 max	N.P.[b]	[a]	10 max	10 min	11 min	11 min

[a] See Table 4.

[b] N.P. = nonplastic.

Table 4. AASHTO classification of soil and soil-aggregate mixtures (after ASTM D3282).

General classification	**Granular Materials ≤35% passing 75 µm (No. 200)**							**Silt-Clay Materials >35% passing 75 µm (No. 200)**			
	A-1			A-2							A-7
Group classification	A-1-a	A-1-b	A-3	A-2-4	A-2-5	A-2-6	A-2-7	A-4	A-5	A-6	A-7-5, A-7-6
Sieve analysis, % passing	—	—	—	—				—	—	—	—
2.00 mm (No. 10)	50 max	—	—	—	—	—	—	—	—	—	—
425 µm (No. 40)	30 max	50 max	51 min	—	—	—	—	—	—	—	—
75 µm (No. 200)	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing 425 µm (No. 40)	—	—	—	—	—	—	—	—	—	—	—
Liquid limit	—		—	40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min
Plastic limit	6 max		N.P.[a]	10 max	10 max	11 max	11 max	10 max	10 max	11 min	11 min[b]
Usual types of significant constituent materials	Stone fragments and sand		Fine sand	Silty or clayey gravel and sand				Silty soils		Clayey soils	

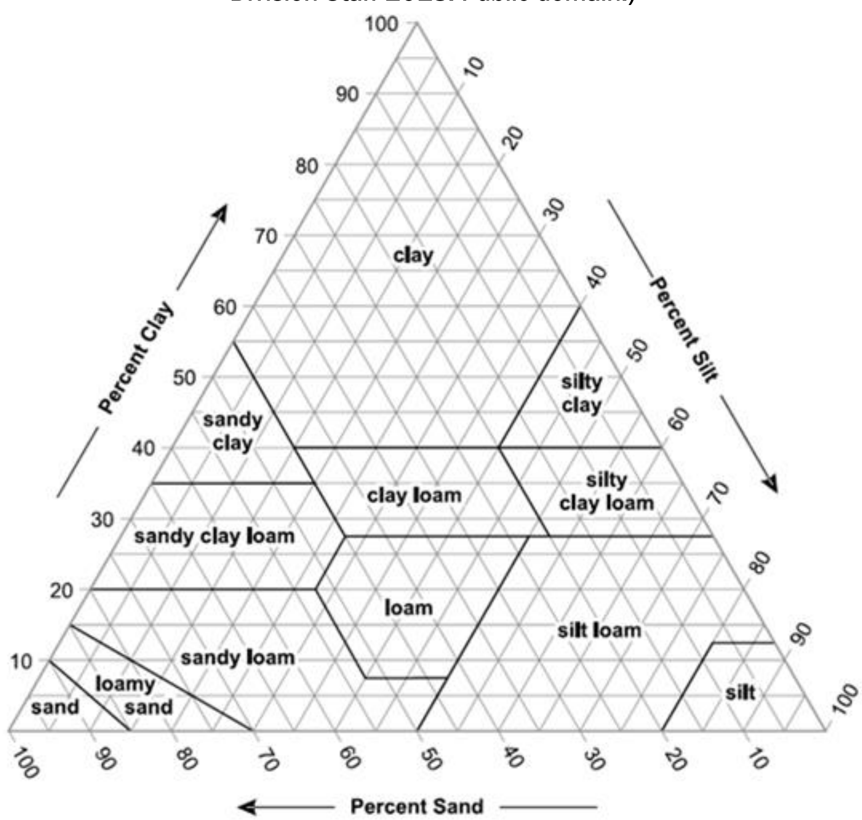
[a] N.P. = nonplastic.

[b] Plasticity index of A-7-5 subgroup is equal to or less than *LL* minus 30. Plasticity index of A-7-6 subgroup is greater than *LL* minus 30.

5.4.5 US Department of Agriculture (USDA) soil texture classification

While the USDA uses a particle-size distribution to classify soil, it is distinct from the other systems since its primary use is for agriculture and because it uses texture as the basis for its classification. USDA Handbook 18 defines soil texture as the "weight proportion of the [soil types] for particles less than 2 mm in diameter as determined from a laboratory particle-size distribution."[68] Because of the basis of the USDA classification is texture, there is an additional soil type, termed "loam," that is not present in the other systems; in an agricultural context, loam refers to a rich, fertile soil. The USDA system divides soil into clay (0.0002 to 0.002 mm), silt (0.002 to 0.05 mm), and sand (0.05 to 2 mm). Once each soil type is determined, the textural classification can be determined using the USDA textural triangle chart (Figure 92).

Figure 92. USDA soil texture triangle. (Image reproduced from Soil Science Division Staff 2018. Public domain.)



68. Soil Science Division Staff, *Soil Survey Manual*, edited by C. Ditzler, K. Scheffe, and H.C. Monger, USDA Handbook 18 (Washington, DC: Government Printing Office, 2018), 120.

5.4.6 Visual-manual classification

The visual-manual classification procedures (ASTM D2488) use visual examination combined with simple tests that can be performed by hand to classify soil with particles less than 3 in., (larger particles must be removed).[69] The manual-visual classification is similar to the USCS, though the percentages (of coarse-grain or fine-grain soil) are based on volume judged by visual inspection. Additionally, the visual-manual classification uses the USCS group symbols.

The visual-manual system divides soil into either coarse grain (>50% of the soil appears coarse grained) or fine grain (>50% of the soil appears fine grained). If the soil is identified as coarse grained, it can then be classified as either gravel or sand depending on what the predominant particle size appears to be. After that, the soil is further classified by whether it is clean or has fines and then its gradation. If the soil is identified as fine grained, then a series of manual tests are performed to determine dry strength (using finger pressure), dilatancy, toughness, and plasticity.

5.4.7 Materials tested

Five adobe soils were tested in this study. Table 5 presents these soils.

Table 5. List of soils tested.

Description	Number
East Brick	9
West Exterior Brick	15
East Brick	16
Shed East Wall	19
Shed West Wall	21

5.4.8 Methodology

The methodology used to develop the specification for each soil was driven by the small sample sizes obtained while on site. Indeed, the small sample size precluded many of the typical characterization tests. Per ASTM D6913, a particle-size analysis requires a minimum sample weight of 1.3 kg when the maximum particle size is ¾ in. (19.0 mm); each soil had trace

69. ASTM, *Standard Practice for Description and Identification of Soils (Visual-Manual Procedures)*, D2488-17 (West Conshohocken, PA: American Society for Testing and Material, 2017).

amounts of soil particles with a particle size of ¾ in. (approximately 5% by volume, judged visually).

Additionally, per ASTM DD4318, the tests to determine the Atterberg limits require at least 150 to 200 g of soil passing the no. 40 sieve (425 µm), but four of the five soils yielded less than 100 g, with the fifth yielding approximately 60 g.[70]

Considering these difficulties, the authors developed a method to obtain the engineering parameters for adobe soil specifications. Additionally, the authors opted to use methods that were inexpensive and repeatable by personnel with little to no geotechnical laboratory experience. Thus, the authors decided to specify the adobe soil by soil type, plasticity index, and color.

5.4.9 Soil type

Soil type was obtained using the visual-manual classification system. While ASTM D2488 specifies that a minimum of 2.2 lb (1.0 kg) of soil is required when the maximum particle size is 3/4 in. (19.0 mm), it also states that the soil still be classified if the minimum is not met, though it must be noted.[71] Thus, the reader should note that none of the adobe soils met these criteria.

The five soils behaved similarly during the visual-manual classification and are thus described together. The authors identified each of the five soils as fine grained and each with a medium strength (the dry specimens broke with considerable finger pressure). Each specimen exhibited a slow dilatancy (water appeared slowly on the surface of a ball-shaped specimen during shaking) and a medium toughness (only medium pressure was required to roll the thread to near the plastic limit). Finally, each soil was easy to roll into an approximately 1/8 in. (3 mm) thread and could be rerolled after reaching the plastic limit; thus, each specimen was classified as having medium plasticity. Based on the results of the visual-manual classification, the five specimens were all identified as an elastic silt (USCS group MH).

70. ASTM, *Liquid Limit, Plastic Limit, and Plasticity Index of Soils*.

71. ASTM, *Description and Identification of Soils (Visual-Manual Procedures)*.

5.4.10 Soil color

Soil colors were identified using the Munsell color chart. Table 6 presents the colors of soil sampled.

Table 6. Soil colors obtained using the Munsell color chart.

Description	Number	Color
East Brick	9	7.5YR 2.5/1 (black)
West Exterior Brick	15	10YR 3/3 (dark brown)
East Brick	16	10YR 3/3 (dark brown)
Shed East Wall	19	10YR 3/2 (very dark-grayish brown)
Shed West Wall	21	10YR 3/2 (very dark-grayish brown)

5.4.11 Atterberg limits for small soil samples

In the United States, Atterberg limits are typically obtained using ASTM D4318 via the Casagrande cup (for *LL*) and the thread-rolling method (for *PL*). Performing the *LL* test using the Casagrande cup requires approximately 200 g of soil, which, due to the small sample size, was not available.[72] The *LL* for each soil was not obtained via laboratory testing, though the authors recognized that it would be needed to determine *PL* as part of the specifications for adobe soil.

To overcome this limitation, the authors opted to obtain the *PI* via correlation. This would be possible by determining the *PL* using a fall cone penetrometer.[73] The fall cone method is performed dropping a cone weighing 80 g over a distance of 20 mm into a sample of soil and allowing the cone to penetrate a soil specimen for 5 sec. The depth of penetration, d, is recorded along with the ω of the soil. The depth of penetration and ω can then be plotted against each other allowing the *PL* to be determined using the following equation:[74]

$$PL = \omega \left(\frac{2}{d}\right)^{m}, \tag{2}$$

72. ASTM, *Liquid Limit, Plastic Limit, and Plasticity Index of Soils*.

73. Tao-Wei Feng, “Fall-Cone Penetration and Water Content Relationship of Clays,” *Geotechnique* 50, no. 2 (2000): 181–187.

74. Tao-Wei Feng, “Using a Small Ring and a Fall-Cone to Determine the Plastic Limit,” *Journal of Geotechnical and Geoenvironmental Engineering* 130, no. 6 (2004): 630–635.

where

d = depth of penetration and

m = slope of the regression line obtained from the fall cone penetrometer analysis.

Once PL is known, PI can be computed using the equation from O'Kelly et al.:[75]

$$PI = PL(10^m - 1) \tag{3}$$

The results of the fall cone penetrometer analysis are summarized in Table 7.

Table 7. Plastic limit and plasticity index of sampled soils.

Description	Number	*PL*	*PI*
East Brick	9	13	26
West Exterior Brick	15	19	26
East Brick	16	15	34
Shed East Wall	19	12	22
Shed West Wall	21	12	21

5.4.12 Final specifications

New soils used to repair the historic construction at the José María Gil Adobe can be obtained using the specifications given in Table 8.

Table 8. Final specifications to match historic soils.

Description	Number	Soil Type	Soil Color	*PL*	*PI*
East Brick	9	Elastic silt (MH)	7.5YR 2.5/1 (black)	13	26
West Exterior Brick	15	Elastic silt (MH)	10YR 3/3 (dark brown)	19	26
East Brick	16	Elastic silt (MH)	10YR 3/3 (dark brown)	15	34
Shed East Wall	19	Elastic silt (MH)	10YR 3/2 (very dark-grayish brown)	12	22
Shed West Wall	21	Elastic silt (MH)	10YR 3/2 (very dark- grayish brown)	12	21

75 B. C. O'Kelly, G. Mesri, and R. B. Peck, "Discussion on a New Method of Measuring Plastic Limit of Fine Materials," *Geotechnique* 61, no. 1 (2011): 88–92.

6 Stage IV: Wood

The José María Gil Adobe has both exterior and interior wood details. There is significant damage to these features due to neglect, as the building has been abandoned for many decades. The “POOR” present conditions are a result of the wooden material’s age and exposure to the outdoor elements, as well as deterioration from wildlife that have entered the building. Many wooden details, both exterior and interior, have been added, replaced, and strengthened, as there have been many owners and as various features of the structure failed. Some wooden details may be original.

6.1 Exterior wood features

The José María Gil Adobe has a veranda that currently surrounds all but the north-facing sides of the building. The veranda roof is held up by wooden members, some appearing to be actual size 2 × 4 in. boards and some nominal 2 × 4 in. boards (Figure 93).[76] The roof is supported by both 2 × 4 in. and 4 × 4 in. members. Some of the newer wooden members are in “GOOD” condition; however, the frames themselves are in “POOR” condition due to inadequate connections and neglect.

76. An “actual” size 2 × 4 in. board refers to a wooden member that is truly 2 inches by 4 inches in dimension. A “nominal” size 2 × 4 in. board refers to a wooden member that is 1.5 inches by 3.5 inches: a shift in the lumber industry in response to high lumber demands post World War I, in the mid-1920s. Looking at these lumber sizes is valuable in determining the age of the lumber (i.e., when these sizes were available and used).

Figure 93. All wood support types, 2 × 4 in. and 4 × 4 in., as structural components for the veranda roof of the José María Gil Adobe, 2021. (ERDC-CERL.)

The underside of some portions of the existing veranda of the José María Gil Adobe are wooden shingles that are in “POOR” condition. These shingles are visible when standing under the veranda looking up. Figure 94 shows the shingles resting on the wooden frame without any roof sheathing, which is historically accurate for a wood-shingled roof built during the 19th century.

Figure 94. Looking up at wooden shingles under the south veranda roof of the José María Gil Adobe, 2021. (ERDC-CERL.)

In some areas, the veranda roof is not original and was added by connecting the rafters (Figure 95). The boards extending from the structure itself may be part of the original roof overhang. The wooden members with a notch at their ends may be part of the original roof.

Figure 95. Looking at the connection between the veranda roof to the roof of the José María Gil Adobe, 2021. (ERDC-CERL.)

The José María Gil Adobe has multiple roofs. There are areas of the building where roofs are stacked in layers. Based on the coloration of the material, the sizes of the material, and the clear failure of the lower roof, all seen in Figure 96, the roof seen from the exterior is not the original roof. Pictured in Figure 96 is what could be the original roof, collapsed underneath the upper roof that was added in 1993.

Figure 96. Collapsed roof under the top layer roof on the south side of the José María Gil Adobe, 2021. (ERDC-CERL)

Wooden trim lines the exterior windows and doors of the José María Gil Adobe (Figure 97 and Figure 98). The trim varies in sizes from 3 to 5 in. within and between windows, meaning a single window could have a 5 in. piece of trim on the left side and a 4 in. piece of trim on the right. In some cases, the edges of the wood have split and broken off. The trim is missing in some areas, and it is also very crooked due to lack of fasteners as many have rusted away. It is important to remember that no two doors or windows are alike on this structure. This is due to the uniqueness of the adobe building, resulting in multisized window and door openings, as well as the fact that some are of different materials and ages. The windows were originally six-over-six, double-hung wood windows. Many windows are missing either some or all of their muntins (Figure 99).

Figure 97. White-painted door trim surrounding a door on the west side of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 98. White-painted window trim surrounding a window on the west side of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 99. Sagging windows and missing muntins on the west side of the José María Gil Adobe, 2021. (ERDC-CERL.)

The José María Gil Adobe has two types of exterior wooden doors. The main type is a door constructed of vertical boards (Figure 100), with an X-brace on the inside (Figure 101).

Figure 100. Main exterior door type on the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 101. X-brace pattern on the inside of the main exterior door type on the José María Gil Adobe, 2021. (ERDC-CERL.)

There is another door type that is constructed using verticle boards but has a window opening (Figure 102).

Figure 102. Door type with window opening, located on the southwest facade of the José María Gil Adobe, 2021. (ERDC-CERL.)

Animals digging along the perimeter of the José María Gil Adobe led to the exposure of the wooden base of the adobe wall (Figure 103). It was common for builders to use wooden members or stones to act as a foundation, though some adobes had little to no foundation.

Figure 103. Wooden sill supporting the base of the adobe wall at grade level of the José María Gil Adobe, 2021. (ERDC-CERL.)

The US Army purchased the José María Gil Adobe in September of 1940 and since then has tried to keep the adobe standing by using insufficient and temporary methods. Wooden, buttress-like support braces were added on the north side of the building to prevent the walls from collapsing outward, contributing to load support in the lateral direction (Figure 104). The concrete columns on the northeast side of the building (there are crumbling columns on the south side) have been increased in height by wooden disks, most likely for leveling purposes (Figure 105). Some columns have failed and are now supported with wooden braces (Figure 106).

Figure 104. Wooden support braces supporting the northeast wall of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 105. Wooden disks on top of the concrete columns supporting the veranda roof, possibly for leveling purposes, on the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 106. Two wooden 2 × 4 in. boards supporting a concrete column that is cracked in multiple places, 2021. (ERDC-CERL.)

Due to the erosion on the exterior portion of the south chimney, two circular wooden posts horizontally placed into the chimney are now exposed (Figure 107). It was common to place wooden shims within adobe walls for leveling and strengthening purposes. These wooden pieces are not visible on the interior of the building.

Figure 107. Circular posts imbedded into the south chimney of the José María Gil Adobe, 2021. (ERDC-CERL.)

6.2 Interior wood features

There are many wooden details on the interior of the José María Gil Adobe, most in "POOR" condition. There is a major bat infestation, leaving much of the wooden material on the floor and walls saturated in bat guano. Many windows and doors lack trim on the interior. There are no major failures or breaks in the ceiling boards, but it is likely that most of the wooden components are rotten. The floor is broken in multiple locations, and boards are missing in many areas, making it unsafe to walk on.

The entire ceiling of the José María Gil Adobe is made of wooden materials. Of the eight rooms, most of the ceiling's boards are supported by exposed 2 × 4 in., 4 × 4 in. boards, or other various-sized wooden joists spaced unevenly and randomly, most likely added where sagging occurred.

The ceiling boards are multisized planks (Figure 108 and Figure 109), and some are beadboard (Figure 110). Some boards appear to be much newer than others, specifically the studs supporting the middle of the ceiling (Figure 111). All of the paint on the ceiling boards is peeling.

Figure 108. Multisized and multiaged wooden members supporting the ceiling within the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 109. Wooden ceiling joists, 2 × 4 in., supporting wooden ceiling boards in the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 110. Beadboard ceiling in the northern portion of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 111. Wooden 4 × 4 in. post supporting the ceiling in the José María Gil Adobe, 2021. (ERDC-CERL.)

The floor of the José María Gil Adobe is wood strip flooring in some rooms and dirt in others. The wooden floors are in "POOR" condition. The majority of the floorboards are rotten due to their age and exposure to the elements due to roof leaks and wildlife. The floor is missing boards in some areas due to breakage (Figure 112, Figure 113, and Figure 114).

Figure 112. Wood strip flooring with breakthrough areas near an exterior door of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 113. Wood strip flooring with breakthrough areas in a central location of a floor in the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 114. Broken wood strip flooring piled near exposed plumbing in the José María Gil Adobe, 2021. (ERDC-CERL.)

There is a wooden shelf located in the north portion of the José María Gil Adobe (Figure 115). The room with the shelf has plumbing connections, square shower floors, and a wooden toilet paper roll holder that is pictured in Figure 116. These bathroom fixtures were installed when the Army acquired the José María Gil Adobe during World War II. There is a wooden coat closet near an interior door in the south portion (Figure 117).

Figure 115. Wooden shelf in the World War II–era bathroom of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 116. Wooden toilet paper roll holder in the World War II–era bathroom of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 117. Wooden coat closet in the southern portion of the José María Gil Adobe near an interior door, 2021. (ERDC-CERL.)

The José María Gil Adobe has wooden windows and wooden window and door trim throughout the interior of the building. There is a singular wooden door that remains on the interior of the building. There are many wooden elements within the adobe walls, such as shims or headers. The wooden trim varies in sizes throughout the building as some of the edges are broken due to splitting. There are many irregular shapes as well as crooked details due to the age of the material and the uniqueness of the openings.

The interior wooden window and door trim has various sizes, measuring in the range of 3 to 5 in. The trim is in “POOR” condition. Many trim boards are rotton or out of place (Figure 118 and Figure 119).

Figure 118. Crooked and various-sized window trim in the north wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 119. Interior wooden door trim with a missing board on the *right side* in the José María Gil Adobe, 2021. (ERDC-CERL.)

The current windows are wooden and appear to have originally been six-over-six, wood-sash, double-hung windows, though many are missing some or all of their muntins. See Figure 120, showing intact wood muntin on the top half of the window.

Figure 120. Remnants of a six-over-six, wood-sash, double-hung window on the south wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

The José María Gil Adobe has wooden window and door headers throughout the building of various forms and sizes. Some header components are covered by wooden trim (see covered version in Figure 121 and exposed version in Figure 122). Most interior doors are missing; however, the wooden door headers support the thick adobe walls in the openings (Figure 123). The doors have wooden thresholds (Figure 124).

Figure 121. Wooden window header covered with wooden trim in the south wing in the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 122. Exposed wooden window header in the south wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 123. Wooden door header in the south wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 124. Wooden threshold transition between two rooms in the south wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

The wooden elements are used for structural or leveling purposes to act as a frame to help the handmade blocks rise to a consistent height. The wooden elements are placed horizontally between rows of adobe bricks (Figure 125).

Figure 125. Wooden element embedded within the adobe wall in the south wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

On the interior walls of the José María Gil Adobe are wooden wainscoting, (some with chair rails) of various board forms and dimensions. In the north wing of the building is approximately 3 in. beadboard wainscoting that was painted olive green (Figure 126). Some rooms have wainscoting built of larger boards of various sizes, shown in Figure 127.

Figure 126. Beadboard wainscoting in the north wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 127. Various-sized plank wainscoting with a chair rail in the south wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

The north wing of the José María Gil Adobe was heavily modified after the building was acquired by the Army during World War II. Wooden cabinets and counters as well as partition walls were added to create kitchen and bathroom space in this wing. The wooden kitchen elements remain in “POOR” condition (Figure 128). The addition of wooden walls served a double purpose of creating the bathroom space as well as supporting roof loads in this wing. The walls were constructed using a 2 × 4 in. frame with a mixture of plywood and wood plank sheathing (Figure 129 and Figure 130). The wooden materials appear to be in “FAIR” condition.

Figure 128. Wooden kitchen elements in the north wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 129. Wooden partition wall using plywood and studs, framing the bathroom space in the north wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 130. Wood plank portion of the partition wall in the north wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

In the northmost corner of the building's north wing is a wooden element that extends from the floor to the ceiling (Figure 131). The element is painted olive green to match the painted interior plaster. The purpose of this element is unknown.

Figure 131. Floor to ceiling wooden element in the northmost corner of the José María Gil Adobe, 2021. (ERDC-CERL.)

6.3 Treatment measures

The following images and documents offer treatment measures for exterior and interior wooden materials that are in "POOR" condition. The sources include information from the National Park Service and *Adobe Conservation: A Preservation Handbook*.

6.3.1 *Adobe Conservation: A Preservation Handbook*, “Lintel Repair, Replacement, and Installation,” 2006[77]

LINTEL REPAIR, REPLACEMENT AND INSTALLATION

A lintel is a horizontal architectural element, typically made from a strong wood beam that spans the top of a window or door opening and carries the load of the wall and roof above the opening. The successful installation of a lintel in an adobe or stone structure, whether it is for repair of an existing door or window or, as we discuss in the next section, for a new door or window opening, depends upon the correct transfer of the weight loads above it. The sizing and installation of the replacement lintel is very important in successfully carrying that weight. Keep in mind that the weight load above the window or door opening must be supported while the installation process is going on.

As with every procedure discussed in this handbook, the first step is to identify the source of the problem that has caused the old lintel to deteriorate. Typically a lintel needs to be replaced because it has rotted, cracked or broken, or was undersized to begin with and is incapable, therefore, of supporting the load it must carry. In some cases the lintel may be missing altogether.

You must also keep in mind that an old lintel contains valuable information about the building it is part of, and therefore you should seek to repair before you replace it. Clues to the age of the building, or at least of the age of the lintel, can be obtained from observing whether it was cut by hand with an ax or adze, or with a saw. Also, experts may be able to determine when the old lintel was cut using dendrochronology - the tree ring dating system. Always check with your State Historic Preservation Office before working with the wooden elements of an historic building. They can advise you on correct procedures for inspecting, analyzing and, if necessary, archiving historic wooden materials.

Lintel repair and replacement was an important part of the preservation project completed in 2005 at the mid-19th century mission at Soccoro, Texas.
(Pat Taylor, 2004)

77. This section reprints with permission from Cornerstones Community Partnerships, “Lintel Repair, Replacement, and Installation,” in *Adobe Conservation: A Preservation Handbook*, illustrated by Contreras Francisco Uviña (Santa Fe, NM: Sunstone Press, 2006), 117–126.

TOOLS AND MATERIALS REQUIRED

REPLACING AN EXISTING LINTEL

1. The space below the lintel must be shored up. If a door or window rough buck is in place, it should be left in position until the replacement lintel has been installed.

2. Determine the correct length for the replacement lintel by measuring the width of the window or door opening. The lintel must span the opening and extend beyond it on each side of the opening for a minimum of one-third of the width of the opening. For example, if the width of the opening is four feet (48 inches), then the lintel needs to extend for a minimum of 16 inches into the adjacent wall. If the opening the lintel needs to span is wider than the typical three- or four-foot window or door opening, we recommend that you consult with an experienced tradesperson or structural engineer to determine the optimum dimension for the replacement lintel.

3. For a standard three- to four-foot opening, a six-inch lintel is adequate. If an existing lintel of a lesser height is in good condition, not deflecting, broken or deteriorated, do not replace it.

4. The depth of the wall will dictate the number of pieces of lumber you will need to create the lintel. You will need at least two identically sized pieces of lumber, one for each side of the wall, and in cases where the wall is particularly deep, you may need to build the lintel from more than two pieces of wood. Figure out how many you will actually need and have them nearby.

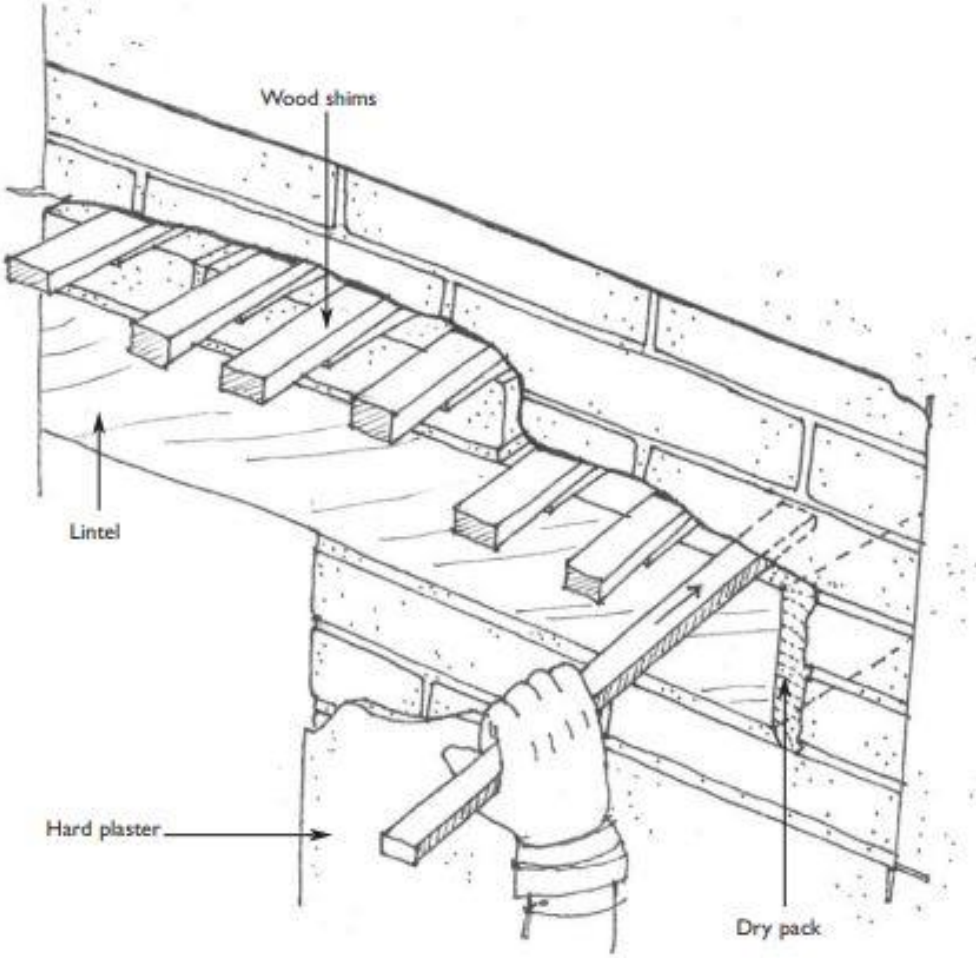
5. Remove the damaged or rotten lintel on only one side of the wall at a time. (Always remove just the amount of wall plaster and material necessary to create a space large enough to remove the old lintel and to insert the new.) If you need to remove any adobe or stone from the area in order to fit the new lintel in place, make sure you only remove them from a space equal to one-half the wall depth. This is essential for correctly transferring wall loads and for your safety. Remember: Never remove more than half the depth of the wall at any point in this process. If rough buck and window are in place, do not remove adobes first from above because they help support the wall load. In that event, remove adobes from the opposite side first.

6. A wrecking bar, hammer, trowel, and/or a drill with a masonry bit can be used to remove material. It is very important to keep vibrations to a minimum when removing material. Do not do any heavy banging on the wall. If the material is too difficult to remove, the drill and masonry bit can help in drilling out the mortar joints in order to get started. Clean out the opening with a whiskbroom as soon as one side of the old lintel and any extraneous wall material have been removed.

7. Place the first piece of the lintel in the opening you have created. Check to see that you have an even space of 1/2 to 3/4 inches all around the lintel. Make sure the base of the lintel where it bears on the wall is flat and level. If the depth of half the wall is deeper than just one lintel install the first lintel all the way to the back of your cleaned out opening. If your work has to stop for the day, or be otherwise interrupted, shim the lintel with wood shims so that your space is even all the way around it. Place shims every four to six inches and snug them tight.

8. When you are certain the new lintel fits well into the space and is level, lift it out of the space and wet all of the wall surfaces around the space where the lintel will fit and lightly wet the surface of the lintel. Spread a thin layer of mud mortar (no more than 3/4 of an inch thick) on the surfaces of the opening and then insert the lintel into the space. Place wood shims between the top of the lintel and the walls every four to six inches. Make sure they are snug and tight and then allow the wet mortar to dry.

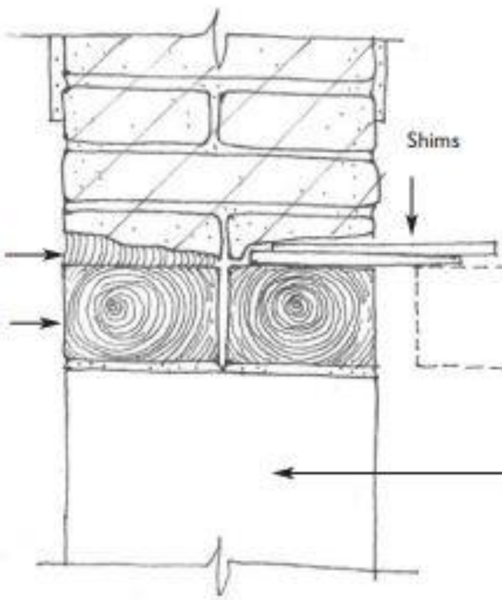
9. Fill in the space around the lintel with dry-pack mortar. It is preferable to make the dry-pack mortar from the same material that the adobes, stones or brick were originally mortared with. When using mud, mix the material well and add some of the dry material to it. The dry material should be screened so that it will mix well with the wet material. Mix your mortar thoroughly so that it is not wet, but just moist enough so that when you close your hand around it, it will keep its form and will not squeeze out between your fingers (see Part Two, *Basal Repairs*).



10. Using a 3/8-inch margin trowel push the dry-pack mortar into the space around the lintel. Do not remove your shims just yet. Make sure the dry-pack is pushed the entire way back into the space around the lintel. A push stick may be needed to get this material all the way to the back. As you push this material in, you want to pack it tightly and slowly build it out to the face of the lintel. Double check that you have it forced back all the way and that it is well compacted and keeps its shape.

NOTE: The reason for using a dry-pack mud mortar is that if you used a wet mix it would shrink and not evenly carry the weight of the wall above it. If the packing mortar is too wet it will shrink and leave a gap as it dries, which will eventually result in the lintel cracking or even failing sometime in the future. In cases where you are using a lime rather than a mud dry-pack mortar mix, make sure the lime mortar is mixed thoroughly and is not too soupy. A lime mortar mix can have a little more moisture in it than a mud dry-pack. As a lime mortar dries, one needs to to push or pack it back into the space being filled. This will ensure that the lime mortar does not create problems as it dries out and shrinks. Remember that the material the adobe, stone, or brick was laid with originally will dictate the type of mortar to be used around the replacement lintel.

11. As soon as the material has dried, pull the shims out one at a time. Then dry-pack the space that is left until you have completely set the lintel. The amount of time it takes for the dry-pack mortar to completely dry will depend on weather conditions.



12. If you need to set in another piece of lintel on this side of the wall, repeat the steps followed for inserting and dry-packing the first piece of the lintel.

13. When one side of the wall is finished and has been allowed to dry, begin the other side. Using a drill and a long, thin masonry bit drill holes just above and below the new lintel and at each of its corners all the way through to the other side of the wall. The exit holes created on the opposite side of the wall will act as guides when work begins on that side.

14. Move to the other side of the wall and find the holes just drilled. Remove the wall material that is outlined by the drill holes created from the other side of the wall. Use a chisel to remove the wall plaster covering the remaining portion of the old lintel on this side of the wall. This can also be done by using a large masonry bit to drill holes about 2 inches apart that create a pattern of squares. Then use a small crowbar or chisel to slowly break the wall material apart within each square. (Whichever method used, always remove just the amount of wall plaster and material necessary to create a space large enough to remove the old lintel and insert the new.) Continue to excavate in this manner into the wall until the remaining portion of the old lintel is located, if it still exists, or the backside of the lintel installed from the other side of the wall is encountered.

15. Adjust the opening being created so that everything lines up correctly. Then install the remaining piece or pieces of the new lintel by repeating the steps carried out on the other side of the wall.

NOTE: Remember to insert blocking or shims as major portions of the old lintel or surrounding wall material are removed so that the weight of the wall above the opening being made always remains supported.

INSTALLING A NEW LINTEL

The process for creating an entirely new opening for a door or window in an adobe wall is similar to that described in the preceding section. However, you should never create a new opening in an historic building without first consulting with preservation experts at Cornerstones or your State Historic Preservation Office. They will advise you about how to do this in a manner that does not compromise the historic and architectural integrity of the old building. There are also certain building codes that you must comply with and you may need professionals to help you understand them.

It is also important to remember that a new door or window opening in an adobe building must never be placed too close to the corner of a room, nor too close to the point of intersection with another wall. Should this be done, excessive strain will be placed on the adobe walls in the vicinity of the new door or window.

Before beginning refer to the preceeding section and the illustrations included in it.

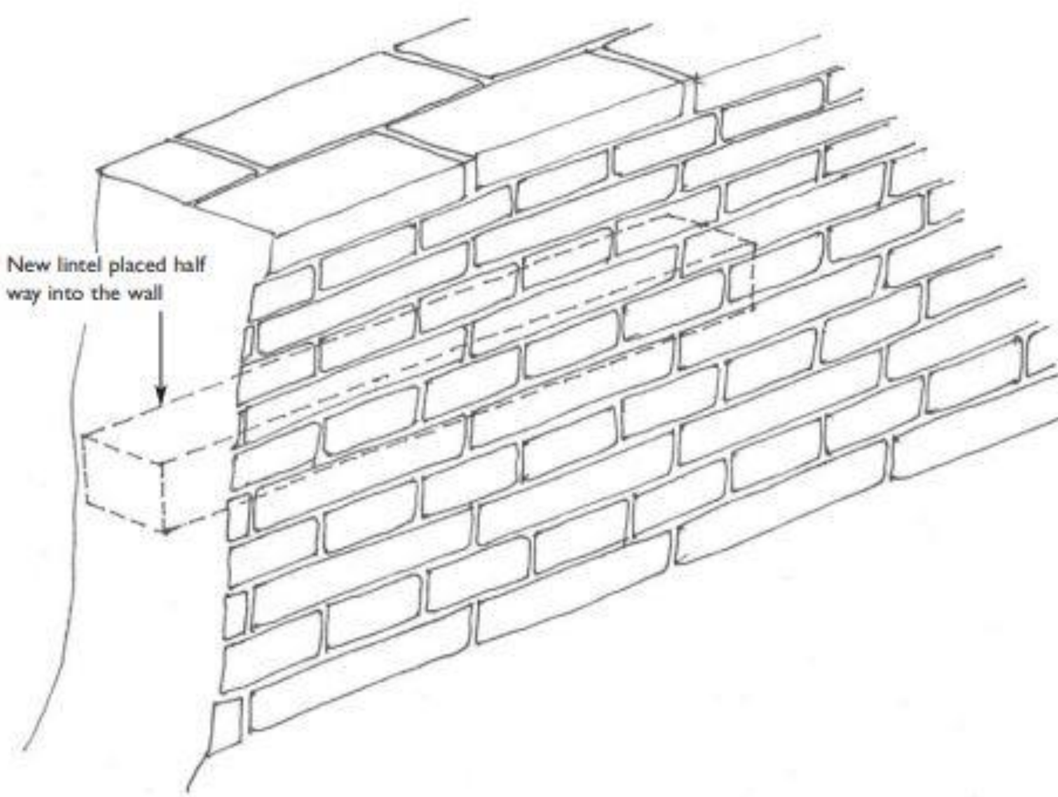
1. Determine the width of the opening needed for the window or door that needs to be installed. Actually draw it out on the wall using a tape measure, level and pencil. Review the information on loading in the previous section. Remember, that a minimum of one-third the width of the window or door is required on each side of the new opening to ensure that the new lintel will properly support the weight of the wall above it.

2. The height dimension of the lintel should be determined by the width of the opening and the load of the wall above. Typically, the height dimension of the lintel will be dictated by the coursing of the adobes. Usually a two course height of adobe will provide an adequate lintel height for a modestly sized (three to four feet) door or window. If the width of the opening is wider than a typical door or window opening seek the advice of an experienced tradesperson or engineer. And remember, a new opening should not be located next to a corner or an intersecting wall. Stay at least the width of the opening away from such a corner (See *New Mexico Historic Earthen Buildings Code*).

3. Now score the lintel dimensions on top of the opening you drew on the wall. Draw the length and height and allow an extra 1/2 or 3/4 inch space around your actual lintel. This extra space will be important when you install your lintel so that you have enough room to maneuver and also for shimming and dry-packing. The depth of the wall will dictate the number of lintel members you will need. At least two members are needed; one for each side of the wall. Figure out how many are actually needed and have them nearby.

4. Install the lintel in two steps by inserting it into a space that is half the depth of the wall in each step. Start on one side of the wall by removing the adobes within the first half of the depth of the wall. This is essential in order to transfer the wall loads and for safety. Never remove more than half of the wall depth at any time.

5. The assortment of tools that can be used to remove the material include a crowbar, hammer, trowel, and/or a drill with a masonry bit. Keep vibrations to a minimum when removing the material. Do not do any heavy banging on the wall. If the material is too difficult to remove, the drill and masonry bit can be used to assist in drilling mortar out of the joints in order to get started.



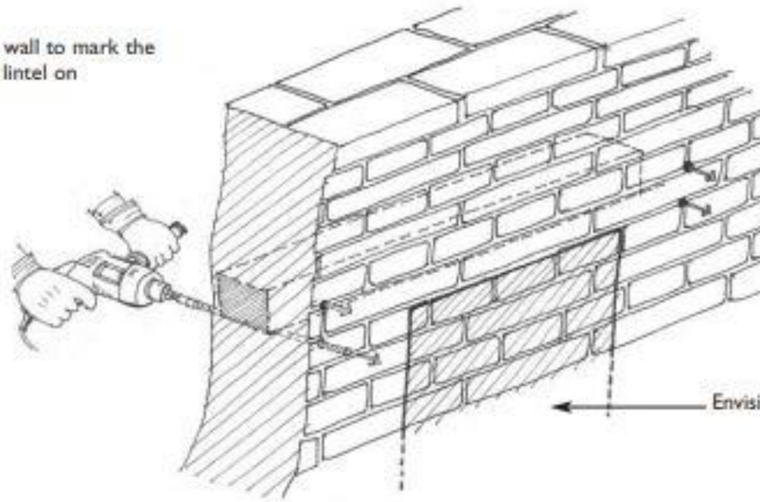
6. Once the material is removed, clean out the space with a whiskbroom and place the lintel in the opening created. Check to see that an even space of 1/2 to 3/4 of an inch exists around the lintel. Make sure the base of the lintel where it bears on the wall is flat and level. If the depth of half the wall is deeper than just one lintel install the first lintel all the way to the back of the cleaned-out opening.

7. Shim the lintel with wood shims so that your space is even all the way around it. Place your shims every four to six inches and snug them tight. Make sure the base of the lintel remains flat and level.

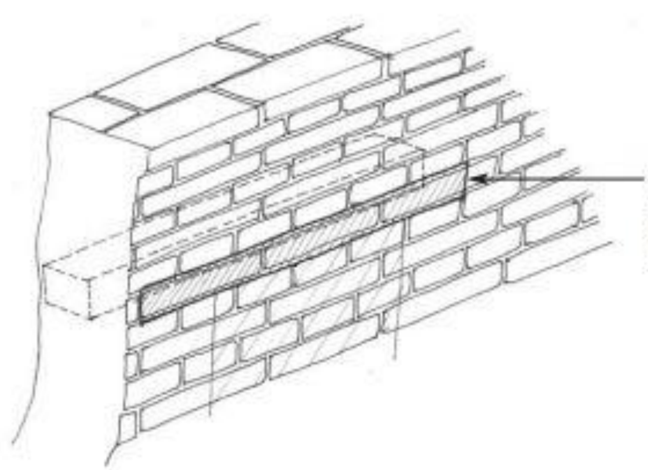
8. Now you are ready to fill in the space around the lintel. It is preferable to fill this space with the same type of material that the adobes are mortared with. When using mud, mix the material well and add some of the dry material to it. The dry material will be the same type of material used for mud mortar, but screened in order to mix well. Mix it thoroughly so that it is not wet. Rather, when you close your hand around it, it should have enough moisture to keep its form but not squeeze out between your fingers. Using a 3/8-inch margin trowel push the dry-pack material into the space around the lintel. Do not remove your shims just yet. Make sure the dry-pack is pushed the entire way back into the space around the lintel. You might need a push stick to get this material all the way to the back. Pack the material in and slowly build it out to the face of the lintel. Double check that the material has been forced back all the way, and that it is compacting well and keeping its shape.

NOTE: The reason a dry-pack mud is used is because a wet mix will shrink and not carry the weight of the wall above it evenly. When using a lime mortar mix make sure it is mixed thoroughly and that it is not too soupy. This mix can have a little more moisture than the mud dry-pack. You will be able to push in the lime mortar as it dries to ensure that it does not create problems as it shrinks. Remember that the material you use will be dictated by the material with which the adobe, stone, or brick was laid. See Part Two, *Basal Repairs* for more information on using dry-pack mud.

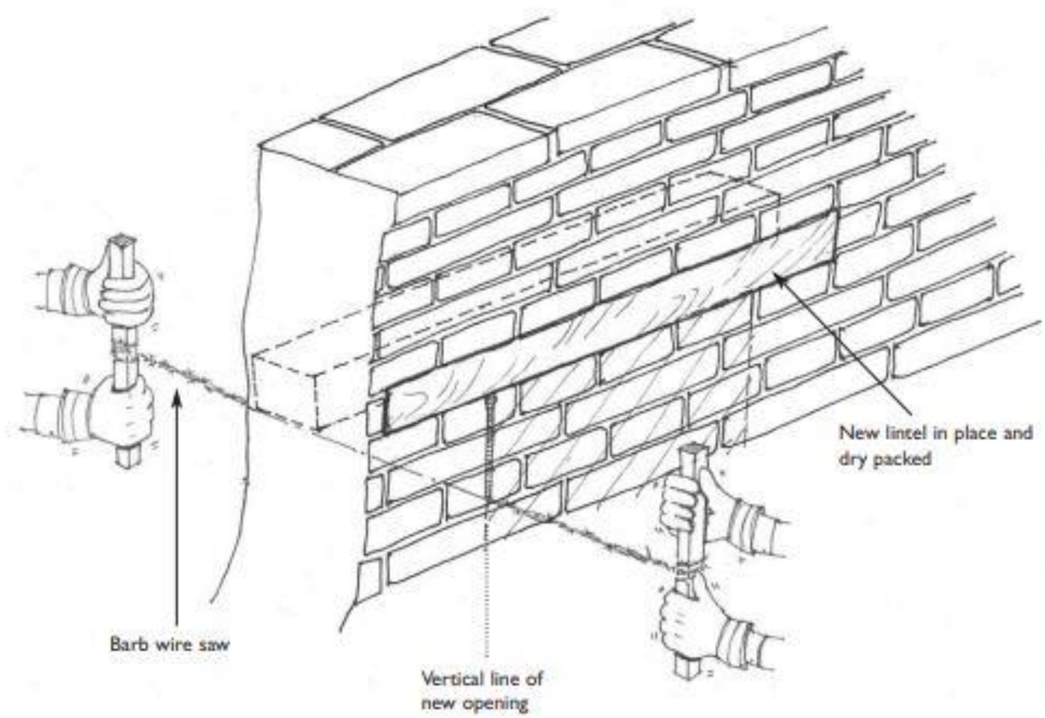
9. Once the material has dried, pull the shims out one at a time and dry-pack the voids left by each shim until the process is complete. Repeat this process if you need to set another lintel in place because the depth of half the wall is greater than the depth of the first lintel installed.



10. Now that you have finished one side of the wall, you are ready to begin the other side. Using a drill and a masonry bit, drill through to the other side at all four corners of the new lintel and at the outside width of the new opening . You can also use a section of electrical conduit pipe, driving it through the wall a few inches at a time with a hammer and occasionally removing the dirt from the conduit with a hammer and/or a screwdriver. If the wall is stone or brick, a conduit pipe or drill will not be effective. In that case, you will need to measure up from the floor or down from the ceiling and/or from the corners to determine placement of the new lintel and opening.



11. Using a measuring tape, level and pencil, layout the placement of the opening and the lintel. Double-check the measurements. Make sure everything is going to line up correctly. Start the removal of wall material from each end of the lintel space. Once you have dug back into the wall and located the backside of the new lintel on the other side, adjust your opening so that everything lines up. After that, it is a straight-forward process; just repeat the installation instructions above.



12. Once you have installed the lintels on both sides of the wall you can cut out the opening for the new door or window. There are several ways to do this. In an adobe wall the easiest way is to make a saw out of several strands of barbed wire twisted together and fastened to wooden handles at each end. The "saw" will need to be at least three feet longer than the depth of the wall in order to prevent you from scraping your hands and fingers against the rough wall as you pull the saw back and forth. First cut a hole that is just big enough to get the barbed wire saw through just below the lintel and at the edge of the opening . Once the barbed wire saw is ready to go locate someone to help you on the other side. Then just start sawing back and forth keeping an eye on the vertical line drawn for the opening.

13. When you have finished one side, set up and start on the other. Wear dust masks and goggles, and have a fan going to move the dust from the area. If you are working inside, cover and protect anything you don't want to get dirty. Allow time for the mortar to sufficiently dry before starting the other side. Leave the middle mass of material in the opening to help support the bearing weight until all your mortar work is dry.

6.3.2 Preservation Brief 19, *The Repair and Replacement of Historic Wooden Shingle Roofs*, 1978[78]

19 PRESERVATION BRIEFS

The Repair and Replacement of Historic Wooden Shingle Roofs

Sharon C. Park, AIA

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

The Secretary of the Interior's "Standards for Rehabilitation" call for the repair or replacement of missing architectural features "based on accurate duplication of features, substantiated by historic, physical, or pictorial evidence rather than on conjectural designs." On a wooden shingle roof, it is important not only to match the size, shape, texture, and configuration of historic shingles, but also to match the craftsmanship and details that characterize the historic roof. Proper installation and maintenance will extend the life of the new roof.

Introduction

Wooden shingle roofs are important elements of many historic buildings. The special visual qualities imparted by both the *historic shingles* and the *installation patterns* should be preserved when a wooden shingle roof is replaced. This requires an understanding of the size, shape, and detailing of the historic shingle and the method of fabrication and installation. These combined to create roofs expressive of particular architectural styles, which were often influenced by regional craft practices. The use of wooden shingles from the early settlement days to the present illustrates an extraordinary range of styles (see illus. 1, 2, 3, 4).

Wooden shingle roofs need periodic replacement. They can last from 15 to over 60 years, but the shingles should be replaced before there is deterioration of other wooden components of the building. Appropriate replacement shingles are available, but careful research, design, specifications, and the selection of a skilled roofer are necessary to assure a job that will both preserve the appearance of the historic building and extend the useful life of the replacement roof.

Unfortunately, the wrong shingles are often selected or are installed in a manner incompatible with the appearance of the historic roof. There are a number of reasons why the wrong shingles are selected for replacement roofs. They include the failure to identify the appearance of the original shingles; unfamiliarity with available products; an inadequate budget; or a *confusion in terminology.* In any discussion about historic roofing materials and practices, it is important to understand the historic definitions of terms like "shingles," as well as the modern definitions or use of those terms by craftsmen and the industry. Historically, from the first buildings in America, these wooden roofing products were called *shingles,* regardless of whether they were the earliest handsplit or the later machine-sawn type. The term *shake* is a relatively recent one, and today is used by the industry to distinguish the sawn products from the split products, but through most of our building history there has been no such distinction.

Considering the confusion among architects and others regarding these terms as they relate to the appearance of early roofs, it should be stated that there is a considerable body of documentary information about historic roofing practices and materials in this country, and that many actual specimens of historic shingles from various periods and places have been collected and preserved so that their historic appearances are well established. Essentially, the rustic looking shake that we see used so much today has little in common with the shingles that were used on most of our early buildings in America.

Throughout this **Brief,** the term *shingle* will be used to refer to historic wooden roofs in general, whether split or sawn, and the term *shake* will be used only when it refers to a commercially available product. The variety and complexity of terminology used for currently available products will be seen in the accompanying chart entitled "Shingles and Shakes."

This **Brief** discusses what to look for in historic wooden shingle roofs and when to replace them. It discusses ways to select or modify modern products to duplicate the appearance of a historic roof, offers guidance on proper installation, and provides information on coatings and maintenance procedures to help preserve the new roof.*

(***Preservation Brief 4: Roofing for Historic Buildings** discusses research methods, analysis of deterioration, and the general significance of historic roofs.)

78. This section reproduces Sharon C. Park, *The Repair and Replacement of Historic Wooden Shingle Roofs*, Preservation Brief 19 (Washington, DC: National Park Service, 1978), https://www.nps.gov/orgs/1739/upload/preservation-brief-19-wood-shingle-roofs.pdf. Public domain.

Wooden Shingle Roofs in America

Because trees were plentiful from the earliest settlement days, the use of wood for all aspects of construction is not surprising. Wooden shingles were lightweight, made with simple tools, and easily installed. Wooden shingle roofs were prevalent in the Colonies, while in Europe at the same time, thatch, slate and tile were the prevalent roofing materials. Distinctive roofing patterns exist in various regions of the country that were settled by the English, Dutch, Germans, and Scandinavians. These patterns and features include the size, shape and exposure length of shingles, special treatments such as swept valleys, combed ridges, and decorative butt end or long side-lapped beveled handsplit shingles. Such features impart a special character to each building, and prior to any restoration or rehabilitation project the physical and photographic evidence should be carefully researched in order to document the historic building as much as possible. Care should be taken not to assume that aged or deteriorated shingles in photographs represent the historic appearance.

Shingle Fabrication. Historically wooden shingles were usually thin (3/8″–3/4″), relatively narrow (3″–8″), of varying length (14″–36″), and almost always smooth. The traditional method for making wooden shingles in the 17th and 18th centuries was to handsplit them from log sections known as bolts (see illus. 5A). These bolts were quartered or split into wedges. A mallet and froe (or ax) were used to split or rive out thin planks of wood along the grain. If a tapered shingle was desired, the bolt was flipped after each successive strike with the froe and mallet. The wood species varied according to available local woods, but only the heartwood, or inner section, of the log was usually used. The softer sapwood generally was not used because it deteriorated quickly. Because handsplit shingles were somewhat irregular along the split surface, it was necessary

1. The Rolfe-Warren House, a tidewater Virginia property, was restored to its 18th-century appearance in 1933. The handsplit and dressed wooden shingles are typical of the tidewater area with special features such as curved butts, projecting ridge comb and closed swept valleys at the dormer roof connections. Circa 1970 Photo: Association for the Preservation of Virginia Antiquities.

2. Handsplit and dressed shingles were also used on less elaborate buildings as seen in the restoration of the circa 1840 kitchen at the Winedale Inn, Texas. The uneven surfaces of the handsplit shingles were generally dressed or smoothed with a draw-knife to keep the rainwater from collecting in the wood grain and to ensure that the shingles lay flat on the sub-roof. Photo: Thomas Taylor.

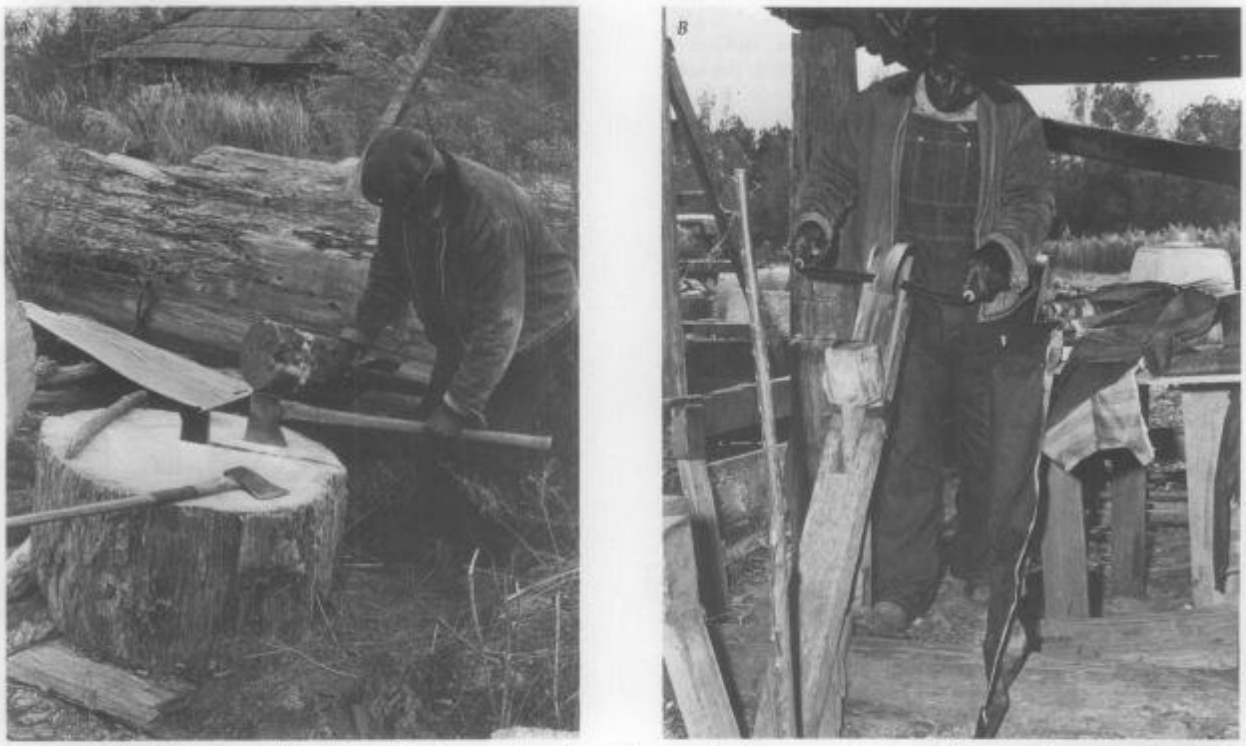
3. Readily available and inexpensive sawn shingles were used not only for roofs, but also for gables and wall surfaces. The circa 1891 Chambers House, Eugene, Oregon used straight sawn butts for the majority of the roof and hexagonal butts for the lower portion of the corner tower. Decorative shingles in the gable ends and an attractive wooden roof cresting feature were also used. Photo: Lane County Historical Society.

4. With the popularity of the revival of historic styles in the late 19th and early 20th centuries, a new technique was developed to imitate English thatch roofs. For the Tudor Revival thatch cottages, steaming and curving of sawn shingles provided an undulating pattern to this picturesque roof shape. Photo: Courtesy of C.H. Roofing.

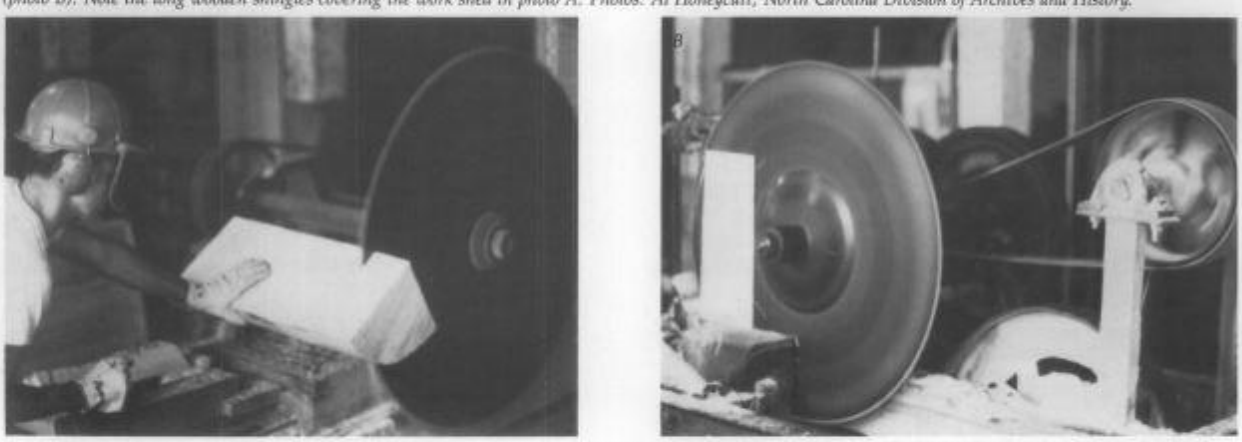
to dress or plane the shingles on a shavinghorse with a draw-knife or draw-shave (see illus. 5B) to make them fit evenly on the roof. This reworking was necessary to provide a tight-fitting roof over typically open shingle lath or sheathing boards. Dressing, or smoothing of shingles, was almost universal, no matter what wood was used or in what part of the country the building was located, except in those cases where a temporary or very utilitarian roof was needed.

Shingle fabrication was revolutionized in the early 19th century by steam-powered saw mills (see illus. 6). Shingle mills made possible the production of uniform shingles in mass quantities. The sawn shingle of uniform taper and smooth surface eliminated the need to hand dress. The supply of wooden shingles was therefore no longer limited by local factors. These changes coincided with (and in turn increased) the popularity of architectural styles such as Carpenter Gothic and Queen Anne that used shingles to great effect.

Handsplit shingles continued to be used in many places well after the introduction of machine sawn shingles. There were, of course, other popular roofing materials, and some regions rich in slate had fewer examples of wooden shingle roofs. Some western



5. Custom Handsplit shingles are still made the traditional way with a mallet and froe or ax. For these cypress shingles, a "bolt" section of log (photo A) the length of the shingle has been sawn and is ready to be split into wedge-shaped segments. Handsplit shingles are fabricated with the ax or froe cutting the wood along the grain and separating, or riving, the shingle away from the remaining wedge. The rough surfaces are dressed on a shavinghorse using a draw-knife as shown above (photo B). Note the long wooden shingles covering the work shed in photo A. Photos: Al Honeycutt, North Carolina Division of Archives and History.



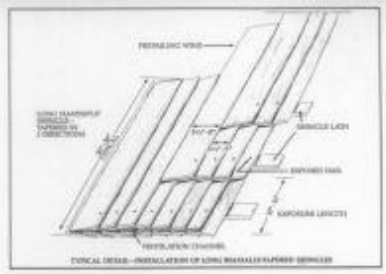
6. Modern machine-made shingles are sawn. Shown are: (photo A) Eastern White Pine quarter split shingle block on equalizer saw being trimmed to parallel the ends; and (photo B) the restored 19th-century shingle mill saw cutting tapered flitches or shingles. The thickness and taper can be precisely controlled. Photo: Steve Ruscio, The Shingle Mill.

"boom" towns used sheet metal because it was light and easily shipped. Slate, terneplate, and clay tile were used on ornate buildings and in cities that limited the use of flammable wooden shingles. Wooden shingles, however, were never abandoned. Even in the 20th century, architectural styles such as the Colonial Revival and Tudor Revival, used wooden shingles.

Modern wooden shingles, both sawn and split, continue to be made, but it is important to understand how these new products differ from the historic ones and to know how they can be modified for use on historic buildings. Modern commercially available shakes are generally thicker than the historic handsplit counterpart and are usually left "undressed" with a rough, corrugated surface. The rough surface shake, furthermore, is often promoted as suitable for historic preservation projects because of its rustic appearance. It is an erroneous assumption that the more irregular the shingle, the more authentic or "historic" it will appear.

Historic Detailing and Installation Techniques. While the size, shape and finish of the shingle determine the roof's texture and scale, the installation patterns and details give the roof its unique character. Many details reflect the craft practices of the builders and the architectural style prevalent at the time of construction. Other details had specific purposes for reducing moisture penetration to the structure. In addition to the most visible aspects of a shingle roof, the details at the rake boards, eaves, ridges, hips, dormers, cupolas, gables, and chimneys should not be overlooked.

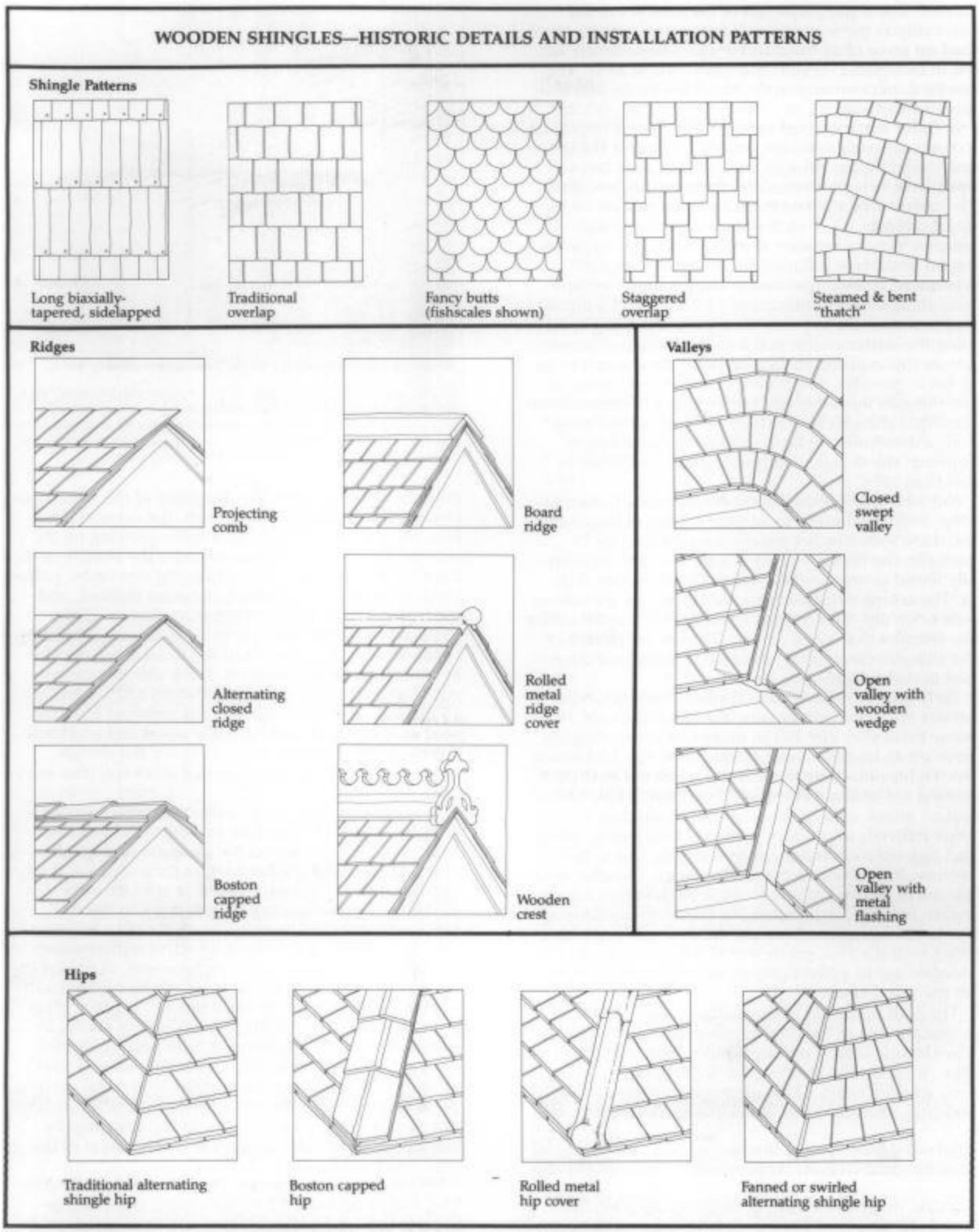
The way the shingles were laid was often based on functional and practical needs. Because a roof is the most vulnerable element of a building, many of the roofing details that have become distinctive features were first developed simply to keep water out. Roof combs on the windward side of a roof protect the ridge line. Wedges, or cant strips, at dormer cheeks roll the water away from the vertical wall. Swept valleys and fanned hips keep the grain of the wood in the shingle parallel to the angle of the building joint to aid water



8. The long biaxially tapered handsplit shingles on the Ephrata Cloisters in Pennsylvania were overlapped both vertically and horizontally. The insert sketch shows channels under the shingles that provided ventilation and drainage of any trapped moisture. The aged appearance of these handsplit and dressed shingles belies their original smoothness. Replacement shingles should match the original, not the aged appearance. Photo: National Park Service; Sketch: Reed Engle.

7. The reshingling of the circa 1856 Stovewood House in Decorah, Iowa, revealed the original open sheathing boards and pole rafters. Sawn cedar shingles were used as a replacement for the historic cedar shingles seen still in place at the ridge. A new starter course is being laid at the eaves. Photo: Norwegian-American Museum, Decorah, Iowa.

9. This 1927 view of the reshingling of the French Castle at Old Fort Niagara, N.Y., shows the wooden sleepers being laid (see arrow) over solid sheathing in order to raise the shingles up slightly to allow under-shingle ventilation. Note that the horizontal strips are not continuous to allow airflow and trapped moisture to drain away. This cedar roof has lasted for over 60 years in a harsh moist environment. Photo: Old Fort Niagara, Assoc. Inc.



10. The Historic Details and Installation Patterns Chart illustrates a number of special features found on wooden roofs. Documented examples of these features, different for every building and often reflecting regional variations, should be accurately reproduced when a replacement roof is installed. Chart: Sharon C. Park; delineation by Kaye Ellen Simonson.

run-off. The slight projection of the shingles at the eaves directs the water run-off either into a gutter or off the roof away from the exterior wall. These details varied from region to region and from style to style. They can be duplicated even with the added protection of modern flashing.

In order to have a weathertight roof, it was important to have adequate coverage, proper spacing of shingles, and straight grain shingles. Many roofs were laid on open shingle lath or open sheathing boards (see illus. 7). Roofers typically laid three layers of shingles with approximately 1/3 of each shingle exposed to the weather. Spaces between shingles (1/8"–1/2" depending on wood type) allowed the shingles to expand when wet. It was important to stagger each overlapping shingle by a minimum of 1-1/2" to avoid a direct path for moisture to penetrate a joint. Doubling or tripling the starter course at the eave gave added protection to this exposed surface. In order for the roof to lay as flat as possible, the thickness, taper and surface of the shingles was relatively uniform; any unevenness on handsplit shingles had already been smoothed away with a drawknife. To keep shingles from curling or cupping, the shingle width was generally limited to less than 10".

Not all shingles were laid in evenly spaced, overlapping, horizontal rows. In various regions of the country, there were distinct installation patterns; for example, the biaxially-tapered long shingles occasionally found in areas settled by the Germans (see illus. 8). These long shingles were overlapped on the side as well as on top. This formed a ventilation channel under the shingles that aided drying. Because ventilation of the shingles can prolong their life, roofers paid attention to these details (see illus. 9).

Early roofers believed that applied coatings would protect the wood and prolong the life of the roof. In many cases they did; but in many cases, the shingles were left to weather naturally and they, too, had a long life. Eighteenth-century coatings included a pine pitch coating not unlike turpentine, and boiled linseed oil or fish oil mixed with oxides, red lead, brick dust, or other minerals to produce colors such as yellow, Venetian red, Spanish brown, and slate grey. In the 19th century, in addition to the earlier colors, shingles were stained or painted to complement the building colors: Indian red, chocolate brown, or brown-green. During the Greek Revival and later in the 20th century with other revival styles, green was also used. Untreated shingles age to a silver-grey or soft brown depending on the wood species.

The craft traditions of the builders often played an important role in the final appearance of the building. The Historic Details and Installation Patterns Chart (see illus. 10) identifies many of the features found on historic wooden roofs. These elements, different on each building, should be preserved in a re-roofing project.

Replacing Deteriorated Roofs: Matching the Historic Appearance

Historic wooden roofs using straight edgegrain heartwood shingles have been known to last over sixty years. Fifteen to thirty years, however, is a more realistic lifespan for most premium modern wooden shingle roofs. Contributing factors to deterioration include the thinness of the shingle, the durability of the wood species used, the exposure to the sun, the slope of the roof, the presence of lichens or moss growing on the shingle, poor ventilation levels under the shingle or in the roof, the presence of overhanging tree limbs, pollutants in the air, the original installation method, and the history of the roof maintenance. Erosion of the softer wood within the growth rings is caused by rainwater, wind, grit, fungus and the breakdown of cells by ultraviolet rays in sunlight. If the shingles cannot adequately dry between rains, if moss and lichens are allowed to grow, or if debris is not removed from the roof, moisture will be held in the wood and accelerate deterioration. Moisture trapped under the shingle, condensation, or poorly ventilated attics will also accelerate deterioration.

11. The replacement sawn red cedar shingles matched the deteriorated shingles exactly for this barn re-roofing. The old shingles, seen to the far left, were removed as the new shingles were installed. Even the horizontal coursing matched because the exposure length for both old and new shingles was the same. Photo: Williamsport Preservation Training Center.

In addition to the eventual deterioration of wooden shingles, impact from falling branches and workmen walking on the roof can cause localized damage. If, however, over 20% of the shingles on any one surface appear eroded, cracked, cupped or split, or if there is evidence of pervasive moisture damage in the attic, replacement should be considered. If only a few shingles are missing or damaged, selective replacement may be possible. For limited replacement, the old shingle is removed and a new shingle can be inserted and held in place with a thin metal tab, or "babbie." This reduces disturbance to the sound shingles above. In instances where a few shingles have been cracked or the joint of overlapping shingles is aligned and thus forms a passage for water penetration, a metal flashing piece slipped under the shingle can stop moisture temporarily. If moisture is getting into the attic, repairs must be made quickly to prevent deterioration of the roof structural framing members.

When damage is extensive, replacement of the shingles will be necessary, but the historic sheathing or shingle lath under the shingles may be in satisfactory condition. Often, the historic sheathing or shingle laths, by their size, placement, location of early nail holes, and water stain marks, can give important infor-

12. Inappropriately selected and installed wooden shingles can drastically alter the historic character of a building. This tavern historically was roofed with handsplit and dressed shingles of a relatively smooth appearance. In this case, a commercially available shake was used to effect a "rustic" appearance. Photo: National Park Service.

mation regarding the early shingles used. Before specifying a replacement roof, it is important to *establish the original shingle material, configuration, detailing and installation* (see illus. 11). If the historic shingles are still in place, it is best to remove several to determine the size, shape, exposure length, and special features from the unweathered portions. If there are already replacement shingles on the roof, it may be necessary to verify through photographic or other research whether the shingles currently on the roof were an accurate replacement of the historic shingles.

The following information is needed in order to develop accurate specifications for a replacement shingle:

Original wood type (White Oak, Cypress, Eastern White Pine, Western, Red Cedar, etc.)
Size of shingle (length, width, butt thickness, taper)
Exposure length and nailing pattern (amount of exposure, placement and type of nails)
Type of fabrication (sawn, handsplit, dressed, beveled, etc.)
Distinctive details (hips, ridges, valleys, dormers, etc.)
Decorative elements (trimmed butts, variety of pattern, applied color coatings, exposed nails)
Type of substrate (open shingle lath or sheathing, closed sheathing, insulated attics, sleepers, etc.)

Replacement roofs must comply with local codes which may require, for example, the use of shingles treated with chemicals or pressure-impregnated salts to retard fire. These requirements can usually be met without long-term visual effects on the appearance of the replacement roof.

The accurate duplication of a wooden shingle roof will help ensure the preservation of the building's architectural integrity. Unfortunately, the choice of an inappropriate shingle or poor installation can severely detract from the building's historic appearance (see illus. 12). There are a number of commercially available wooden roofing products as well as custom roofers who can supply specially-made shingles for historic preservation projects (see Shingle and Shake Chart, illus. 13). Unless restoration or reconstruction is being undertaken, shingles that match the visual appearance of the historic roof without replicating every aspect of the original shingles will normally suffice. For example, if the historic wood species is no longer readily available, Western Red Cedar or Eastern White Pine may be acceptable. Or, if the shingles are located high on a roof, sawn shingles or commercially available shakes with the rustic faces factory-sawn off may adequately reproduce the appearance of an historic handsplit and dressed shingle.

There will always be certain features, however, that are so critical to the building's character that they should be accurately reproduced. Following is guidance on matching the most important visual elements.

Highest Priority in Replacement Shingles:

- best quality wood with a similar surface texture
- matching size and shape: thickness, width, length
- matching installation pattern: exposure length, overlap, hips, ridges, valleys, etc.
- matching decorative features: fancy butts, color, exposed nails

Areas of Acceptable Differences:

- species of wood
- method of fabrication of shingle, if visual appearance matches
- use of fire-retardants, or preservative treatments, if visual impact is minimal
- use of modern flashing, if sensitively installed
- use of small sleepers for ventilation, if the visual impact is minimal and rake boards are sensitively treated
- method of nailing, if the visual pattern matches

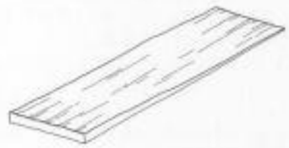
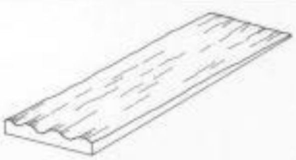
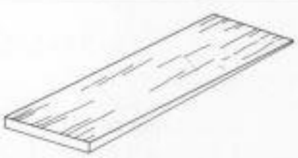
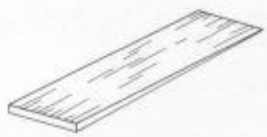
Treatments and Materials to Avoid:

- highly textured wood surfaces and irregular butt ends, unless documented
- standardized details (prefab hips, ridges, panels, etc.) unless documented
- too wide shingles or those with flat grain (which may curl), unless documented

What is Currently Available

Types of Wood: Western Red Cedar, Eastern White Pine, and White Oak are most readily available today. For custom orders, cypress, red oak, and a number of other historically used woods may still be available. Some experiments using non-traditional woods (such as yellow pine and hemlock) treated with preservative chemicals are being tested for the new construction market, but are generally too thick, curl too easily, or have too pronounced a grain for use on historic buildings.

Method of manufacture: Commercially available modern shingles and shakes are for the most part machine-made. While commercially available shakes are promoted by the industry as handsplit, most are split by machine (this reduces the high cost of hand labor). True handsplit shingles, made the traditional way with a froe and mallet, are substantially more expensive, but are more authentic in appearance than the rough, highly textured machine-split shakes. An experienced shingler can control the thickness of the handsplit shingle and keep the shingle surface grain relatively

AVAILABLE WOODEN SHINGLES AND SHAKES FOR RE-ROOFING				
TYPE		SIZE	DESCRIPTION	NOTES
Custom split & dressed		Made to match historic shingles	Handsplit the traditional way with froe & mallet. Tapered. Surfaces dressed for smoothness	Appropriate if: • Worked to match uniformly dressed original shingles
Tapersplit*		Typically: L = 15", 18", 24" W = 4"–14" Butts vary 1/2"–3/4"	Commercially available. Handsplit the traditional way with froe & mallet. Tapered. Bundles contain varying widths & butt thicknesses. Surfaces may be irregular along grain.	Appropriate if: • irregular surfaces are dressed • butt thicknesses ordered uniform • wide shingles are split
Straightsplit		Typically: L = 15", 18", 24" W = 4"–14" Butts vary mediums = 3/8–3/4" heavies = 3/4–1¼"	Commercially available. Hand or machine split without taper. Bundles contain varying butt thicknesses; often very wide shingles. Surface may be irregular along the grain. Thick shingles not historic.	*Not* appropriate for most preservation projects • Limited use of thin, even straightsplits on some cabins, barns, etc.
Handsplit* resawn		Typically: L = 15", 18", 24" W = 4"–14" Butts vary mediums = 3/8–3/4" heavies = 3/4–1¼"	Commercially available. Machine split and sawn on the backs to taper. Split faces often irregular, even corrugated in appearance. Butt thickness vary and may be too wide.	*Not* appropriate for preservation projects
Tapersawn*		Typically: L = 15", 18", 24" W = 4"–14" Butts vary 1/2"–3/4"	Commercially available. Made from split products with sawn surfaces. Tapered. Butt thicknesses vary and shingles may be too wide. Saw marks may be pronounced.	Appropriate if: • butt thicknesses ordered uniform • wide shingles are split • pronounced saw marks sanded
Sawn-straight butt		Typically: L = 16"–.40 (< 3/8") 18"–.45 24"–.50 (1/2") W = Varies by order	Custom or commercially available. Tapered. Sawn by circular saw.	Appropriate to reproduce historic sawn shingles
Sawn-fancy butt		Typically: L = 16"–.40 (< 3/8") 18"–.45 24"–.50 (1/2") W = Varies by order	Custom or commercially available. Tapered. Sawn by circular saw. A variety of fancy butts available	Appropriate to reproduce historic fancy butts
Steam-bent		Varies by order to match, "Thatch" roofs	Custom or commercially available. Tapered. Thin sawn shingles are steamed and bent into rounded forms.	Appropriate to reproduce "thatch" shingles

*13. This chart identifies a variety of shingles and shakes used for reroofing buildings. The * identifies product names used by the Red Cedar Shingle and Handsplit Shake Bureau, although shingles and shakes of the types described are available in other woods. Manufacturers define "Shakes" as split products while "shingles" refer to sawn products.* Shingle, *however, is the historic term used to describe wooden roofing products, regardless of how they were made. Whether shingles or shakes are specified for re-roofing, they should match the size and appearance of the historic shingles. Chart: Sharon C. Park; delineation by Kaye Ellen Simonson.*

even. To have an even roof installation, it is important to have handsplit shingles of uniform taper and to have less than 1/8th variation across the surface of the shingle. For that reason, it is important to dress the shingles or to specify uniform butt thickness, taper, and surfaces. Commercially available shakes are shipped with a range of butt sizes within a bundle (e.g., 1/2", 5/8", 3/4" as a mix) unless otherwise specified. Commercially available shakes with the irregular surfaces sawn off are also available. In many cases, except for the residual circular saw marks, these products appear not unlike a dressed handsplit shingle.

Sawn shingles are still made much the same way as they were historically—using a circular saw. The circular saw marks are usually evident on the surface of most sawn shingles. There are a number of grooved, striated, or steamed shingles of the type used in the 20th century to effect a rustic or thatched appearance. Custom sawn shingles with fancy butts or of a specified thickness are still available through mill shops. In fact, shingles can be fabricated to the weathered thickness in order to be integrated into an existing historic roof. If sawn shingles are being used as a substitute for dressed handsplit shingles, it may be desirable to belt sand the surface of the sawn shingles to reduce the prominence of the circular saw marks.

As seen from the Shingle and Shake chart, few of the commercially available shakes can be used without some modification or careful specification. Some, such as heavy shakes with a corrugated face, should be avoided altogether. While length, width, and butt configuration can be specified, it is more difficult to ensure that the thickness and the texture will be correct. For that reason, whatever shingle or shake is desired, it is important to view samples, preferably an entire bundle, before specifying or ordering. If shingles are to be trimmed at the site for special conditions, such as fanned hips or swept valleys, additional shingles should be ordered.

Coatings and Treatments: Shingles are treated to obtain a fire-retardant rating; to add a fungicide preservative (generally toxic); to revitalize the wood with a penetrating stain (oil as well as water-based); and to give color.

While shingles can be left untreated, local codes may require that only fire-retardant shingles be used. In those circumstances, there are several methods of obtaining rated shingles (generally class "B" or "C"). The most effective and longest-lasting treatment is to have treated salts pressure-impregnated into the wood cells after the shingles have been cut. Another method (which must be periodically renewed) is to apply chemicals to the surface of the shingles. If treated shingles need trimming at the site, it is important to check with the manufacturer to ensure that the fire-retardant qualities will not be lost. Pressure-impregnated shingles, however, may usually be trimmed without loss of fire-retardant properties.

The life of a shingle roof can be drastically shortened if moss, lichens, fungi or bacterial spores grow on the wood. Fungicides (such as chromated copper arsenate, CCA) have been found to be effective in inhibiting such fungal growth, but most are toxic. Red cedar has a natural fungicide in the wood cells and unless the shingles are used in unusually warm, moist environments, or where certain strains of spores are found, an applied fungicide is usually not needed. For most woods, the Forest Products Laboratory of the U.S. Department of Agriculture has found that fungicides do extend the life of the shingles by inhibiting growth on or in the wood. There are a variety available. Care should be taken in applying these chemicals and meeting local code requirements for proper handling.

Penetrating stains and water repellent sealers are sometimes recommended to revitalize wood shingles subject to damage by ultraviolet rays. Some treatments are oil-borne, some are water-borne, and some are combined with a fungicide or a water repellent. If any of these treatments is to be used, they should be identified as part of the specifications. Manufacturers should be consulted regarding the toxicity or other potential complications arising from the use of a product or of several in combination. It is also important not to coat the shingles with vapor-impermeable solutions that will trap moisture within the shingle and cause rotting from beneath.

Specifications for the Replacement Roof

Specifications and roofing details should be developed for each project. Standard specifications may be used as a basic format, but they should be modified to reflect the conditions of each job. Custom shingles can still be ordered that accurately replicate a historic roof, and if the roof is simple, an experienced shingler could install it without complicated instructions. Most rehabilitation projects will involve competitive bidding, and each contractor should be given very specific information as to what type of shingles are required and what the installation details should be. For that reason, both written specifications and detailed drawings should be part of the construction documents.

For particularly complex jobs, it may be appropriate to indicate that only roofing contractors with experience in historic preservation projects be considered (see illus. 14). By pre-qualifying the bidders, there is greater assurance that a proper job will be done. For smaller jobs, it is always recommended that the owner or architect find a roofing contractor who has recently completed a similar project and that the roofers are similarly experienced.

Specifications identify exactly what is to be received from the supplier, including the wooden shingles, nails, flashing, and applied coatings. The specifications also include instructions on removing the old roofing (sometimes two or more earlier roofs), and on preparing the surface for the new shingles, such as repairing damage to the lath or sheathing boards. If there are to be modifications to a standard product, such as cutting beveled butts, planing off residual surface circular saw marks, or controlling the mixture of acceptable widths (3"–8"), these too should be specified. Every instruction for modifying the shingles themselves should be written into the specifications or they may be overlooked.

The specifications and drawn details should describe special features important to the roof. Swept valleys, combed ridges, or wedged dormer cheek run-offs should each be detailed not only with the patterning of the shingles, but also with the placement of flashing or other unseen reinforcements. There are some modern products that appear to be useful. For example, paper-

Replacement Roofing for Appomattox Manor: City Point Unit of Petersburg National Battlefield, Hopewell, Virginia

A. The later non-historic shingles were removed from Appomattox Manor (circa 1840 with later additions) and roofing paper was installed for temporary protection during the re-shingling.

B. These weathered historic 19th-century handsplit and dressed shingles were found in place under a later altered roof. Note the straight butt eave shingles under the curved butts of the historic dormer shingles.

D. The fanned hips (seen here), swept valleys, and projecting ridge combs were installed as part of the re-roofing project. Special features, when documented, should be reproduced when re-shingling historic roofs.

Excerpts from Specifications:

Type of wood to be used: Western Red Cedar.
Grade of wood and manufacturing process: Number One, Tapersplit Shakes, 100% clear, 100% edgegrain, 100% heartwood, no excessive grain sweeps, curvatures not to exceed 1/2" from level plain in length of shake; off grade (7% tolerance) material must *not* be used.
Size of the shingle: 18" long, 5/8" butt tapered to 1/4" head, 3"-4" wide, sawn curved butts, 5-1/2" exposure
Surface finish and any applied coatings: relatively smooth natural grain, no more than 1/8" variation in surface texture, butt thickness to be uniform throughout bundles. Site dipped with fire-rated chemicals tinted with red iron oxide for opaque color.
Type of nails and flashing: double hot dipped galvanized nails sized to penetrate sheathing totally; metal flashing to be 20 oz. lead-coated copper, or terne-coated stainless steel; additional flashing reinforcement to be aluminum foil type with fiber backing to use at hips, ridges, eaves, and valleys.
Type of sheathing: uninsulated attic, any deteriorated 3/4" sheathing boards, spaced 1/2"-3/4", to be replaced in kind.

C. The replacement shingles (see specifications above), matched the historic shingles and were of such high quality that little hand dressing was needed at the site. The building paper, a temporary protection, was removed as the shingles were installed on the sheathing boards.

E. In order to achieve a "Class B" fire-rating, the shingles were dipped in fire-retardant chemicals and allowed to dry prior to installation. Iron oxide was added to this chemical dip to stain the shingles to match the historic red color. These coatings will need periodic reapplication.

14. Original 19th-century handsplit and dressed wooden shingles 18" long, 3"-4" wide, and 5/8" thick were found in place on the Appomattox Manor at Hopewell, Virginia. The butts were curved and evidence of a red stain remained. The specifications and details were researched so that the appearance of the historic shingles and installation patterns could be matched in the re-shingling project. Photos: John Ingle.

coated and reinforced metal-laminated flashing is easy to use and, in combination with other flashing, gives added protection over eaves and other vulnerable areas; adhesives give a stronger attachment at projecting roofing combs that could blow away in heavy wind storms. Clear or light-colored sealants may be less obvious than dark mastic often used in conjunction with flashing or repairs. These modern treatments should not be overlooked if they can prolong the life of the roof without changing its appearance.

Roofing Practices to Avoid

Certain common roofing practices for modern installations should be avoided in re-roofing a historic building unless specifically approved in advance by the architect. These practices interfere with the proper drying of the shingles or result in a sloppy installation that will accelerate deterioration (see illus. 15). They include improper coverage and spacing of shingles, use of staples to hold shingles, inadequate ventilation, particularly for heavily insulated attics, use of heavy building felts as an underlayment, improper application of surface coatings causing stress in the wood surfaces, and use of inferior flashing that will fail while the shingles are still in good condition.

Avoid skimpy shingle coverage and heavy building papers. It has become a common modern practice to lay impregnated roofing felts under new wooden shingle roofs. The practice is especially prevalent in roofs that do not achieve a full triple layering of shingles. Historically, approximately one third of each single was exposed, thus making a three-ply or three-layered roof. This assured adequate coverage. Due to the expense of wooden shingles today, some roofers expose more of the shingle if the pitch of the roof allows, and compensate for less than three layers of shingles by using building felts interwoven at the top of each row of shingles. This absorptive material can hold moisture on the underside of the shingles and accelerate deterioration. If a shingle roof has proper coverage and proper flashing, such felts are unnecessary as a general rule.

15. These commercially available roofing products with rustic split faces are not appropriate for historic preservation projects. In addition to the inaccurate appearance, the irregular surfaces and often wide spaces between shingles will allow wind-driven moisture to penetrate up and under them. The excessively wide boards will tend to cup, curl and crack. Moss, lichens and debris will have a tendency to collect on these irregular surfaces, further deteriorating the roofing. Photo: Sharon C. Park.

However, the selective use of such felts or other reinforcements at ridges, hips and valleys does appear to be beneficial.

Beware of heavily insulated attic rafters. Historically, the longest lasting shingle roofs were generally the ones with the best roof ventilation. Roofs with shingling set directly on solid sheathing and where there is insulation packed tightly between the wooden rafters without adequate ventilation run the risk of condensation-related moisture damage to wooden roofing components. This is particularly true for air-conditioned structures. For that reason, if insulation must be used, it is best to provide ventilation channels between the rafters and the roof decking, to avoid heavy felt building papers, to consider the use of vapor barriers, and perhaps to raise the shingles slightly by using "sleepers" over the roof deck. This practice was popular in the 1920s in what the industry called a "Hollywood" installation, and examples of roofs lasting 60 years are partly due to this under-shingle ventilation (refer to illus. 9).

Avoid staples and inferior flashing. The common practice of using pneumatic staple guns to affix shingles can result in shooting staples through the shingles, in crushing the wood fibers, or in cracking the shingle. Instead, corrosion-resistant nails, generally with barked or deformed shanks long enough to extend about 3/4" into the roof decking, should be specified. Many good roofers have found that the pneumatic nail guns, fitted with the proper nails and set at the correct pressure with the nails just at the shingle surface, have worked well and reduced the stress on shingles from missed hammer blows. If red cedar is used, copper nails should not be specified because a chemical reaction between the wood and the copper will reduce the life of the roof. Hot-dipped, zinc-coated, aluminum, or stainless steel nails should be used. In addition, copper flashing and gutters generally should not be used with red cedar shingles as staining will occur, although there are some historic examples where very heavy gauge copper was used which outlasted the roof shingles. Heavier weight flashing (20 oz.) holds up better than lighter flashing, which may deteriorate faster than the shingles. Some metals may react with salts or chemicals used to treat the shingles. This should be kept in mind when writing specifications. Terne-coated stainless steel and lead-coated copper are generally the top of the line if copper is not appropriate.

Avoid patching deteriorated roof lath or sheathing with plywood or composite materials. Full size lumber may have to be custom-ordered to match the size and configuration of the original sheathing in order to provide an even surface for the new shingles. It is best to avoid plywood or other modern composition boards that may deteriorate or delaminate in the future if there is undetected moisture or leakage. If large quantities of shingle lath or sheathing must be removed and replaced, the work should be done in sections to avoid possible shifting or collapse of the roof structure.

Avoid spray painting raw shingles on a roof after installation. Rapidly drying solvent in the paint will tend to warp the exposed surface of the shingles. Instead, it is best to dip new shingles prior to installation to keep all of the wood fibers in the same tension. Once the entire shingle has been treated, however, later coats can be limited to the exposed surface.

Maintenance

The purpose of regular or routine maintenance is to extend the life of the roof. The roof must be kept clean and inspected for damage both to the shingles and to the flashing, sheathing, and gutters. If the roof is to be walked on, rubber soled shoes should be worn. If there is a simple ridge, a ladder can be hooked over the roof ridge to support and distribute the weight of the inspector.

Keeping the roof free of debris is important. This may involve only sweeping off pine needles, leaves and branches as needed. It may involve trimming overhanging branches. Other aspects of maintenance, such as removal of moss and lichen build-up, are more difficult. While they may impart a certain charm to roofs, these moisture-trapping organisms will rot the shingles and shorten the life of the roof. Buildups may need scraping and the residue removed with diluted bleaching solutions (chlorine), although caution should be used for surrounding materials and plants. Some roofers recommend power washing the roofs periodically to remove the dead wood cells and accumulated debris. While this makes the roof look relatively new, it can put a lot of water under shingles, and the high pressure may crack or otherwise damage them. The added water may also leach out applied coatings.

If the roof has been treated with a fungicide, stain, or revitalizing oil, it will need to be re-coated every few years (usually every 4–5). The manufacturer should be consulted as to the effective life of the coating. With the expense associated with installation of wood shingles, it is best to extend the life of the roof as long as possible. One practical method is to order enough shingles in the beginning to use for periodic repairs.

Periodic maintenance inspections of the roof may reveal loose or damaged shingles that can be selectively replaced before serious moisture damage occurs (see illus. 16). Keeping the wooden shingles in good condition and repairing the roof, flashing and guttering, as needed, can add years of life to the roof.

16. Routine maintenance is necessary to extend the life of the roof. On this roof, the shingles have not seriously eroded, but the presence of lichens and moss is becoming evident and there are a few cracked and missing shingles. The moss spores should be removed, missing shingles replaced, and small pieces of metal flashing slipped under cracked shingles to keep moisture from penetrating. Photo: Williamsport Preservation Training Center.

Cover Photo: 1907 view of a young couple's first home in a cedar stump with a shingled roof. Photo: Historical Society of Seattle and King County, Washington.

Conclusion

A combination of careful research to determine the historic appearance of the roof, good specifications, and installation details designed to match the historic roof, and long-term maintenance, will make it possible to have not only a historically authentic roof, but a cost-effective one. It is important that professionals be part of the team from the beginning. A preservation architect should specify materials and construction techniques that will best preserve the roof's historic appearance. The shingle supplier must ensure that the best product is delivered and must stand behind the guarantee if the shipment is not correct. The roofer must be knowledgeable about traditional craft practices. Once the new shingle roof is in place, it must be properly maintained to give years of service.

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6.3.3 *Adobe Conservation: A Preservation Handbook*, "Installing Wood Shingles and Shakes," 2006[79]

INSTALLING WOOD SHINGLES AND SHAKES

In New Mexico, roofs with wood shingles were introduced after 1848. Wood shingles were costly and, therefore, were only used on important buildings such as churches and officers' quarters.

Many historic structures have lost their wood shingle roofs. In some cases they have been replaced with metal roofs. However, some historic churches in New Mexico still retain wood shingles, while others have only remnants of wood shingles on belfries and gable ends.

Cedar shingles are widely available, but only the highest grade should be installed. As with any roof, flashing at joints, valleys and points of penetration are the keys to its ultimate success.

This section explains the restoration or replacement of a wood shingle roof on an historic structure. This method can also be applied to wood shingle gable ends and belfries.

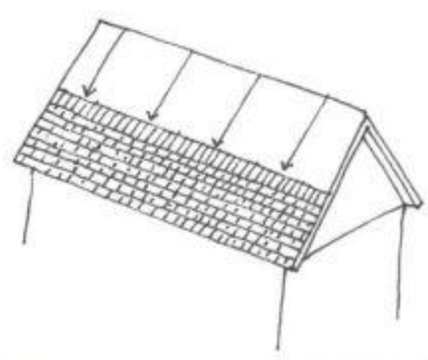
Considering the cost of cedar shingles, great care should be taken in installing them. When possible avoid using a pneumatic roofing stapler; instead, hand nail with 3d or 4d hot-dipped galvanized nails. Do not use electro-galvanized nails. Use only two nails per shingle. Make two shingles out of any shingle wider than 12 inches.

Shingles that are pre-dipped in a preservative stain are recommended. Cornerstones has had success obtaining them from the Cedar Shake and Shingle Bureau and recommends its installation guide:

Cedar Shake and Shingle Bureau
515 116th Ave. NE, Suite 275
Bellevue, WA 98004-529
Phone 425-453-1323

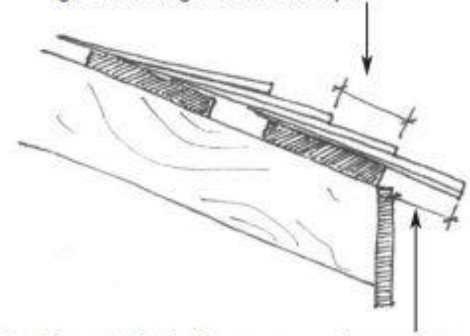
INSTALLATION PRINCIPLES

The following drawings and directions serve as a guide for installation of wood shingles on adobe structures. NOTE: Shingles are sawn, shakes are split. Four bundles equals 25 square feet. Cedar is a natural insect repellent and does not rot.



Measure from ridge to check alignment of shingles. Strike a line with chalk.

All bundles of shingles contain a graph that indicates the appropriate overlap for the shingles according to the roof slope.



Double or triple the first course at the overhang.

79. This section reprints with permission from Cornerstones Community Partnerships, "Installing Wood Shingles and Shakes," in *Adobe Conservation: A Preservation Handbook*, illustrated by Contreras Francisco Uviña (Santa Fe, NM: Sunstone Press, 2006), 111–115.

Shingle and shake roofs are very durable when installed correctly and maintained properly. Though somewhat costly, they are an important part of the history of New Mexico and the Southwest; they were the first non-native roofing materials to be introduced. Next to the rapidly disappearing earthen roofs, they are perhaps the most endangered element of historic New Mexican architecture.

TOOLS AND MATERIALS REQUIRED


Air compressor


Broom


Cedar shingles


Chalk line


Circular saw


Circular saw blade, diamond blade


Flashing


Gloves


Goggles


Hammer


Ice and water shield


Ladder


Measuring tape


Nails


Scaffolding


Sheet metal shears


Shovel

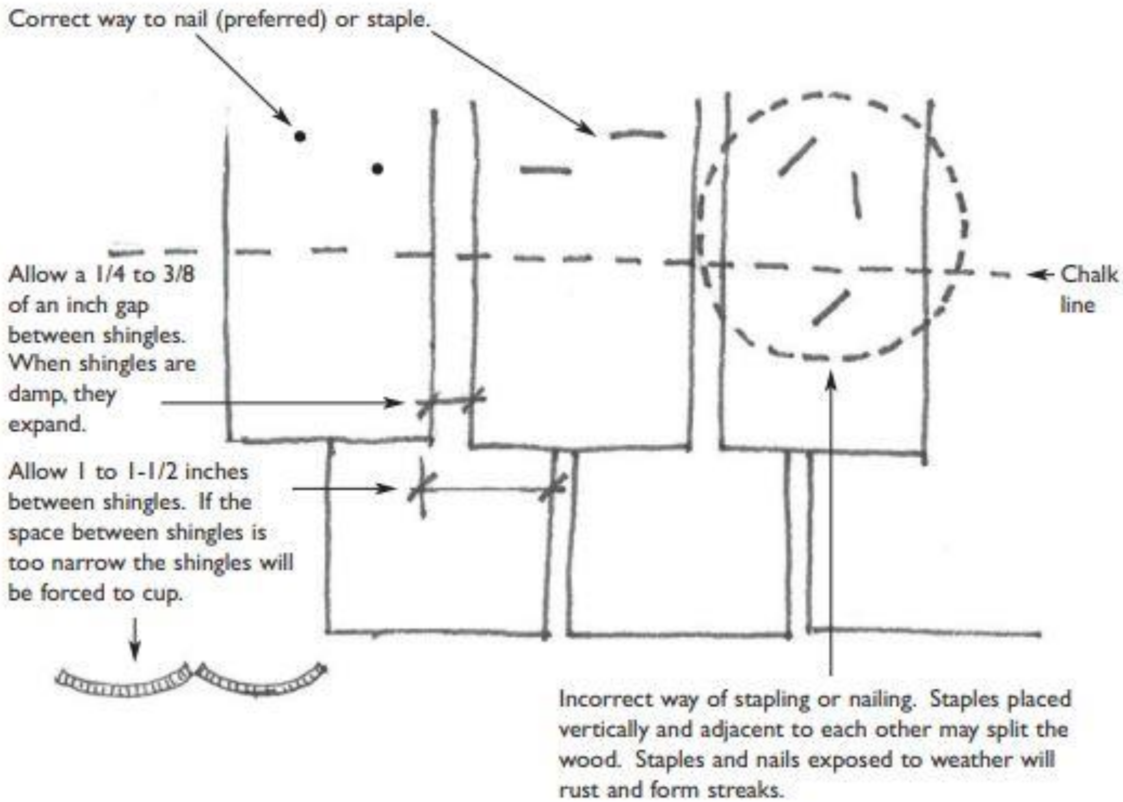

Staple gun

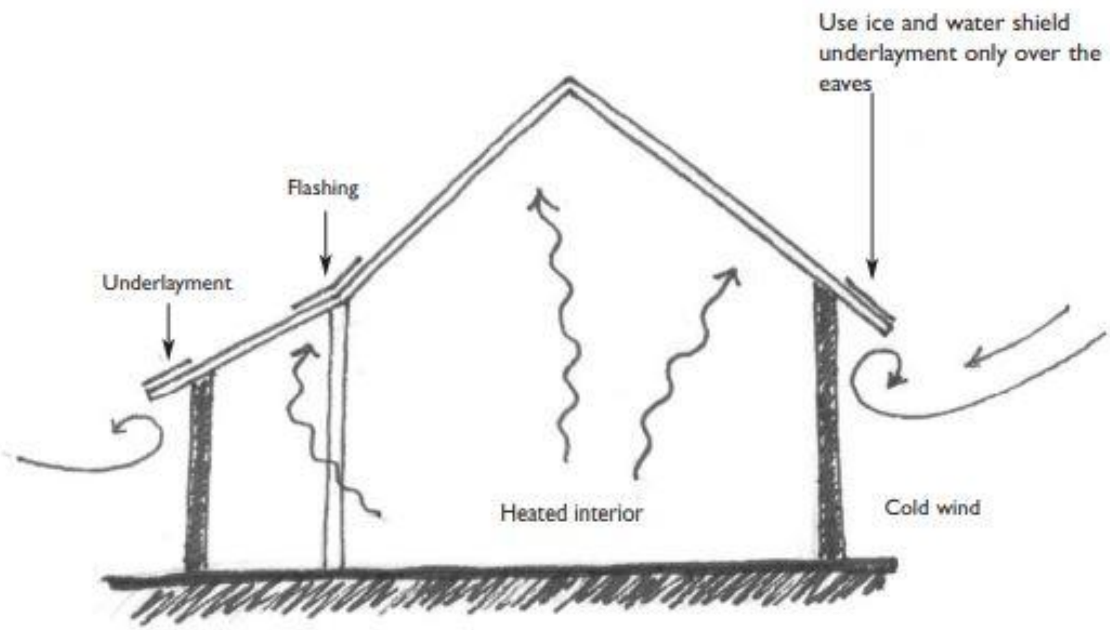

Staples


String


Utility knife

INSTALLATION PRINCIPLES CONTINUED





1. Remove existing shingles if any.

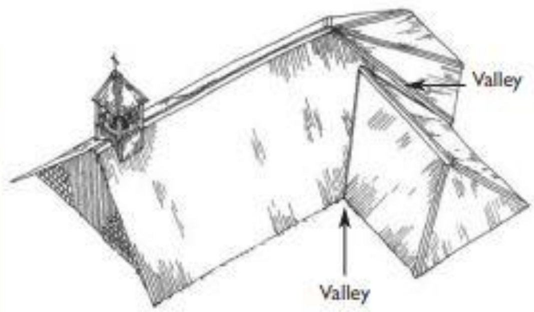
2. Sweep and clean the roof surface.

3. Drive in or pull out existing nails and repair or replace damaged purlins.

4. Ice and water shield should be installed on all overhangs. Roll out shield, cut to a workable length, and cut to fit at the hip if a hip exists.

5. Carefully remove kraft paper from underside of the shield. Work from one end to the other. Carefully place the shield on roof surface.

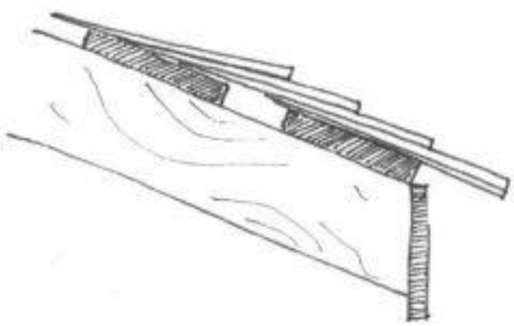
WARNING: When shield glue touches any surface, it will stick and stay!



6. When the roof structure contains valleys, place galvanized, stainless steel or copper sheet metal flashing in the valley. Cut to length. Nail flashing in place.

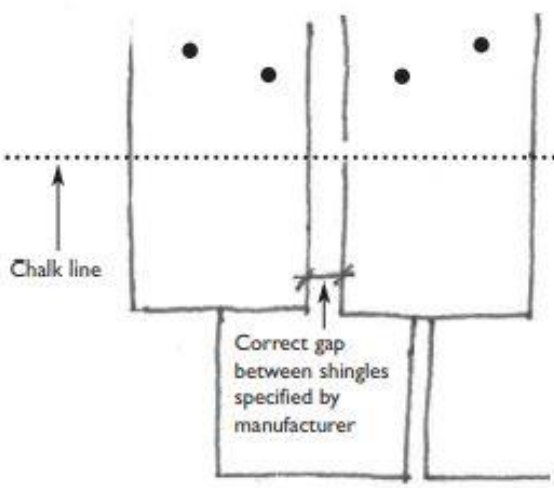
7. After shield and flashing installation has begun, determine the eave overhang and nail a guide shingle at one end. Leave a three inch overhang.

8. Nail a shingle at the other end of the span. Pull a string as a guide at the outside edge of the shingle.



9. Nail two or three overlapped shingles. Illustration shows the bottom layer of shingles with three laps and a single layer above.

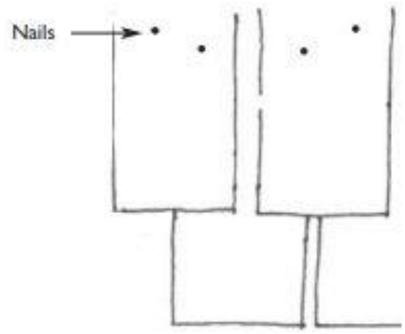
10. Hand place shingles with the right spacing.



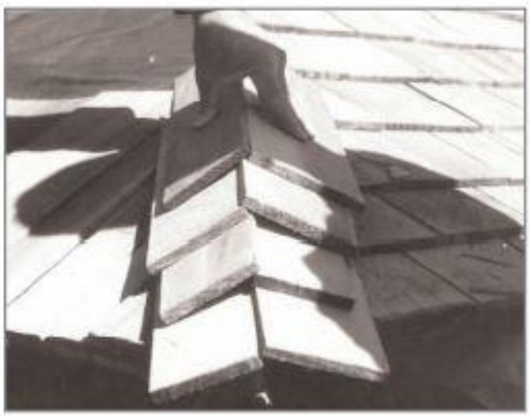
11. Break shingles by hand to obtain the correct spacing of the gap between shingles.

12. Make sure to use a chalk line to strike a line as a guide. The shingle manufacturer specifies the correct distance for the spacing between shingles.

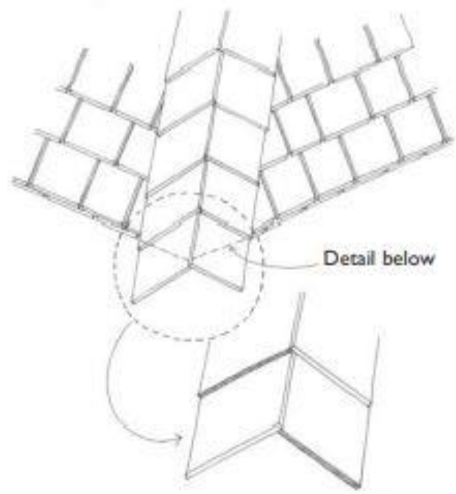
13. Continue the process of placing shingles.



14. Once the row of shingles has been put in place, anchor each shingle with two nails as shown above.



15. At the hip each side of the shingle overlaps in an alternating fashion.



16. Using a circular saw cut the extending shingles at the hip in order to place ridge cap.

NOTE: When installing wood cedar shakes, the process is similar except a 15-pound roofing felt is installed on every course. The roll of roofing felt is cut in half in order to install it over each layer of shakes. The first course should always begin with shingles and then continue with shakes. Shakes are nailed in similar fashion and since a shake is split not sawn, there is always a rough or textured side. This side should always face up. The felt, when installed, should be completely hidden under the layers of shakes and not exposed to sunlight.

7 Stage IV: Concrete

Concrete was not an original construction material but was incorporated throughout the many construction stages of the José María Gil Adobe residence and the site. There are concrete pavers under the veranda on all but the north side of the building. The building roof was reinforced with concrete columns, and there are various concrete objects throughout the site itself.

7.1 Exterior concrete features

The José María Gil Adobe veranda has a concrete paver floor, each paver measuring approximately 2 × 2 ft. The pavers line the building's perimeter on all but the northwest side of the building (Figure 132). Many pavers have been removed for archeological reasons, discussed previously in Section 3.4 (Figure 133). Most of the square concrete pavers appear to be in "FAIR" condition; however, the connections and raised porch floor are spalling and cracking due to settling (Figure 134 and Figure 135).

Figure 132. Concrete pavers lining the northeast side of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 133. Removed concrete pavers on the northeast side of the José María Gil Adobe, 2021. (ERDC-CERL.)

The south portion of the site of the José María Gil Adobe decreases in elevation. The porch floor on the south side of the building is leveled off with concrete to allow for a level surface along the building's immediate edge.

Figure 134. Raised concrete porch floor on the southwest side of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 135. Spalling and cracking of concrete on the south side of the porch floor of the José María Gil Adobe, 2021. (ERDC-CERL.)

The José María Gil Adobe has concrete columns that support the veranda roof on all but the northwest side of the building (Figure 136). The intact columns are topped with wooden disks, possibly for leveling purposes of the roof. Many columns have cracked and failed, exposing metal reinforcements (Figure 137). Some columns have completely separated from their square concrete bases (Figure 138), while some have completely tipped over (Figure 139).

Figure 136. Intact concrete column on the northeast side of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 137. Crumbled concrete column showing metal reinforcement, on the southwest side of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 138. Concrete base with separated concrete column on the south corner of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 139. Concrete column tipped over with base still attached on the northwest corner of the José María Gil Adobe, 2021. (ERDC-CERL.)

The José María Gil Adobe has concrete components throughout the site that served a purpose for the building in the past. East of the building is a 10 × 21.5 ft concrete slab with two raised square corners on the northeast edge. The raised square corners are approximately 42 × 44 in. and are approximately 4 in. tall (Figure 140).

An integral feature of the site is the cobblestone wall that surrounds the building. Near the north corner of the site is an opening of this wall with cast concrete entrance pillars that are at the height of the cobblestone wall (Figure 141).

Approximately 17 ft from the building is a round, tube-like object along the southwest side. The object has a 42 in. diameter (Figure 142).

East of the building is a 52 × 31.5 in. concrete, rectangular object with a hollow center. The rim of the object is 7 in., and the overall height of the object is 12 in. (Figure 143). There is metal bracing visible.

Figure 140. Concrete slab with raised square corners on the northeast side, approximately 25 ft east of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 141. Cast-concrete entrance pillars attached to cobblestone wall near the north corner of the site of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 142. Tube-like, concrete object near the southwest side of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 143. Rectangular, concrete object with a hollow center on the east side of the José María Gil Adobe, 2021. (ERDC-CERL.)

The cold storage building, described in Section 3.1.2, has two wooden front veranda posts that sit on concrete blocks (Figure 144).

Figure 144. Concrete blocks supporting front wooden posts on the veranda of the cold storage building, 2021. (ERDC-CERL.)

7.2 Interior concrete features

There are no interior concrete features in the José María Gil Adobe.

7.3 Treatment measures

The following images and documents offer treatment measures for concrete materials that are in “POOR” condition. The sources include information from the General Services Administration.

7.3.1 "Patching Spalled Concrete," 2017[80]

Patching Spalled Concrete

Procedure code:
373204S
Source:
National Capitol Region Specification - Agriculture Building
Division:
Concrete
Section:
Concrete Repair
Last Modified:
07/07/2017

PART 1---GENERAL

1.01 SUMMARY

A. This procedure includes guidance on patching spalls and holes in concrete with a cementitious patching material.
B. See 01100-07-S for general project guidelines to be reviewed along with this procedure. These guidelines cover the following sections:
   1. Safety Precautions
   2. Historic Structures Precautions
   3. Submittals
   4. Quality Assurance
   5. Delivery, Storage and Handling
   6. Project/Site Conditions
   7. Sequencing and Scheduling
   8. General Protection (Surface and Surrounding)

These guidelines should be reviewed prior to performing this procedure and should be followed, when applicable, along with recommendations from the Regional Historic Preservation Officer (RHPO).

1.02 QUALITY ASSURANCE

A. Masonry and Concrete Repair: Prepare sample panels of size indicated for each type of masonry material indicated to be patched, rebuilt or replaced.

80. This section reproduces US General Services Administration, "Patching Spalled Concrete," Historic Preservation Technical Procedures, 2017, https://www.gsa.gov/real-estate/historic-preservation/historic-preservation-policy-tools/preservation-tools-resources/technical-documentsno.Concrete. Public domain.

PART 2---PRODUCTS

2.01 MANUFACTURERS

A. Sika Corporation usa.skie.com
B. General Polymers, www.generalpolymers.com
C. BASF Master Builders Solutions, www.master-builders-solutions-basf.us
D. Euclid Chemical, www.euclidchemical.com

2.02 MATERIALS

A. Concrete Patching Material: One component, earlystrength, cementitious patching material "Sike Repair 222" (Sika Corporation); "TPM 723" (General Polymers); (Master Builders), or approved equal.
B. Water: Clean, free of oils, acids, alkalis and organic matter.

2.03 EQUIPMENT

A. Trowels
B. Chisels
C. Stiff bristle brushes (non-metallic)

PART 3---EXECUTION

3.01 PREPARATION

A. Protection:
   1. Protect persons, motor vehicles, surrounding surfaces of building whose masonry surfaces are being restored, building site, and surrounding buildings from injury resulting from masonry restoration work.
   2. Erect temporary protection covers over pedestrian walkways and at points of entrance and exit for persons and vehicles which must remain in operation during course of masonry restoration work.
   3. Contractor shall test those areaway drains, window well drains, etc., which will be used to assure that drains are functioning properly prior to performing masonry restoration operations in those areas. The Contractor shall report immediately to the Construction Engineer the location of drains which are found to be stopped up or blocked.
   4. Prevent grout or mortar used in repointing and repair work from staining face of surrounding masonry and other surfaces. Remove immediately grout and mortar in contact with exposed masonry and other surfaces.
   5. Protect sills, ledges, windows, and projections from patching material droppings.

3.02 ERECTION, INSTALLATION, APPLICATION

A. Remove deteriorated concrete at spalls to sound material. Grind, chisel or saw cut 1" deep undercut around perimeter of patch. Clean with compressed air. Thoroughly remove any concrete showing traces of oils or grease.
B. Thoroughly wet patched area prior to casting concrete patching material. If cement patching material manufacturer recommends a different procedure, such procedure is to be followed and executed in accordance with published instructions and in accordance with approved test patch.
C. Install cement patching material in strict accordance with manufacturer's published instructions.
D. Finish surface to match surface being patched, by grinding, troweling, sacking, or brushing.

3.03 ADJUSTING/CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter using stiff nylon or bristle brushes and clean water, spray applied at low pressure.
B. Use of metal scrapers or brushes will not be permitted.
C. Use of acid or alkali cleaning agents will not be permitted.

7.3.2 "Removing Surface Dirt from Concrete," 2016[81]

Removing Surface Dirt From Concrete

Procedure code:
371015S
Source:
Hstrc Concrete: Investigation & Rpr/Pre-Conf Training - 1989
Division:
Concrete
Section:
Concrete Cleaning
Last Modified:
08/02/2016

PREFACE: The cleaning or removal of stains from concrete may involve the use of liquids, detergents or solvents which may run off on\ adjacent material, discolor the concrete or drive the stains deeper into porous concrete. Use the products and techniques described here only for the combinations of dirt/stain and concrete specified.

PART 1---GENERAL

1.01 SUMMARY

A. This procedure includes guidance on removing dirt from concrete using a detergent, chemical solvent or steam.
B. Dirt encompasses deposits of almost any material in a location where it's not wanted, but it usually includes fine, dark-colored solid particles, often surrounded by some kind of oily film. It is particularly troublesome on architectural and decorative concrete, including exposed aggregate surfaces.
C. Safety Precautions:
    1. DO NOT save unused portions of stain-removal materials.
    2. DO NOT store any chemicals in unmarked containers.
    3. EXCELLENT VENTILATION MUST BE PROVIDED WHEREVER ANY SOLVENT IS USED. USE RESPIRATORS WITH SOLVENT FILTERS.
    4. Whenever acid is used, the surface should be thoroughly rinsed with water as soon as its action has been adequate. Otherwise it will continue etching the concrete even though the stain is gone.
    5. Provide adequate clothing and protective gear where the chemicals are indicated to be dangerous.
    6. Have available antidote and accident treatment chemicals where noted.
D. See "General Project Guidelines" for general project guidelines to be reviewed along with this procedure. These guidelines cover the following sections:
    1. Safety Precautions
    2. Historic Structures Precautions
    3. Submittals
    4. Quality Assurance
    5. Delivery, Storage and Handling
    6. Project/Site Conditions

81. This section reproduces US General Services Administration, "Removing Surface Dirt from Concrete," Historic Preservation Technical Procedures, 2016, https://www.gsa.gov/real-estate/historic-preservation/historic-preservation-policy-tools/preservation-tools-resources/technical-procedures/removing-surface-dirt-from-concrete. Public domain.

7. Sequencing and Scheduling
8. General Protection (Surface and Surrounding)
   These guidelines should be reviewed prior to performing this procedure and should be followed, when applicable, along with recommendations from the Regional Historic Preservation Officer (RHPO).

PART 2---PRODUCTS

2.01 MATERIALS

NOTE: Chemical products are sometimes sold under a common name. This usually means that the substance is not as pure as the same chemical sold under its chemical name. The grade of purity of common name substances, however, is usually adequate for stain removal work, and these products should be purchased when available, as they tend to be less expensive. Common names are indicated below by an asterisk (*).

A. Hydrochloric Acid:
   1. A strong corrosive irritating acid.
   2. Other chemical or common names include Chlorhydric acid; Hydrogen chloride; Muriatic acid*; Marine acid*; Spirit of salt*; Spirit of sea salt*.
   3. Available from chemical supply house, drugstore, hardware store.
B. Detergent:
   1. CAUTION: SOME DETERGENTS CONTAIN AMMONIA AND MAY REACT VIGOROUSLY WITH HYDROCHLORIC ACID.
C. Clean, potable water
D. Clean white cloths or towels

2.02 EQUIPMENT

A. Steam cleaning equipment
B. Stiff bristle brushes (non-metallic)

PART 3---EXECUTION

3.01 PREPARATION

A. Protection:
   1. Provide adequate wash solutions (i.e. water, soap and towels) before starting the job.
   2. Whenever acid is used, the surface should be thoroughly rinsed with water as soon as its action has been adequate. Otherwise it will continue etching the concrete even though the stain is gone.

3.02 ERECTION, INSTALLATION, APPLICATION

NOTE: DO NOT TRY MORE THAN ONE TREATMENT ON A GIVEN AREA UNLESS THE CHEMICALS USED FROM PRIOR TREATMENT HAVE BEEN WASHED AWAY.

A. Brush affected area with water and strong detergent.
B. Rinse the area thoroughly with clean, clear water and blot the surface dry with clean towels.
C. Repeat the treatment as necessary until the desired level of cleanliness is achieved.
   -OR-
D. Mix 1 part hydrochloric acid in 19 parts water.
E. Scrub the concrete surface with this solution. NOTE: THIS IS A STRONG METHOD AND MAY ROUGHEN THE CONCRETE.
F. Rinse the area thoroughly with clean, clear water, blot the surface dry with clean towels.
G. Repeat the treatment as necessary until the desired level of cleanliness is achieved.
   -OR-
H. Steam cleaning is generally effective and may be used in combination with proprietary materials, such as detergents for dirt removal.
I. If there is oil present in the dirt, follow the procedure described for removing lubricating oil, see 03710-31-R "Poulticing Lubricating and Petroleum Oil Stains From Concrete".

8 Stage IV: Stone

8.1 Exterior stone features

The José María Gil Adobe has stone features that are both architecturally and historically important to the site. Many of the stone features were constructed from stones found near the site or the San Antonio River, which is south of the site. Along the perimeter of the site is a cobblestone wall that is intact in some places and crumbling in others (Figure 145, Figure 146, and Figure 147). Atop the cobblestone wall is a smeared concrete surface (Figure 148). The cobblestones are of various sizes, ranging between 3 to 10 in. in dimension (Figure 149).

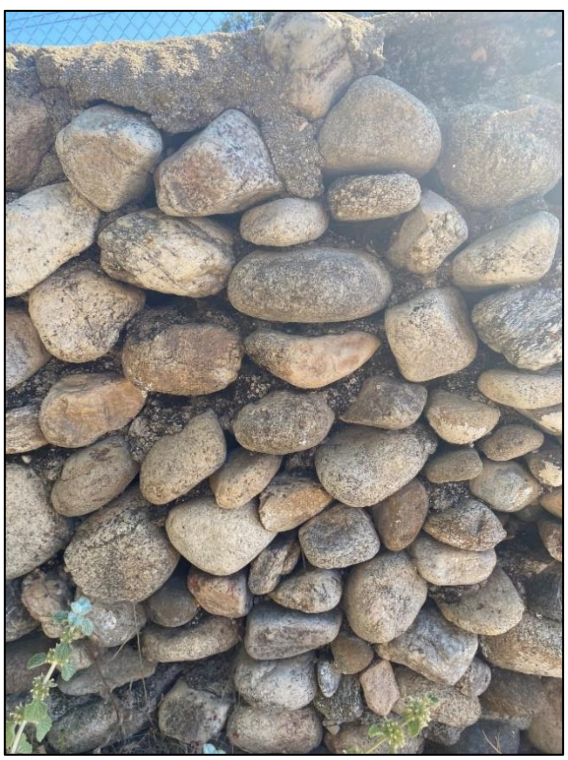
Figure 145. Cobblestone wall on the northeast side of the site of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 146. Cobblestone wall on the northmost corner of the site of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 147. Crumbling cobblestone wall on the north side of the site of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 148. Smeared concrete surface on top of the cobblestone wall along the perimeter of the site of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 149. Various sizes of cobblestone making up the perimeter wall of the site of the José María Gil Adobe, 2021. (ERDC-CERL.)



Within the site of the José María Gil Adobe are piles of cobblestone left over from the wall as it has eroded over the years (Figure 150 and Figure 151), as well as other small stones that are scattered throughout the site in no clear relation to the location of the wall (Figure 152).

Figure 150. Crumbled and scattered cobblestone wall on the east side of the site of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 151. Crumbled and scattered cobblestone wall on the north side of the site of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 152. Small stone scattered amongst the site of the José María Gil Adobe, 2021. (ERDC-CERL.)

A unique feature of the José María Gil Adobe site is a small cobblestone fire pit that is dangerously close to the building. The fire pit is elliptical in shape, measuring 48 in. along the long side and 32 in. along the short side. The height is 10 in. The fire pit was constructed from natural cobblestones that are native to the area, being close to the San Antonio River and numerous wetlands. See the cobblestone fire pit in Figure 153.

Figure 153. Elliptical cobblestone fire pit near the southeast corner of the José María Gil Adobe, 2021. (ERDC-CERL.)

8.2 Interior stone features

There are two stone features in the José María Gil Adobe. The stone fire pit and hearth, seen in Figure 154, is currently painted yellow. At the front-left corner of the hearth is "1760" carved into the stone (Figure 155). The meaning of this number is unknown.

Figure 154. Stone hearth painted yellow in the south wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 155. The number “1760” carved into the front-left corner of the stone hearth in the south wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

8.3 Treatment measures

Generally, the best treatment measure for the actual stones used in stonework is to leave them alone. If stones must be cleaned, then the cleaning methods used should be effective but gentle and should leave no damage behind that would further deteriorate them. The patina of age on stones used in stonework is one of the hallmarks of historic buildings, and a “like new” appearance should not be the goal.

The first step is to identify why it needs be cleaned. Some staining issues are caused by water or moisture issues while others are from biological growth. There are different methods for these types of stains, but it needs to be reiterated that stonework should be cleaned only if absolutely necessary.

Testing should be performed first on an inconspicuous portion of the stonework. Water tends to be the gentlest, and cleaning work is always done from the bottom up and not the top down.

Work should be contracted out to those that have experience in historic stonework. Each project is unique due to different types of stones and mortars. The types of stone should be listed as part of any contract when attempting to assess the appropriate contractor.

The following images and documents offer treatment measures for exterior and interior mortar materials that are in poor condition. The sources include information from the National Park Service.

8.3.1 Preservation Brief 1, *Accessing Cleaning and Water-Repellent Treatments for Historic Masonry Buildings*, 1978[82]

1 PRESERVATION BRIEFS

Assessing Cleaning and Water-Repellent Treatments for Historic Masonry Buildings

Robert C. Mack, AIA
Anne Grimmer

U.S. Department of the Interior
National Park Service
Cultural Resources
Heritage Preservation Services

Inappropriate cleaning and coating treatments are a major cause of damage to historic masonry buildings. While either or both treatments may be appropriate in some cases, they can be very destructive to historic masonry if they are not selected carefully. Historic masonry, as considered here, includes stone, brick, architectural terra cotta, cast stone, concrete and concrete block. It is frequently cleaned because cleaning is equated with improvement. Cleaning may sometimes be followed by the application of a water-repellent coating. However, unless these procedures are carried out under the guidance and supervision of an architectural conservator, they may result in irrevocable damage to the historic resource.

The purpose of this Brief is to provide information on the variety of cleaning methods and materials that are available for use on the *exterior* of historic masonry buildings, and to provide guidance in selecting the most appropriate method or combination of methods. The difference between water-repellent coatings and waterproof coatings is explained, and the purpose of each, the suitability of their application to historic masonry buildings, and the possible consequences of their inappropriate use are discussed.

The Brief is intended to help develop sensitivity to the qualities of historic masonry that makes it so special, and to assist historic building owners and property managers in working cooperatively with architects, architectural conservators and contractors (Fig. 1). Although specifically intended for historic buildings, the information is applicable to all masonry buildings. This publication updates and expands *Preservation Brief 1: The Cleaning and Waterproof Coating of Masonry Buildings*. The Brief is not meant to be a cleaning manual or a guide for preparing specifications. Rather, it provides general information to raise awareness of the many factors involved in selecting cleaning and water-repellent treatments for historic masonry buildings.

Figure 1. Low-to medium-pressure steam (hot-pressurized water washing), is being used to clean the exterior of the U.S. Tariff Commission Building, the first marble building constructed in Washington, D.C., in 1839. This method was selected by an architecural conservator as the "gentlest means possible" to clean the marble. Steam can soften heavy soiling deposits such as those on the cornice and column capitals, and facilitate easy removal. Note how these deposits have been removed from the right side of the cornice which has already been cleaned.

82. This section reproduces Robert C. Mack and Anne Grimmer, *Accessing Cleaning and Water-Repellent Treatments for Historic Masonry Buildings*, Preservation Brief 1 (Washington, DC: National Park Service, 1978), Preservation Brief 1: Assessing Cleaning and Water-Repellant Treatments for Historic Masonry Buildings (nps.gov). Public domain.

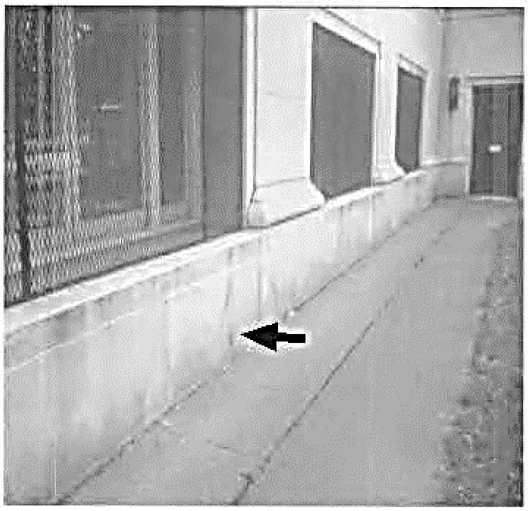


Figure 2. Biological growth as shown on this marble foundation can usually be removed using a low-pressure water wash, possibly with a non-ionic detergent added to it, and scrubbing with a natural or synthetic bristle brush.

Figure 3. This small test area has revealed a red brick patch that does not match the original beige brick. This may explain why the building was painted, and may suggest to the owner that it may be preferable to keep it painted.

Preparing for a Cleaning Project

Reasons for cleaning. First, it is important to determine whether it is appropriate to clean the masonry. The objective of cleaning a historic masonry building must be considered carefully before arriving at a decision to clean. There are several major reasons for cleaning a historic masonry building: **improve the appearance of the building** by removing unattractive dirt or soiling materials, or non-historic paint from the masonry; **retard deterioration** by removing soiling materials that may be damaging the masonry; or **provide a clean surface** to accurately match repointing mortars or patching compounds, or to conduct a condition survey of the masonry.

Identify what is to be removed. The general nature and source of dirt or soiling material on a building must be identified to remove it in the *gentlest means possible*—that is, in the most effective, yet least harmful, manner. Soot and smoke, for example, require a different cleaning agent to remove than oil stains or metallic stains. Other common cleaning problems include biological growth such as mold or mildew, and organic matter such as the tendrils left on masonry after removal of ivy (Fig. 2).

Consider the historic appearance of the building. If the proposed cleaning is to remove paint, it is important in each case to learn whether or not unpainted masonry is historically appropriate. And, it is necessary to consider why the building was painted (Fig. 3). Was it to cover bad repointing or unmatched repairs? Was the building painted to protect soft brick or to conceal deteriorating stone? Or, was painted masonry simply a fashionable treatment in a particular historic period? Many buildings were painted at the time of construction or shortly thereafter; retention of the paint, therefore, may be more appropriate historically than removing it. And, if the building appears to have been painted for a long time, it is also important to think about whether the paint is part of the character of the historic building and if it has acquired significance over time.

Consider the practicalities of cleaning or paint removal. Some gypsum or sulfate crusts may have become integral with the stone and, if cleaning could result in removing some of the stone surface, it may be preferable not to clean. Even where unpainted masonry is appropriate, the retention of the paint may be more practical than removal in terms of long range preservation of the masonry. In some cases, however, removal of the paint may be desirable. For example, the old paint layers may have built up to such an extent that removal is necessary to ensure a sound surface to which the new paint will adhere.

Study the masonry. Although not always necessary, in some instances it can be beneficial to have the coating or paint type, color, and layering on the masonry researched before attempting its removal. Analysis of the nature of the soiling or of the paint to be removed from the masonry, as well as guidance on the appropriate cleaning method, may be provided by professional consultants, including architectural conservators, conservation scientists and preservation architects. The State Historic Preservation Office (SHPO), local historic district commissions, architectural review boards and preservation-oriented websites may also be able to supply useful information on masonry cleaning techniques.

Understanding the Building Materials

The construction of the building must be considered when developing a cleaning program because inappropriate cleaning can have a deleterious effect on the masonry as well as on other building materials. The masonry material or materials must be correctly identified. It is sometimes difficult to distinguish one type of stone from another; for example, certain sandstones can be easily confused with limestones. Or, what appears to be natural stone may not be stone at all, but cast stone or concrete. Historically, cast stone and architectural terra cotta were frequently used in combination with natural stone, especially for trim elements or on upper stories of a building where, from a distance, these substitute materials looked like real stone (Fig. 4). Other features on historic buildings that appear to be stone, such as decorative cornices, entablatures and window hoods, may not even be masonry, but metal.

Identify prior treatments. Previous treatments of the building and its surroundings should be researched and building maintenance records should be obtained, if available. Sometimes if streaked or spotty areas do not seem to get cleaner following an initial cleaning, closer inspection and analysis may be warranted. The discoloration may turn out not to be dirt but the remnant of a water-repellent coating applied long ago which has darkened the surface of the masonry over time (Fig. 5). Successful removal may require testing several cleaning agents to find something that will dissolve and remove the coating. Complete removal may not always be possible. Repairs may have been stained to match a dirty building, and cleaning may make these differences apparent. De-icing salts used near the building that have dissolved can

Figure 4. The foundation of this brick building is limestone, but the decorative trim above is architectural terra cotta intended to simulate stone.

Figure 5. Repeated water washing did not remove the staining inside this limestone porte cochere. Upon closer examination, it was determined to be a water-repellent coating that had been applied many years earlier. An alkaline cleaner may be effective in removing it.

migrate into the masonry. Cleaning may draw the salts to the surface, where they will appear as efflorescence (a powdery, white substance), which may require a second treatment to be removed. Allowances for dealing with such unknown factors, any of which can be a potential problem, should be included when investigating cleaning methods and materials. Just as more than one kind of masonry on a historic building may necessitate multiple cleaning approaches, unknown conditions that are encountered may also require additional cleaning treatments.

Choose the appropriate cleaner. The importance of testing cleaning methods and materials cannot be over emphasized. Applying the wrong cleaning agents to historic masonry can have disastrous results. Acidic cleaners can be extremely damaging to acid-sensitive stones, such as marble and limestone, resulting in etching and dissolution of these stones. Other kinds of masonry can also be damaged by incompatible cleaning agents, or even by cleaning agents that are usually compatible. There are also numerous kinds of sandstone, each with a considerably different geological composition. While an acid-based cleaner may be safely used on some sandstones, others are acid-sensitive and can be severely etched or dissolved by an acid cleaner. Some sandstones contain water-soluble minerals and can be eroded by water cleaning. And, even if the stone type is correctly identified, stones, as well as some bricks, may contain unexpected impurities, such as iron particles, that may react negatively with a particular cleaning agent and result in staining. Thorough understanding of the physical and chemical properties of the masonry will help avoid the inadvertent selection of damaging cleaning agents.

Figure 6. Timed water soaking can be very effective for cleaning limestone and marble as shown here at the Marble Collegiate Church in New York City. In this case, a twelve-hour water soak using a multi-nozzle manifold was followed by a final water rinse. Photo: Diane S. Kaese, Wiss, Janney, Elstner Associates, Inc., N.Y., N.Y.

Other building materials also may be affected by the cleaning process. Some chemicals, for example, may have a corrosive effect on paint or glass. The portions of building elements most vulnerable to deterioration may not be visible, such as embedded ends of iron window bars. Other totally unseen items, such as iron cramps or ties which hold the masonry to the structural frame, also may be subject to corrosion from the use of chemicals or even from plain water. The only way to prevent problems in these cases is to study the building construction in detail and evaluate proposed cleaning methods with this information in mind. However, due to the very likely possibility of encountering unknown factors, any cleaning project involving historic masonry should be viewed as unique to that particular building.

Cleaning Methods and Materials

Masonry cleaning methods generally are divided into three major groups: water, chemical, and abrasive. *Water methods* soften the dirt or soiling material and rinse the deposits from the masonry surface. *Chemical cleaners* react with dirt, soiling material or paint to effect their removal, after which the cleaning effluent is rinsed off the masonry surface with water. *Abrasive methods* include blasting with grit, and the use of grinders and sanding discs, all of which mechanically remove the dirt, soiling material or paint (and, usually, some of the masonry surface). Abrasive cleaning is also often followed with a water rinse. *Laser cleaning*, although not discussed here in detail, is another technique that is used sometimes by conservators to clean small areas of historic masonry. It can be quite effective for cleaning limited areas, but it is expensive and generally not practical for most historic masonry cleaning projects.

Although it may seem contrary to common sense, masonry cleaning projects should be carried out starting at the bottom and proceeding to the top of the building always keeping all surfaces wet below the area being cleaned. The rationale for this approach is based on the principle that dirty water or cleaning effluent dripping from cleaning in progress above will leave streaks on a dirty surface but will not streak a clean surface as long as it is kept wet and rinsed frequently.

Water Cleaning

Water cleaning methods are generally the *gentlest means possible*, and they can be used safely to remove dirt from all types of historic masonry.* There are essentially four kinds of water-based methods: soaking; pressure water washing; water washing supplemented with non-ionic detergent; and steam, or hot-pressurized water cleaning. Once water cleaning has been completed, it is often necessary to follow up with a water rinse to wash off the loosened soiling material from the masonry.

Soaking. Prolonged spraying or misting with water is particularly effective for cleaning limestone and marble. It is also a good method for removing heavy accumulations of soot, sulfate crusts or gypsum crusts that tend to form in protected areas of a building not regularly washed by rain. Water is distributed to lengths of punctured hose or pipe with non-ferrous fittings hung from moveable scaffolding or a swing stage that continuously mists the surface of the masonry with a very fine spray (Fig. 6). A timed on-off spray is another approach to using this cleaning technique. After one area has been cleaned, the apparatus is moved on to another. Soaking is often used in combination with water washing and is also followed by a final water rinse. Soaking is a very slow method — it may take several days or a week—but it is a very gentle method to use on historic masonry.

Water Washing. Washing with low-pressure or medium-pressure water is probably one of the most commonly used methods for removing dirt or other pollutant soiling from historic masonry buildings (Fig. 7). Starting with a very low pressure (100 psi or below), even using a garden hose, and progressing as needed to slightly higher pressure —generally no higher than 300-400 psi—is always the recommended way to begin. Scrubbing with natural bristle or synthetic bristle brushes—never metal which can abrade the surface and leave metal particles that can stain the masonry—can help in cleaning areas of the masonry that are especially dirty.

Water Washing with Detergents. Non-ionic detergents —which are not the same as soaps —are synthetic organic compounds that are especially effective in removing oily soil. (Examples of some of the numerous proprietary non-ionic detergents include Igepal by GAF, Tergitol by Union Carbide and Triton by Rohm & Haas.) Thus, the addition of a non-ionic detergent, or surfactant, to a low- or medium-pressure water wash can be a useful aid in the cleaning

*Water cleaning methods may not be appropriate to use on some badly deteriorated masonry because water may exacerbate the deterioration, or on gypsum or alabaster which are very soluble in water.

process. (A non-ionic detergent, unlike most household detergents, does not leave a solid, visible residue on the masonry.) Adding a non-ionic detergent and scrubbing with a natural bristle or synthetic bristle brush can facilitate cleaning textured or intricately carved masonry. This should be followed with a final water rinse.

Steam/Hot-Pressurized Water Cleaning. Steam cleaning is actually low-pressure hot water washing because the steam condenses almost immediately upon leaving the hose. This is a gentle and effective method for cleaning stone and particularly for acid-sensitive stones. Steam can be especially useful in removing built-up soiling deposits and dried-up plant materials, such as ivy disks and tendrils. It can also be an efficient means of cleaning carved stone details and, because it does not generate a lot of liquid water, it can sometimes be appropriate to use for cleaning interior masonry (Figs. 8-9).

Potential hazards of water cleaning. Despite the fact that water-based methods are generally the most gentle, even they can be damaging to historic masonry. Before beginning a water cleaning project, it is important to make sure that all mortar joints are sound and that the building is watertight. Otherwise water can seep through the walls to the interior, resulting in rusting metal anchors and stained and ruined plaster.

Some water supplies may contain traces of iron and copper which may cause masonry to discolor. Adding a chelating or complexing agent to the water, such as EDTA (ethylene diamine tetra-acetic acid), which inactivates other metallic ions, as well as softens minerals and water hardness, will help prevent staining on light-colored masonry.

Any cleaning method involving water should never be done in cold weather or if there is any likelihood of frost or freezing because water within the masonry can freeze, causing spalling and cracking. Since a masonry wall may take over a week to dry after cleaning, no water cleaning should be permitted for several days prior to the first average frost date, or even earlier if local forecasts predict cold weather.

Most essential of all, it is important to be aware that using water at too high a pressure, a practice common to "power washing" and "water blasting", is very abrasive and can easily etch marble and other soft stones, as well as some types of brick (Figs. 10-11). In addition, the distance of the nozzle from the masonry surface and the type of nozzle, as well as gallons per minute (gpm), are also important variables in a water cleaning process that can have a significant impact on the outcome of the project. This is why it is imperative that the cleaning be closely monitored to ensure that the cleaning operators do not raise the pressure or bring the nozzle too close to the masonry in an effort to "speed up" the process. The appearance of grains of stone or sand in the cleaning effluent on the ground is an indication that the water pressure may be too high.

Figure 7. Glazed architectural terra cotta often may be cleaned successfully with a low-pressure water wash and hand scrubbing supplemented, if necessary, with a non-ionic detergent. Photo: National Park Service Files.

Chemical Cleaning

Chemical cleaners, generally in the form of proprietary products, are another material frequently used to clean historic masonry. They can remove dirt, as well as paint and other coatings, metallic and plant stains, and graffiti. Chemical cleaners used to remove dirt and soiling include **acids, alkalies and organic compounds.** Acidic cleaners, of course, should not be used on masonry that is acid sensitive. Paint removers are alkaline, based on organic solvents or other chemicals.

Chemical Cleaners to Remove Dirt

Both alkaline and acidic cleaning treatments include the use of water. Both cleaners are also likely to contain surfactants (wetting agents), that facilitate the chemical reaction that removes the dirt. Generally, the masonry is wet first for both types of cleaners, then the chemical cleaner is sprayed on at very low pressure or brushed onto the surface. The cleaner is left to dwell on the masonry for an amount of time recommended by the product manufacturer or, preferably, determined by testing, and rinsed off with a low- or moderate-pressure cold, or sometimes hot, water wash. More than one application of the cleaner may be necessary, and it is always a good practice to test the product manufacturer's recommendations concerning dilution rates and dwell times. Because each cleaning situation is unique, dilution rates and dwell times can vary considerably. The masonry surface may be scrubbed lightly with natural or synthetic bristle brushes prior to rinsing. After rinsing, pH strips should be applied to the surface to ensure that the masonry has been neutralized completely.

Figure 8. (Left) Low-pressure (under 100 psi) steam cleaning (hot-pressurized water washing), is part of the regular maintenance program at the Jefferson Memorial, Washington, D.C. The white marble interior of this open structure is subject to constant soiling by birds, insects and visitors. (Right) This portable steam cleaner enables prompt cleanup when necessary. Photos: National Park Service Files.

Acidic Cleaners. Acid-based cleaning products may be used on **non-acid sensitive** masonry, which generally includes: granite, most sandstones, slate, unglazed brick and unglazed architectural terra cotta, cast stone and concrete (Fig. 12). Most commercial acidic cleaners are composed primarily of hydrofluoric acid, and often include some phosphoric acid to prevent rust-like stains from developing on the masonry after the cleaning. Acid cleaners are applied to the pre-wet masonry which should be kept wet while the acid is allowed to "work", and then removed with a water wash.

Alkaline Cleaners. Alkaline cleaners should be used on **acid-sensitive** masonry, including: limestone, polished and unpolished marble, calcareous sandstone, glazed brick and glazed architectural terra cotta, and polished granite. (Alkaline cleaners may also be used sometimes on masonry materials that are not acid sensitive—after testing, of course—but they may not be as effective as they are on acid-sensitive masonry.) Alkaline cleaning products consist primarily of two ingredients: a non-ionic detergent or surfactant; and an alkali, such as potassium hydroxide or ammonium hydroxide. Like acidic cleaners, alkaline products are usually applied to pre-wet masonry, allowed to dwell, and then rinsed off with water. (Longer dwell times may be necessary with alkaline cleaners than with acidic cleaners.) Two additional steps are required to remove alkaline cleaners after the initial rinse. First the masonry is given a slightly acidic wash—often with acetic acid—to neutralize it, and then it is rinsed again with water.

Chemical Cleaners to Remove Paint and Other Coatings, Stains and Graffiti

Removing paint and some other coatings, stains and graffiti can best be accomplished with alkaline paint removers, organic solvent paint removers, or other cleaning compounds. The removal of layers of paint from a masonry surface usually involves applying the remover either by brush, roller or spraying, followed by a thorough water wash. As with any chemical cleaning, the manufacturer's recommendations regarding application procedures should always be tested before beginning work.

Alkaline Paint Removers. These are usually of much the same composition as other alkaline cleaners, containing potassium or ammonium hydroxide, or trisodium phosphate. They are used to remove oil, latex and acrylic paints, and are effective for removing multiple layers of paint. Alkaline cleaners may also remove some acrylic, water-repellent coatings. As with other alkaline cleaners, both an acidic neutralizing wash and a final water rinse are generally required following the use of alkaline paint removers.

Organic Solvent Paint Removers. The formulation of organic solvent paint removers varies and may include a combination of solvents, including methylene chloride, methanol, acetone, xylene and toluene.

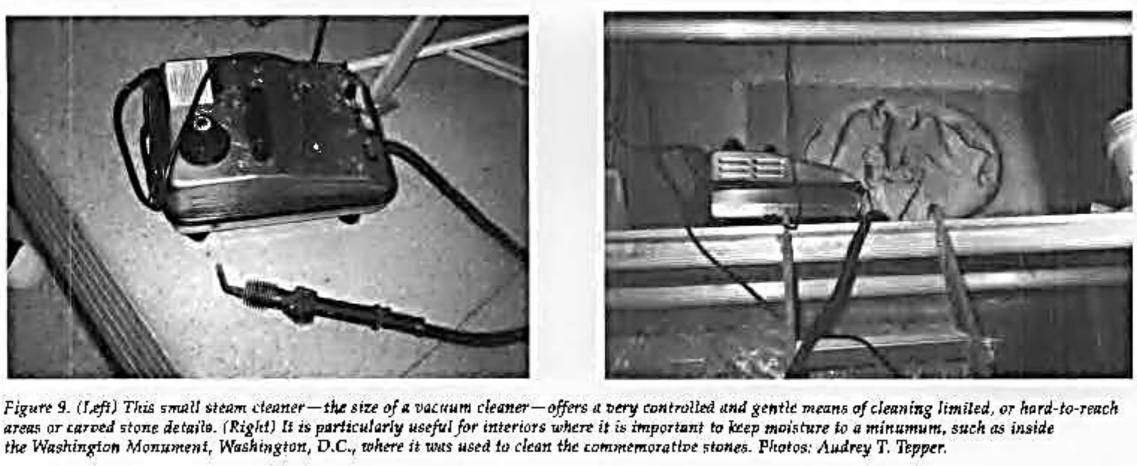


Figure 9. (Left) This small steam cleaner—the size of a vacuum cleaner—offers a very controlled and gentle means of cleaning limited, or hard-to-reach areas or carved stone details. (Right) It is particularly useful for interiors where it is important to keep moisture to a minumum, such as inside the Washington Monument, Washington, D.C., where it was used to clean the commemorative stones. Photos: Audrey T. Tepper.

Figure 10. High-pressure water washing too close to the surface has abraded and, consequently, marred the limestone on this early-20th century building.

Other Paint Removers and Cleaners. Other cleaning compounds that can be used to remove paint and some painted graffiti from historic masonry include paint removers based on N-methyl-2-pyrrolidone (NMP), or on petroleum-based compounds. Removing stains, whether they are industrial (smoke, soot, grease or tar), metallic (iron or copper), or biological (plant and fungal) in origin, depends on carefully matching the type of remover to the type of stain (Fig. 13). Successful removal of stains from historic masonry often requires the application of a number of different removers before the right one is found. The removal of layers of paint from a masonry surface is usually accomplished by applying the remover either by brush, roller or spraying, followed by a thorough water wash (Fig. 14).

Potential hazards of chemical cleaning. Since most chemical cleaning methods involve water, they have many of the potential problems of plain water cleaning. Like water methods, they should not be used in cold weather because of the possibility of freezing. Chemical cleaning should never be undertaken in temperatures below 40 degrees F (4 degrees C), and generally not below 50 degrees F. In addition, many chemical cleaners simply do not work in cold temperatures. Both acidic and alkaline cleaners can be dangerous to cleaning operators and, clearly, there are environmental concerns associated with the use of chemical cleaners.

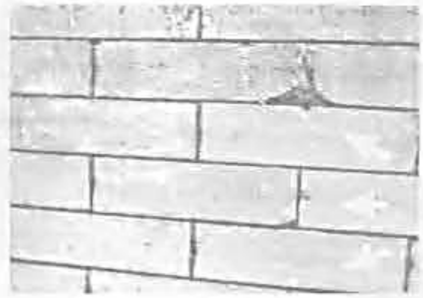


Figure 11. Rinsing with high-pressure water following chemical cleaning has left a horizontal line of abrasion across the bricks on this late-19th century row house.

If not carefully chosen, chemical cleaners can react adversely with many types of masonry. Obviously, acidic cleaners should not be used on acid-sensitive materials; however, it is not always clear exactly what the composition is of any stone or other masonry material. For, this reason, testing the cleaner on an inconspicuous spot on the building is always necessary. While certain acid-based cleaners may be appropriate if used as directed on a particular type of masonry, if left too long or if not adequately rinsed from the masonry they can have a negative effect. For example, hydrofluoric acid can etch masonry leaving a hazy residue (whitish deposits of silica or calcium fluoride salts) on the surface. While this efflorescence may usually be removed by a second cleaning—although it is likely to be expensive and time-consuming—hydrofluoric acid can also leave calcium fluoride salts or a colloidal silica deposit on masonry which may be impossible to remove (Fig. 15). Other acids, particularly **hydrochloric (muriatic) acid,** which is very powerful, should not be used on historic masonry, because it can dissolve lime-based mortar, damage brick and some stones, and leave chloride deposits on the masonry.

Figure 12. A mild acidic cleaning agent is being used to clean this heavily soiled brick and granite building. Additional applications of the cleaner and hand-scrubbing, and even poulticing, may be necessary to remove the dark stains on the granite arches below. Photo: Sharon C. Park, FAIA.

Alkaline cleaners can stain sandstones that contain a ferrous compound. Before using an alkaline cleaner on sandstone it is always important to test it, since it may be difficult to know whether a particular sandstone may contain a ferrous compound. Some alkaline cleaners, such as **sodium hydroxide (caustic soda or lye) and ammonium bifluoride**, can also damage or leave disfiguring brownish-yellow stains and, in most cases, should not be used on historic masonry. Although alkaline cleaners will not etch a masonry surface as acids can, they are caustic and can burn the surface. In addition, alkaline cleaners can deposit potentially damaging salts in the masonry which can be difficult to rinse thoroughly.

Abrasive and Mechanical Cleaning

Generally, abrasive cleaning methods are not appropriate for use on historic masonry buildings. Abrasive cleaning methods are just that—abrasive. Grit blasters, grinders, and sanding discs all operate by *abrading* the dirt or paint off the surface of the masonry, rather than *reacting* with the dirt and the masonry which is how water and chemical methods work. Since the abrasives do not differentiate between the dirt and the masonry, they can also remove the outer surface of the masonry at the same time, and result in permanently damaging the masonry. Brick, architectural terra cotta, soft stone, detailed carvings, and polished surfaces are especially susceptible to physical and aesthetic damage by abrasive methods. Brick and architectural terra cotta are fired products which have a smooth, glazed surface which can be removed by abrasive blasting or grinding (Figs. 18-19). Abrasively-cleaned masonry is damaged aesthetically as well as physically, and it has a rough surface which tends to hold dirt and the roughness will make future cleaning more difficult. Abrasive cleaning processes can also increase the likelihood of subsurface cracking of the masonry. Abrasion of carved details causes a rounding of sharp corners and other loss of delicate features, while abrasion of polished surfaces removes the polished finish of stone.

Figure 13. Sometimes it may be preferable to paint over a thick asphaltic coating rather than try to remove it, because it can be difficult to remove completely. However, in this case, many layers of asphaltic coating were removed through multiple applications of a heavy duty chemical cleaner. Each application of the cleaner was left to dwell following the manufacturer's reccommendations, and then rinsed thoroughly. (As much as possible of the asphalt was first removed with wooden scrapers.) Although not all the asphalt was removed, this was determined to be an acceptable level of cleanliness for the project.

Figure 14. Chemical removal of paint from this brick building has revealed that the cornice and window hoods are metal rather than masonry.

Mortar joints, especially those with lime mortar, also can be eroded by abrasive or mechanical cleaning. In some cases, the damage may be visual, such as loss of joint detail or increased joint shadows. As mortar joints constitute a significant portion of the masonry surface (up to 20 per cent in a brick wall), this can result in the loss of a considerable amount of the historic fabric. Erosion of the mortar joints may also permit increased water penetration, which will likely necessitate repointing.

Figure 15. The whitish deposits left on the brick by a chemical paint remover may have resulted from inadequate rinsing or from the chemical being left on the surface too long and may be impossible to remove.

Poulticing to Remove Stains and Graffiti


a


b


c


d

Graffiti and stains, which have penetrated into the masonry, often are best removed by using a poultice. A poultice consists of an absorbent material or clay powder (such as kaolin or fuller's earth, or even shredded paper or paper towels), mixed with a liquid (solvent or other remover) to form a paste which is applied to the stain (Figs. 16-17). As it dries, the paste absorbs the staining material so that it is not redeposited on the masonry surface. Some commercial cleaning products and paint removers are specially formulated as a paste or gel that will cling to a vertical surface and remain moist for a longer period of time in order to prolong the action of the chemical on the stain. Pre-mixed poultices are also available as a paste or in powder form needing only the addition of the appropriate liquid. The masonry must be pre-wet before applying an alkaline cleaning agent, but not when using a solvent. Once the stain has been removed, the masonry must be rinsed thoroughly.

Figure 16. (a) The limestone base was heavily stained by runoff from the bronze statue above. (b) A poultice consisting of copper stain remover and ammonia mixed with fuller's earth was applied to the stone base and covered with plastic sheeting to keep it from drying out too quickly. (c) As the poultice dried, it pulled the stain out of the stone. (d) The poultice residue was removed carefully from the stone surface with wooden scrapers and the stone was rinsed with water. Photos: John Dugger.

Figure 17. A poultice is being used to remove salts from the brownstone statuary on the facade of this late-19th century stone church. Photo: National Park Service Files.

Figure 18. The glazed bricks in the center of the pier were covered by a signboard that protected them being damaged by the sandblasting which removed the glaze from the surrounding bricks.

Figure 19. A comparison of undamaged bricks surroundng the electrical conduit with the rest of the brick facade emphasizes the severity of the erosion caused by sandblasting.

Abrasive Blasting. Blasting with abrasive grit or another abrasive material is the most frequently used abrasive method. *Sandblasting* is most commonly associated with abrasive cleaning. Finely ground silica or glass powder, glass beads, ground garnet, powdered walnut and other ground nut shells, grain hulls, aluminum oxide, plastic particles and even tiny pieces of sponge, are just a few of the other materials that have also been used for abrasive cleaning. Although abrasive blasting is not an appropriate method of cleaning historic masonry, it can be safely used to clean some materials. Finely-powdered walnut shells are commonly used for cleaning monumental bronze sculpture, and skilled conservators clean delicate museum objects and finely detailed, carved stone features with very small, micro-abrasive units using aluminum oxide.

A number of current approaches to abrasive blasting rely on materials that are not usually thought of as abrasive, and not as commonly associated with traditional abrasive grit cleaning. Some patented abrasive cleaning processes—one dry, one wet—use finely-ground glass powder intended to "erase" or remove dirt and surface soiling only, but not paint or stains (Fig. 20). Cleaning with baking soda (sodium bicarbonate) is another patented process. Baking soda blasting is being used in some communities as a means of quick graffiti removal. However, it should not be used on historic masonry which it can easily abrade and can permanently "etch" the graffiti into the stone; it can also leave potentially damaging salts in the stone which cannot be removed. Most of these abrasive grits may be used either dry or wet, although dry grit tends to be used more frequently.

Figure 20. (Left) A comparison of the limestone surface of a 1920s office building before and after "cleaning" with a proprietary abrasive process using fine glass powder clearly shows the effectiveness of this method. But this is an abrasive technique and it has "cleaned" by removing part of the masonry surface with the dirt. Because it is abrasive, it is generally not recommended for large-scale cleaning of historic masonry, although it may be suitable to use in certain, very limited cases under controlled circumstances. (Right) A vacum chamber where the used glass powder is collected for environmentally safe disposal is a unique feature of this particular process. The specially-trained operators in the chamber wear protective clothing, masks and breathing equipment. Photos: Tom Keohan.

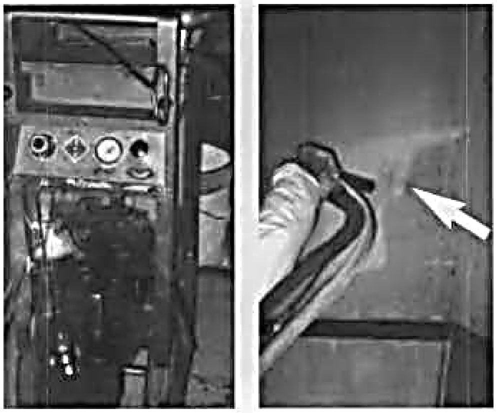


Figure 21. Low-pressure blasting with ice pellets or ice crystals (left) is an abrasive cleaning method that is sometimes recommended for use on interior masonry because it does not involve large amounts of water. However, like other abrasive materials, ice crystals "clean" by removing a portion of the masonry surface with the dirt, and may not remove some stains that have penetrated into the masonry without causing further abrasion (right). Photos: Audrey T. Tepper.

Ice particles, or pelletized dry ice (carbon dioxide or CO_2), are another medium used as an abrasive cleaner (Fig. 21). This is also too abrasive to be used on most historic masonry, but it may have practical application for removing mastics or asphaltic coatings from some substrates.

Some of these processes are promoted as being more environmentally safe and not damaging to historic masonry buildings. However, it must be remembered that they are abrasive and that they "clean" by removing a small portion of the masonry surface, even though it may be only a minuscule portion. The fact that they are essentially abrasive treatments must always be taken into consideration when planning a masonry cleaning project. *In general, abrasive methods should not be used to clean historic masonry buildings.* In some, very limited instances, highly-controlled, gentle abrasive cleaning may be appropriate on selected, hard-to-clean areas of a historic masonry building if carried out under the watchful supervision of a professional conservator. But, abrasive cleaning should never be used on an entire building.

Grinders and Sanding Disks. Grinding the masonry surface with mechanical grinders and sanding disks is another means of abrasive cleaning that should not be used on historic masonry. Like abrasive blasting, grinders and disks do not really clean masonry but instead grind away and abrasively remove and, thus, damage the masonry surface itself rather than remove just the soiling material.

Planning A Cleaning Project

Once the masonry and soiling material or paint have been identified, and the condition of the masonry has been evaluated, planning for the cleaning project can begin.

Testing cleaning methods. In order to determine the *gentlest means possible*, several cleaning methods or materials may have to be tested prior to selecting the best one to use on the building. Testing should always begin with the gentlest and least invasive method proceeding gradually, if necessary, to more complicated methods, or a combination of methods. All too often simple methods, such as low-pressure water wash, are not even considered, yet they frequently are effective, safe, and not expensive. Water of slightly higher pressure or with a non-ionic detergent additive also may be effective. It is worth repeating that these methods should always be tested prior to considering harsher methods; they are safer for the building and the environment, often safer for the applicator, and relatively inexpensive.

The level of cleanliness desired also should be determined prior to selection of a cleaning method. Obviously, the intent of cleaning is to remove most of the dirt, soiling material, stains, paint or other coating. A "brand new" appearance, however, may be inappropriate for an older building, and may require an overly harsh cleaning method to be achieved. When undertaking a cleaning project, it is important to be aware that some stains simply may not be removable. It may be wise, therefore, to agree upon a slightly lower level of cleanliness that will serve as the standard for the cleaning project. The precise amount of residual dirt considered acceptable may depend on the type of masonry, the type of soiling and difficulty of total removal, and local environmental conditions.

Cleaning tests should be carried out in an area of sufficient size to give a true indication of their effectiveness. It is preferable to conduct the test in an inconspicuous location on the building so that it will not be obvious if the test is not successful. A test area may be quite small to begin, sometimes as small as six square inches, and gradually may be increased in size as the most appropriate methods and cleaning agents are determined. Eventually the test area may be expanded to a square yard or more, and it should include several masonry units and mortar joints (Fig. 22). It should be remembered that a single building may have several types of masonry and that even similar materials may have different surface finishes. Each material and different finish should be tested separately. Cleaning tests should be evaluated only after the masonry has dried completely. *The results of the tests may indicate that several methods of cleaning should be used on a single building.*

When feasible, test areas should be allowed to weather for an extended period of time prior to final evaluation. A waiting period of a full year would be ideal in order to expose the test patch to a full range of seasons. If this is not possible, the test patch should weather for at least a month or two. For any building which is considered historically important, the delay is insignificant compared to the potential damage and disfigurement which may result from using an incompletely tested method. *The successfully cleaned test patch should be protected as it will serve as a standard against which the entire cleaning project will be measured.*

Environmental considerations. The potential effect of any method proposed for cleaning historic masonry should be evaluated carefully. Chemical cleaners and paint removers may damage trees, shrubs, grass, and plants. A plan must be provided for environmentally safe removal and disposal of the cleaning materials and the rinsing effluent before beginning the cleaning project. Authorities from the local regulatory agency—usually under the jurisdiction of the federal or state Environmental Protection Agency (EPA) should be consulted prior to beginning a cleaning project, especially if it involves anything more than plain water washing. This advance planning will ensure that the cleaning effluent or run-off, which is the combination of the cleaning agent and the substance removed from the masonry, is handled and disposed of in an environmentally sound and legal manner. Some alkaline and acidic cleaners can be neutralized so that they can be safely discharged into storm sewers. However, most solvent-based cleaners cannot be neutralized and are categorized as pollutants, and must be disposed of by a licensed transport, storage and disposal facility. Thus, it is always advisable to consult with the appropriate agencies before starting to clean to ensure that the project progresses smoothly and is not interrupted by a stop-work order because a required permit was not obtained in advance.

Vinyl guttering or polyethylene-lined troughs placed around the perimeter of the base of the building can serve to catch chemical cleaning waste as it is rinsed off the building. This will reduce the amount of chemicals entering and polluting the soil, and also will keep the cleaning waste contained until it can be removed safely. Some patented cleaning systems have developed special equipment to facilitate the containment and later disposal of cleaning waste.

Concern over the release of volatile organic compounds (VOCs) into the air has resulted in the manufacture of new, more environmentally responsible cleaners and paint removers, while some materials traditionally used in cleaning may no longer be available for these same reasons. Other health and safety concerns have created additional cleaning challenges, such as lead paint removal, which is likely to require special removal and disposal techniques.

Cleaning can also cause damage to non-masonry materials on a building, including glass, metal and wood. Thus, it is usually necessary to cover windows and doors, and other features that may be vulnerable to chemical cleaners. They should be covered with plastic or polyethylene, or a masking agent that is applied as a liquid which dries to form a thin protective film on glass, and is easily peeled off after the cleaning is finished. Wind drift, for example, can also damage other property by carrying cleaning chemicals onto nearby automobiles, resulting in etching of the glass or spotting of the paint finish. Similarly, airborne dust can enter surrounding buildings, and excess water can collect in nearby yards and basements.

Safety considerations. Possible health dangers of each method selected for the cleaning project must be considered before selecting a cleaning method to avoid harm to the

Figure 22. Cleaning test areas may be quite small at first and gradually increase in size as testing determines the "gentlest means possible". Photo: Frances Gale.

cleaning applicators, and the necessary precautions must be taken. The precautions listed in Material Safety Data Sheets (MSDS) that are provided with chemical products should always be followed. Protective clothing, respirators, hearing and face shields, and gloves must be provided to workers to be worn at all times. Acidic and alkaline chemical cleaners in both liquid and vapor forms can also cause serious injury to passers-by (Fig. 23). It may be necessary to schedule cleaning at night or weekends if the building is located in a busy urban area to reduce the potential danger of chemical overspray to pedestrians. Cleaning during non-business hours will allow HVAC systems to be turned off and vents to be covered to prevent dangerous chemical fumes from entering the building which will also ensure the safety of the building's occupants. Abrasive and mechanical methods produce dust which can pose a serious health hazard, particularly if the abrasive or the masonry contains silica.

Water-Repellent Coatings and Waterproof Coatings

To begin with, it is important to understand that waterproof coatings and water-repellent coatings are not the same. Although these terms are frequently interchanged and commonly confused with one another, they are completely different materials. **Water-repellent coatings** —often referred to incorrectly as "sealers", but which do not or should not seal— are intended to keep liquid water from penetrating the surface but to allow water vapor to enter and leave, or pass through, the surface of the masonry (Fig. 24). Water-repellent coatings are generally *transparent*, or clear, although once applied some may darken or discolor certain types of masonry while others may give it a glossy or shiny appearance. **Waterproof coatings** seal the surface from liquid water and from water vapor. They are usually *opaque*, or pigmented, and include bituminous coatings and some elastomeric paints and coatings.

Water-Repellent Coatings

Water-repellent coatings are formulated to be vapor permeable, or "breathable". They do not seal the surface completely to water vapor so it can enter the masonry wall as well as leave the wall. While the first water-repellent coatings to be developed were primarily acrylic or silicone resins in organic solvents, now most water-repellent coatings are water-based and formulated from modified siloxanes, silanes and other alkoxysilanes, or metallic stearates. While some of these products are shipped from the factory ready to use, other waterborne water repellents must be diluted at the job site. Unlike earlier water-repellent coatings which tended to form a "film" on the masonry surface, modern water-repellent coatings actually penetrate into the masonry substrate slightly and, generally, are almost invisible if properly applied to the masonry. They are also more vapor permeable than the old coatings, yet they still reduce the vapor permeability of the masonry. Once inside the wall, water vapor can condense at cold spots producing liquid water which, unlike water vapor, cannot escape through a water-repellent coating. The liquid water within the wall, whether from condensation, leaking gutters, or other sources, can cause considerable damage.

Water-repellent coatings are not consolidants. Although modern water repellents may penetrate slightly beneath the masonry surface, instead of just "sitting" on top of it, they do not perform the same function as a consolidant which is to "consolidate" and replace lost binder to strengthen deteriorating masonry. Even after many years of laboratory study and testing few consolidants have proven very effective. The composition of fired products such as brick and architectural terra cotta, as well as many types of building stone, does not lend itself to consolidation.

Some modern water-repellent coatings which contain a binder intended to replace the natural binders in stone that have been lost through weathering and natural erosion are described in product literature as both a water repellent and a consolidant. The fact that newer water-repellent coatings penetrate beneath the masonry surface instead of just forming a layer on top of the surface may indeed convey at least some consolidating properties to certain stones. However, a water-repellent coating cannot be considered a consolidant. In some instances, a water-repellent or "preservative" coating, if applied to already damaged or spalling stone, may form a surface crust which, if it fails, may exacerbate the deterioration by pulling off even more of the stone (Fig. 25).

Is a Water-Repellent Treatment Necessary?

Water-repellent coatings are frequently applied to historic masonry buildings for the wrong reason. They also are often applied without an understanding of what they are and what they are intended to do. And these coatings can be very difficult, if not impossible, to remove from the masonry if they fail or become discolored. Most importantly, the application of water-repellent coatings to historic masonry is usually unnecessary.

Figure 23. A tarpaulin protects and shields pedestrians from potentially harmful spray while chemical cleaning is underway on the granite exterior of the U.S. Treasury Building, Washington, D.C.

Most historic masonry buildings, unless they are painted, have survived for decades without a water-repellent coating and, thus, probably do not need one now. Water penetration to the interior of a masonry building is seldom due to porous masonry, but results from poor or deferred maintenance. Leaking roofs, clogged or deteriorated gutters and downspouts, missing mortar, or cracks and open joints around door and window openings are almost always the cause of moisture-related problems in a historic masonry building. **If historic masonry buildings are kept watertight and in good repair, water-repellent coatings should not be necessary.**

Rising damp (capillary moisture pulled up from the ground), or condensation can also be a source of excess moisture in masonry buildings. A water-repellent coating will not solve this problem either and, in fact, may be likely to exacerbate it. Furthermore, a water-repellent coating should never be applied to a damp wall. Moisture in the wall would reduce the ability of a coating to adhere to the masonry and to penetrate below the surface. But, if it did adhere, it would hold the moisture inside the masonry because, although a water-repellent coating is permeable to water vapor, liquid water cannot pass through it. In the case of rising damp, a coating may force the moisture to go even higher in the wall because it can slow down evaporation, and thereby retain the moisture in the wall.

Excessive moisture in masonry walls may carry waterborne soluble salts from the masonry units themselves or from the mortar through the walls. If the water is permitted to come to the surface, the salts may appear on the masonry surface as efflorescence (a whitish powder) upon evaporation. However, the salts can be potentially dangerous if they remain in the masonry and crystallize

Figure 24. Although the application of a water-repellent coating was probably not needed on either of these buildings, the coating on the brick building (above), is not visible and has not changed the character of the brick. But the coating on the brick column (below), has a high gloss that is incompatible with the historic character of the masonry.

beneath the surface as subflorescence. Subflorescence eventually may cause the surface of the masonry to spall, particularly if a water-repellent coating has been applied which tends to reduce the flow of moisture out from the subsurface of the masonry. Although many of the newer water-repellent products are more breathable than their predecessors, they can be especially damaging if applied to masonry that contains salts, because they limit the flow of moisture through masonry.

When a Water-Repellent Coating May be Appropriate
There are some instances when a water-repellent coating may be considered appropriate to use on a historic masonry building. Soft, incompletely fired brick from the 18th- and early-19th centuries may have become so porous that paint or some type of coating is needed to protect it from further deterioration or dissolution. When a masonry building has been neglected for a long period of time, necessary repairs may be required in order to make it watertight. If, following a reasonable period of time after the building has been made watertight and has dried out completely, moisture appears actually to be penetrating through the repointed and repaired masonry walls, then the application of a water-repellent coating may be considered *in selected areas only*. This decision should be made in consultation with an architectural conservator. And, if such a treatment is undertaken, it should not be applied to the entire exterior of the building.

Anti-graffiti or barrier coatings are another type of clear coating—although barrier coatings can also be pigmented—that may be applied to exterior masonry, but they are not formulated primarily as water repellents. The purpose of these coatings is to make it harder for graffiti to stick to a masonry surface and, thus, easier to clean. But, like water-repellent coatings, in most cases the application of anti-graffiti coatings is generally not recommended for historic masonry buildings. These coatings are often quite shiny which can greatly alter the appearance of a historic masonry surface, and they are not always effective (Fig. 26). Generally, other ways of discouraging graffiti, such as improved lighting, can be more effective than a coating. However, the application of anti-graffiti coatings may be appropriate in some instances on vulnerable areas of historic masonry buildings which are frequent targets of graffiti that are located in out-of-the-way places where constant surveillance is not possible.

Some water-repellent coatings are recommended by product manufacturers as a means of keeping dirt and pollutants or biological growth from collecting on the surface of masonry buildings and, thus, reducing the need for frequent cleaning. While this at times may be true, in some cases a coating may actually retain dirt more than uncoated masonry. Generally, the application of a water-repellent coating is not recommended on a historic masonry building as a means of preventing biological growth. Some water-repellent coatings may actually encourage biological growth on a masonry wall. Biological growth on masonry buildings has traditionally been kept at bay through regularly-scheduled cleaning as part of a maintenance plan. Simple cleaning of the masonry with low-pressure water using a natural- or synthetic-bristled scrub brush can be very effective if done on a regular basis. Commercial products are also available which can be sprayed on masonry to remove biological growth.

In most instances, a water-repellent coating is not necessary if a building is watertight. The application of a water-repellent coating is not a recommended treatment for historic masonry buildings unless there is a specific

Figure 25. The clear coating applied to this limestone molding has failed and is taking off some of the stone surface as it peels. Photo: Frances Gale.

problem which it may help solve. If the problem occurs on only part of the building, it is best to treat only that area rather than an entire building. Extreme exposures such as parapets, for example, or portions of the building subject to driving rain can be treated more effectively and less expensively than the entire building. Water-repellent coatings are not permanent and must be reapplied

Figure 26. The anti-graffiti or barrier coating on this column is very shiny and would not be appropriate to use on a historic masonry building. The coating has discolored as it has aged and whitish streaks reveal areas of bare concrete where the coating was incompletely applied.

periodically although, if they are truly invisible, it can be difficult to know when they are no longer providing the intended protection.

Testing a water-repellent coating by applying it in one small area may not be helpful in determining its suitability for the building because a limited test area does not allow an adequate evaluation of such a treatment. Since water may enter and leave through the surrounding untreated areas, there is no way to tell if the coated test area is "breathable." But trying a coating in a small area may help to determine whether the coating is visible on the surface or if it will otherwise change the appearance of the masonry.

Waterproof Coatings

In theory, waterproof coatings usually do not cause problems as long as they exclude all water from the masonry. If water does enter the wall from the ground or from the inside of a building, the coating can intensify the damage because the water will not be able to escape. During cold weather this water in the wall can freeze causing serious mechanical disruption, such as spalling.

In addition, the water eventually will get out by the path of least resistance. If this path is toward the interior, damage to interior finishes can result; if it is toward the exterior, it can lead to damage to the masonry caused by built-up water pressure (Fig. 27).

In most instances, waterproof coatings should not be applied to historic masonry. The possible exception to this might be the application of a waterproof coating to below-grade exterior foundation walls as a last resort to stop water infiltration on interior basement walls. **Generally, however, waterproof coatings, which include *elastomeric paints*, should almost never be applied above grade to historic masonry buildings.**

Figure 27. Instead of correcting the roof drainage problems, an elastomeric coating was applied to the already saturated limestone cornice. An elastomeric coating holds moisture in the masonry because it does not "breathe" and does not allow liquid moisture to escape. If the water pressure builds up sufficiently it can cause the coating to break and pop off as shown in this example, often pulling pieces of the masonry with it. Photo: National Park Service Files.

Summary

A well-planned cleaning project is an essential step in preserving, rehabilitating or restoring a historic masonry building. Proper cleaning methods and coating treatments, when determined necessary for the preservation of the masonry, can enhance the aesthetic character as well as the structural stability of a historic building. Removing years of accumulated dirt, pollutant crusts, stains, graffiti or paint, if done with appropriate caution, can extend the life and longevity of the historic resource. Cleaning that is carelessly or insensitively prescribed or carried out by inexperienced workers can have the opposite of the intended effect. It may scar the masonry permanently, and may actually result in hastening deterioration by introducing harmful residual chemicals and salts into the masonry or causing surface loss. Using the wrong cleaning method or using the right method incorrectly, applying the wrong kind of coating or applying a coating that is not needed can result in serious damage, both physically and aesthetically, to a historic masonry building. Cleaning a historic masonry building should always be done using the *gentlest means possible* that will clean, but not damage the building. It should always be taken into consideration before applying a water-repellent coating or a waterproof coating to a historic masonry building whether it is really necessary and whether it is in the best interest of preserving the building.

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This publication has been prepared pursuant to the National Historic Preservation Act of 1966, as amended, which directs the Secretary of the Interior to develop and make available information concerning historic properties. Comments on the usefulness of this publication may be directed to: Sharon C. Park, FAIA, Chief, Technical Preservation Services Branch, Heritage Preservation Services Program, National Park Service, 1849 C Street, N.W., Suite NC200, Washington, D.C. 20240 (www2.cr.nps.gov/tps).

Front Cover: Chemical cleaning of the brick and architectural terra cotta frieze on the 1880s Pension Building, Washington, D.C. (now the National Building Museum), is shown here in progress. Photo: Christina Henry.

Photographs used to illustrate this Brief were taken by Anne Grimmer unless otherwise credited.

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8.3.2 Preservation Brief 6, *Dangers of Abrasive Cleaning to Historic Buildings*, 1978[83]

6 PRESERVATION BRIEFS

Dangers of Abrasive Cleaning to Historic Buildings

Anne E. Grimmer

U.S. Department of the Interior
National Park Service
Cultural Resources
Heritage Preservation Services

"The surface cleaning of structures shall be undertaken with the gentlest means possible. Sandblasting and other cleaning methods that will damage the historic building materials shall not be undertaken."—The Secretary of the Interior's "Standards for Historic Preservation Projects."

Abrasive cleaning methods are responsible for causing a great deal of damage to historic building materials. To prevent indiscriminate use of these potentially harmful techniques, this brief has been prepared to explain abrasive cleaning methods, how they can be physically and aesthetically destructive to historic building materials, and why they generally are not acceptable preservation treatments for historic structures. There are alternative, less harsh means of cleaning and removing paint and stains from historic buildings. However, careful testing should preceed general cleaning to assure that the method selected will not have an adverse effect on the building materials. A historic building is irreplaceable, and should be cleaned using only the "gentlest means possible" to best preserve it.

What is Abrasive Cleaning?

Abrasive cleaning methods include all techniques that physically abrade the building surface to remove soils, discolorations or coatings. Such techniques involve the use of certain *materials* which impact or abrade the surface under pressure, or abrasive *tools and equipment*. Sand, because it is readily available, is probably the most commonly used type of grit material. However, any of the following materials may be substituted for sand, and all can be classified as abrasive substances: ground slag or volcanic ash, crushed (pulverized) walnut or almond shells, rice husks, ground corncobs, ground coconut shells, crushed eggshells, silica flour, synthetic particles, glass beads and micro-balloons. Even *water* under pressure can be an abrasive substance. Tools and equipment that are abrasive to historic building materials include wire brushes, rotary wheels, power sanding disks and belt sanders.

The use of water in combination with grit may also be classified as an abrasive cleaning method. Depending on the manner in which it is applied, water *may* soften the impact of the grit, but water that is too highly pressurized can be very abrasive. There are basically two different methods which can be referred to as "wet grit," and it is important to differentiate between the two. One technique involves the addition of a stream of water to a regular sandblasting nozzle. This is done primarily to cut down dust, and has very little, if any, effect on reducing the aggressiveness, or cutting action of the grit particles. With the second technique, a very small amount of grit is added to a pressurized water stream. This method may be controlled by regulating the amount of grit fed into the water stream, as well as the pressure of the water.

Why Are Abrasive Cleaning Methods Used?

Usually, an abrasive cleaning method is selected as an expeditious means of quickly removing years of dirt accumulation, unsightly stains, or deteriorating building fabric or finishes, such as stucco or paint. The fact that sandblasting is one of the best known and most readily available building cleaning treatments is probably the major reason for its frequent use.

Many mid-19th century brick buildings were painted immediately or soon after completion to protect poor quality brick or to imitate another material, such as stone. Sometimes brick buildings were painted in an effort to produce what was considered a more harmonious relationship between a building and its natural surroundings. By the 1870s, brick buildings

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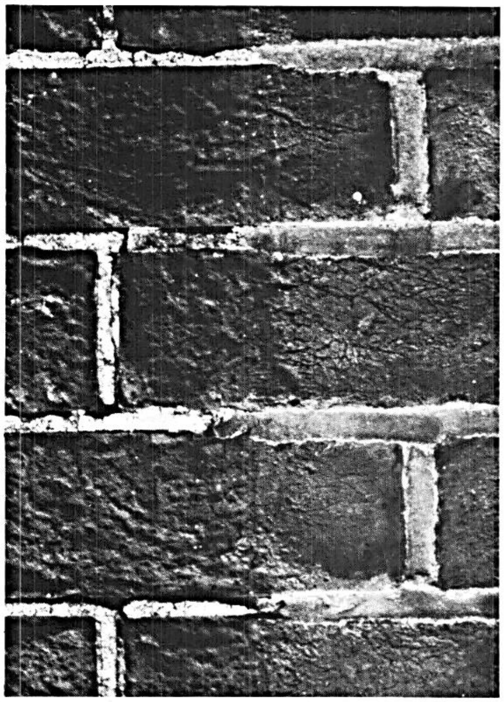
83. This section reproduces Anne E. Grimmer, *Dangers of Abrasive Cleaning to Historic Buildings*, Preservation Brief 6 (Washington, DC: National Park Service, 1978), https://www.nps.gov/orgs/1739/upload/preservation-brief-06-abrasive-cleaning.pdf. Public domain.

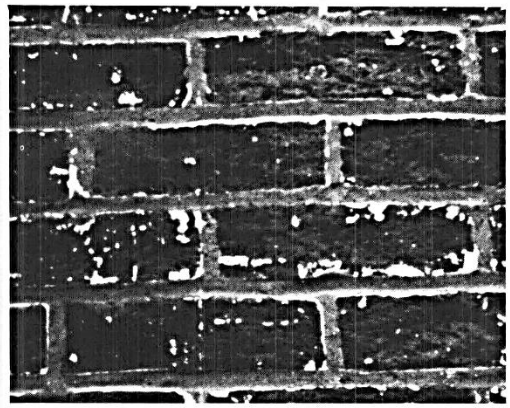


Abrasively Cleaned vs. Untouched Brick. *Two brick rowhouses with a common façade provide an excellent point of comparison when only one of the houses has been sandblasted. It is clear that abrasive blasting, by removing the outer surface, has left the brickwork on the left rough and pitted, while that on the right still exhibits an undamaged and relatively smooth surface. Note that the abrasive cleaning has also removed a considerable portion of the mortar from the joints of the brick on the left side, which will require repointing.*

were often left unpainted as mechanization in the brick industry brought a cheaper pressed brick and fashion decreed a sudden preference for dark colors. However, it was still customary to paint brick of poorer quality for the additional protection the paint afforded.

It is a common 20th-century misconception that all historic masonry buildings were initially unpainted. If the intent of a modern restoration is to return a building to its original appearance, removal of the paint not only may be historically inaccurate, but also harmful. Many older buildings were painted or stuccoed at some point to correct recurring maintenance problems caused by faulty construction techniques, to hide alterations, or in an attempt to solve moisture problems. If this is the case, removal of paint or stucco may cause these problems to reoccur.

Another reason for paint removal, particularly in rehabilitation projects, is to give the building a "new image" in response to contemporary design trends and to attract investors or tenants. Thus, it is necessary to consider the purpose of the intended cleaning. While it is clearly important to remove unsightly stains, heavy encrustations of dirt, peeling paint or other surface coatings, it may not be equally desirable to remove paint from a building which originally was painted. Many historic buildings which show only a slight amount of soil or discoloration are much better left as they are. A thin layer of soil is more often protective of the building fabric than it is harmful, and seldom detracts from the building's



Abrading the Surface without Removing the Paint. *Even though the entire outer surface layer of the brick has been sandblasted off, spots of paint still cling to the masonry. Sandblasting or other similarly abrasive methods are not always a successful means of removing paint.*

architectural and/or historic character. Too thorough cleaning of a historic building may not only sacrifice some of the building's character, but also, misguided cleaning efforts can cause a great deal of damage to historic building fabric. Unless there are stains, graffiti or dirt and pollution deposits which are destroying the building fabric, it is generally preferable to do as little cleaning as possible, or to repaint where necessary. It is important to remember that a historic building does not have to look as if it were newly constructed to be an attractive or successful restoration or rehabilitation project. For a more thorough explanation of the philosophy of cleaning historic buildings see Preservation Briefs: No. 1 "The Cleaning and Waterproof Coating of Masonry Buildings," by Robert C. Mack, AIA.

Problems of Abrasive Cleaning

The crux of the problem is that abrasive cleaning is just that—abrasive. An abrasively cleaned historic structure may be physically as well as aesthetically damaged. Abrasive methods "clean" by eroding dirt or paint, but at the same time they also tend to erode the surface of the building material. In this way, abrasive cleaning is destructive and causes irreversible harm to the historic building fabric. If the fabric is brick, abrasive methods remove the hard, outer protective surface, and therefore make the brick more susceptible to rapid weathering and deterioration. Grit blasting may also increase the water permeability of a brick wall. The impact of the grit particles tends to erode the bond between the mortar and the brick, leaving cracks or enlarging existing cracks where water can enter. Some types of stone develop a protective patina or "quarry crust" parallel to the worked surface (created by the movement of moisture towards the outer edge), which also may be damaged by abrasive cleaning. The rate at which the material subsequently weathers depends on the quality of the inner surface that is exposed.

Abrasive cleaning can destroy, or substantially diminish, decorative detailing on buildings such as a molded brickwork or architectural terra-cotta, ornamental carving on wood or stone, and evidence of historic craft techniques, such as tool marks and other surface textures. In addition, perfectly sound and/or "tooled" mortar joints can be worn away by abrasive techniques. This not only results in the loss of historic craft detailing but also requires repointing, a step involving considerable time, skill and expense, and which might not have been necessary had a gentler method been chosen. Erosion and pitting of the building material by abrasive cleaning creates a greater surface area on which dirt and pollutants collect. In this sense, the building fabric "attracts" more dirt, and will require more frequent cleaning in the future.

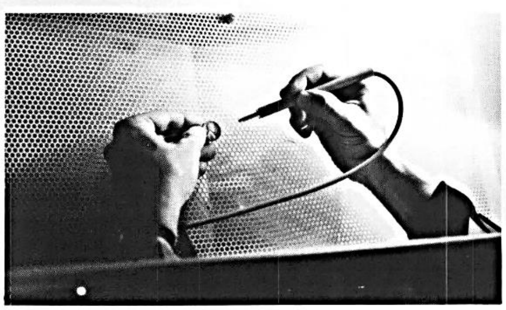
In addition to causing physical and aesthetic harm to the historic fabric, there are several adverse environmental effects of dry abrasive cleaning methods. Because of the friction caused by the abrasive medium hitting the building fabric, these techniques usually create a considerable amount of dust, which is unhealthy, particularly to the operators of the abrasive equipment. It further pollutes the environment around the job site, and deposits dust on neighboring buildings, parked vehicles and nearby trees and shrubbery. Some adjacent materials not intended for abrasive treatment such as wood or glass, may also be damaged because the equipment may be difficult to regulate.

Wet grit methods, while eliminating dust, deposit a messy slurry on the ground or other objects surrounding the base of the building. In colder climates where there is the threat of frost, any wet cleaning process applied to historic masonry structures must be done in warm weather, allowing ample time for the wall to dry out thoroughly before cold weather sets in. Water which remains and freezes in cracks and openings of the masonry surface eventually may lead to spalling. High-pressure wet cleaning may force an inordinate amount of water into the walls, affecting interior materials such as plaster or joist ends, as well as metal building components within the walls.

Variable Factors

The greatest problem in developing practical guidelines for cleaning any historic building is the large number of variable and unpredictable factors involved. Because these variables make each cleaning project unique, it is difficult to establish specific standards at this time. This is particularly true of abrasive cleaning methods because their inherent potential for causing damage is multiplied by the following factors:

- the type and condition of the material being cleaned;
- the size and sharpness of the grit particles or the mechanical equipment;
- the pressure with which the abrasive grit or equipment is applied to the building surface;
- the skill and care of the operator; and
- the constancy of the pressure on all surfaces during the cleaning process.



Micro-Abrasive Cleaning. *This small, pencil-sized micro-abrasive unit is used by some museum conservators to clean small objects. This particular micro-abrasive unit is operated within the confines of a box (approximately 2 cubic feet of space), but a similar and slightly larger unit may be used for cleaning larger pieces of sculpture, or areas of architectural detailing on a building. Even a pressure cleaning unit this small is capable of eroding a surface, and must be carefully controlled.*

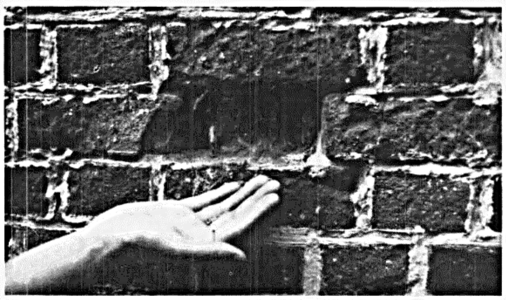
"Line Drop." *Even though the operator of the sandblasting equipment is standing on a ladder to reach the higher sections of the wall, it is still almost impossible to have total control over the pressure. The pressure of the sand hitting the lower portion of the wall will still be greater than that above, because of the "line drop" in the distance from the pressure source to the nozzle. (Hugh Miller)*

Pressure: The damaging effects of most of the variable factors involved in abrasive cleaning are self evident. However, the matter of pressure requires further explanation. In cleaning specifications, pressure is generally abbreviated as "psi" (pounds per square inch), which technically refers to the "tip" pressure, or the amount of pressure at the nozzle of the blasting apparatus. Sometimes "psig," or pressure at the gauge (which may be many feet away, at the other end of the hose), is used in place of "psi." These terms are often incorrectly used interchangeably.

Despite the apparent care taken by most architects and building cleaning contractors to prepare specifications for pressure cleaning which will not cause harm to the delicate fabric of a historic building, it is very difficult to ensure that the same amount of pressure is applied to all parts of the building. For example, if the operator of the pressure equipment stands on the ground while cleaning a two-story structure, the amount of force reaching the first story will be greater than that hitting the second story, even if the operator stands on scaffolding or in a cherry picker, because of the "line drop" in the distance from the pressure source to the nozzle. Although technically it may be possible to prepare cleaning specifications with tight controls that would eliminate all but a small margin of error, it may not be easy to find professional cleaning firms willing to work under such restrictive conditions. The fact is that many professional building cleaning firms do not really understand the extreme delicacy of historic building fabric, and how it differs from modern construction materials. Consequently, they may accept building cleaning projects for which they have no experience.

The amount of pressure used in any kind of cleaning treatment which involves pressure, whether it is dry or wet grit, chemicals or just plain water, is crucial to the outcome of the cleaning project. Unfortunately, no standards have been established for determining the correct pressure for cleaning each of the many historic building materials which would not cause harm. The considerable discrepancy between the way the building cleaning industry and architectural conservators define "high" and "low" pressure cleaning plays a significant role in the difficulty of creating standards.

Nonhistoric/Industrial: A representative of the building cleaning industry might consider "high" pressure *water* cleaning to be anything over 5,000 psi, or even as high as 10,000 to 15,000 psi! Water under this much pressure may be necessary to clean industrial structures or machinery, but would destroy most historic building materials. Industrial *chemical* cleaning commonly utilizes pressures between 1,000 and 2,500 psi.



Spalling Brick. *This soft, early 19th-century brick was sandblasted in the 1960s; consequently, severe spalling has resulted. Some bricks have almost totally disintegrated, and will eventually have to be replaced. (Robert S. Gamble)*

Historic: By contrast, conscientious dry or wet abrasive cleaning of a historic structure would be conducted within the range of 20 to 100 psi at a range of 3 to 12 inches. Cleaning at this low pressure requires the use of a very fine 00 or 0 mesh grit forced through a nozzle with a ¼ inch opening. A similar, even more delicate method being adopted by architectural conservators uses a micro-abrasive grit on small, hard-to-clean areas of carved, cut or molded ornament on a building façade. Originally developed by museum conservators for cleaning sculpture, this technique may employ glass beads, micro-balloons, or another type of micro-abrasive gently powered at approximately 40 psi by a very small, almost pencil-like pressure instrument. Although a slightly larger pressure instrument may be used on historic buildings, this technique still has limited practical applicability on a large scale building cleaning project because of the cost and the relatively few technicians competent to handle the task. In general, architectural conservators have determined that only through very controlled conditions can most historic building material be abrasively cleaned of soil or paint without measurable damage to the surface or profile of the substrate.

Yet some professional cleaning companies which sepcialize in cleaning historic masonry buildings use chemicals and water at a pressure of approximately 1,500 psi, while other cleaning firms recommend lower pressures ranging from 200 to 800 psi for a similar project. An architectural conservator might decide, *after testing*, that some historic structures could be cleaned properly using a moderate pressure (200–600 psi), or even a high pressure (600–1800 psi) water rinse. However, cleaning historic buildings under such high pressure should be considered an exception rather than the rule, and would require *very careful* testing and supervision to assure that the historic surface materials could withstand the pressure without gouging, pitting or loosening.

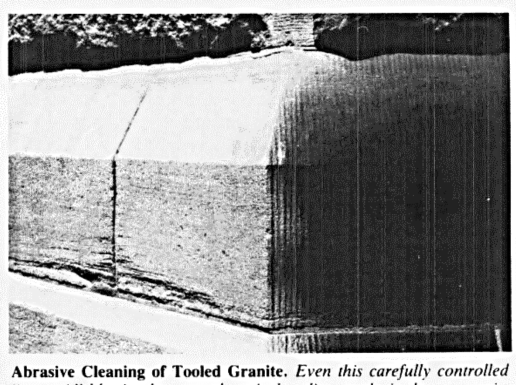
These differences in the amount of pressure used by commercial or industrial building cleaners and architectural conservators point to one of the main problems in using abrasive means to clean historic buildings: misunderstanding of the potentially fragile nature of historic building materials. There is no one cleaning formula or pressure suitable for all situations. Decisions regarding the proper cleaning process for historic structures can be made only after careful analysis of the building fabric, and testing.

How Building Materials React to Abrasive Cleaning Methods

Brick and Architectural Terra-Cotta: Abrasive blasting does not affect all building materials to the same degree. Such techniques quite logically cause greater damage to softer and more porous materials, such as brick or architectural terra-cotta. When these materials are cleaned abrasively, the hard, outer layer (closest to the heat of the kiln) is eroded, leaving the soft, inner core exposed and susceptible to accelerated weathering. Glazed architectural terra-cotta and ceramic veneer have a baked-on glaze which is also easily damaged by abrasive cleaning. Glazed architectual terra-cotta was designed for easy maintenance, and generally can be cleaned using detergent and water; but chemicals or steam may be needed to remove more persistent stains. Large areas of brick or architectural terra-cotta which have been painted are best left painted, or repainted if necessary.

Plaster and Stucco: Plaster and stucco are types of masonry finish materials that are softer than brick or terra-cotta; if treated abrasively these materials will simply disintegrate. Indeed, when plaster or stucco is treated abrasively it is usually with the intention of removing the plaster or stucco from whatever base material or substrate it is covering. Obviously, such abrasive techniques should not be applied to clean sound plaster or stuccoed walls, or decorative plaster wall surfaces.

Building Stones: Building stones are cut from the three main categories of natural rock: dense, igneous rock such as granite; sandy, sedimentary rock such as limestone or sandstone; and crystalline, metamorphic rock such as marble. As op-

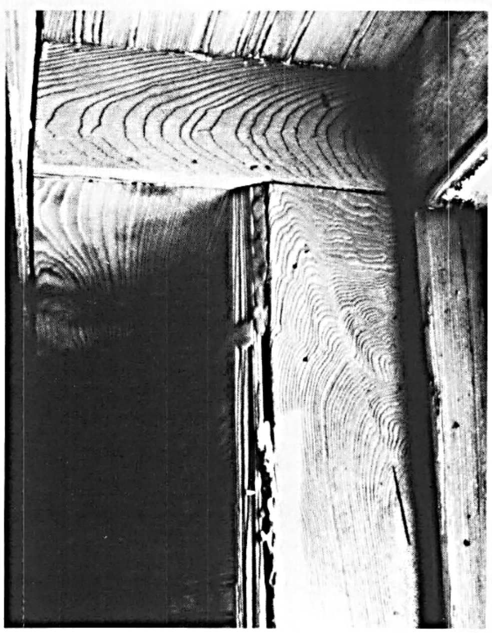


Abrasive Cleaning of Tooled Granite. *Even this carefully controlled "wet grit" blasting has erased vertical tooling marks in the cut granite blocks on the left. Not only has the tooling been destroyed, but the damaged stone surface is now more susceptible to accelerated weathering.*

posed to kiln-dried masonry materials such as brick and architectural terra-cotta, building stones are generally homogeneous in character at the time of a building's construction. However, as the stone is exposed to weathering and environmental pollutants, the surface may become friable, or may develop a protective skin or patina. These outer surfaces are very susceptible to damage by abrasive or improper chemical cleaning.

Building stones are frequently cut into ashlar blocks or "dressed" with tool marks that give the building surface a specific texture and contribute to its historic character as much as ornately carved decorative stonework. Such detailing is easily damaged by abrasive cleaning techniques; the pattern of tooling or cutting is erased, and the crisp lines of moldings or carving are worn or pitted.

Occasionally, it may be possible to clean small areas of rough-cut granite, limestone or sandstone having a heavy dirt encrustation by using the "wet grit" method, whereby a small amount of abrasive material is injected into a controlled, pressurized water stream. However, this technique requires very careful supervision in order to prevent damage to the stone. Polished or honed marble or granite should *never* be treated abrasively, as the abrasion would remove the finish in much the way glass would be etched or "frosted" by such a process. It is generally preferable to underclean, as too strong a cleaning procedure will erode the stone, exposing a new and increased surface area to collect atmospheric moisture and dirt. Removing paint, stains or graffiti from most types of stone may be accomplished by a chemical treatment carefully selected to best handle the removal of the particular type of paint or stain without damaging the stone. (See section on the "Gentlest Means Possible")



Abrasive Cleaning of Wood. *This wooden windowsill, molding and paneling have been sandblasted to remove layers of paint in the rehabilitation of this commercial building. Not only is some paint still embedded in cracks and crevices of the woodwork, but more importantly, grit blasting has actually eroded the summer wood, in effect raising the grain, and resulting in a rough surface.*

Wood: Most types of wood used for buildings are soft, fibrous and porous, and are particularly susceptible to damage by abrasive cleaning. Because the summer wood between the lines of the grain is softer than the grain itself, it will be worn away by abrasive blasting or power tools, leaving an uneven surface with the grain raised and often frayed or "fuzzy." Once this has occurred, it is almost impossible to achieve a smooth surface again except by extensive hand sanding, which is expensive and will quickly negate any costs saved earlier by sandblasting. Such harsh cleaning treatment also obliterates historic tool marks, fine carving and detailing, which precludes its use on any interior or exterior woodwork which has been hand planed, milled or carved.

Metals: Like stone, metals are another group of building materials which vary considerably in hardness and durability. Softer metals which are used architecturally, such as tin, zinc, lead, copper or aluminum, generally should not be cleaned abrasively as the process deforms and destroys the original surface texture and appearance, as well as the acquired patina. Much applied architectural metal work used on historic buildings—tin, zinc, lead and copper—is often quite thin and soft, and therefore susceptible to denting and pitting. Galvanized sheet metal is especially vulnerable, as abrasive treatment would wear away the protective galvanized layer.

In the late 19th and early 20th centuries, these metals were often cut, pressed or otherwise shaped from sheets of metal into a wide variety of practical uses such as roofs, gutters and flashing, and façade ornamentation such as cornices, friezes, dormers, panels, cupolas, oriel windows, etc. The architecture of the 1920s and 1930s made use of metals such as chrome, nickel alloys, aluminum and stainless steel in decorative exterior panels, window frames, and doorways. Harsh abrasive blasting would destroy the original surface finish of most of these metals, and would increase the possiblity of corrosion.

However, conservation specialists are now employing a sensitive technique of glass bead peening to clean some of the harder metals, in particular large bronze outdoor sculpture. Very fine (75–125 micron) glass beads are used at a low pressure of 60 to 80 psi. Because these glass beads are completely spherical, ther are no sharp edges to cut the surface of the metal. After cleaning, these statues undergo a lengthy process of polishing. Coatings are applied which protect the surface from corrosion, but they must be renewed every 3 to 5 years. A similarly delicate cleaning technique employing glass beads has been used in Europe to clean historic masonry structures without causing damage. But at this time the process has not been tested sufficiently in the United States to recommend it as a building conservation measure.

Sometimes a very fine *smooth* sand is used at a low pressure to clean or remove paint and corrosion from copper flashing and other metal building components. Restoration architects recently found that a mixture of crushed walnut shells and copper slag at a pressure of approximately 200 psi was the only way to remove corrosion successfully from a mid-19th century terne-coated iron roof. Metal cleaned in this manner must be painted immediately to prevent rapid recurrence of corrosion. It is thought that these methods "work harden" the surface by compressing the outer layer, and actually may be good for the surface of the metal. But the extremely complex nature and the time required by such processes make it very expensive and impractical for large-scale use at this time.

Cast and wrought iron architectural elements may be gently sandblasted or abrasively cleaned using a wire brush to remove layers of paint, rust and corrosion. Sandblasting was, in fact, developed originally as an efficient maintenance procedure for engineering and industrial structures and heavy machinery—iron and steel bridges, machine tool frames, engine frames, and railroad rolling stock—in order to clean and prepare them for repainting. Because iron is hard, its surface, which is naturally somewhat uneven, will not be noticeably damaged by controlled abrasion. Such treatment will, however, result in a small amount of pitting. But this slight abrasion creates a good surface for paint, since the iron must be repainted immediately to prevent corrosion. Any abrasive cleaning of metal building components will also remove the caulking from joints and around other openings. Such areas must be recaulked quickly to prevent moisture from entering and rusting the metal, or causing deterioration of other building fabric inside the structure.

When is Abrasive Cleaning Permissible?

For the most part, abrasive cleaning is destructive to historic building materials. A limited number of special cases have been explained when it may be appropriate, if supervised by a skilled conservator, to use a delicate abrasive technique on some historic building materials. The type of "wet grit" cleaning which involves a small amount of grit injected into a stream of low pressure water may be used on small areas of stone masonry (i.e., rough cut limestone, sandstone or unpolished granite), where milder cleaning methods have not been totally successful in removing harmful deposits of dirt and pollutants. Such areas may include stone window sills, the tops of cornices or column capitals, or other detailed areas of the façade.

This is still an abrasive technique, and without proper caution in handling, it can be *just as harmful to the building surface as any other abrasive cleaning method.* Thus, the decision to use this type of "wet grit" process should be made only after consultation with an experienced building conservator. Remember that *it is very time consuming and expensive to use any abrasive technique on a historic building in such a manner that it does not cause harm to the often fragile and friable building materials.*

At this time, and only under certain circumstances, abrasive cleaning methods may be used in the rehabilitation of interior spaces of warehouse or industrial buildings for contemporary uses.

Interior spaces of factories or warehouse structures in which the masonry or plaster surfaces do not have significant design, detailing, tooling or finish, and in which wooden architectural features are not finished, molded, beaded or worked by hand, may be cleaned abrasively in order to remove layers of paint and industrial discolorations such as smoke, soot, etc. It is expected after such treatment that brick surfaces will be rough and pitted, and wood will be somewhat frayed or "fuzzy" with raised wood grain. These nonsignificant surfaces will be damaged and have a roughened texture, but because they are interior elements, they will not be subject to further deterioration caused by weathering.

Permissible Abrasive Cleaning. *In accordance with the Secretary of the Interior's* Guidelines for Rehabilitation Projects, *it may be acceptable to use abrasive techniques to clean an industrial interior space such as that illustrated here, because the masonry surfaces* do not *have significant design, detailing, tooling or finish, and the wooden architectural features are not finished, molded, beaded or worked by hand.*

Historic Interiors that Should Not Be Cleaned Abrasively

Those instances (generally industrial and some commercial properties), when it may be acceptable to use an abrasive treatment on the interior of historic structures have been described. But for the majority of historic buildings, the Secretary of the Interior's *Guidelines for Rehabilitation* do not recommend "changing the texture of exposed wooden architectural features (including structural members) and masonry surfaces through sandblasting or use of other abrasive techniques to remove paint, discolorations and plaster. . . ."

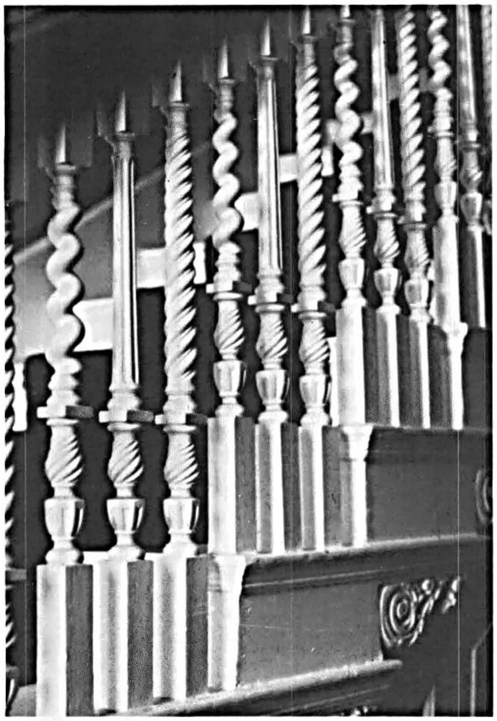
Thus, it is not acceptable to clean abrasively interiors of historic residential and commercial properties which have *finished* interior spaces featuring milled woodwork such as doors, window and door moldings, wainscoting, stair balustrades and mantelpieces. Even the most modest historic *house* interior, although it may not feature elaborate detailing, contains plaster and woodwork that is architecturally significant to the original design and function of the house. Abrasive cleaning of such an interior would be destructive to the historic integrity of the building.

Abrasive cleaning is also impractical. Rough surfaces of abrasively cleaned wooden elements are hard to keep clean. It is also difficult to seal, paint or maintain these surfaces which can be splintery and a problem to the building's occupants. The force of abrasive blasting may cause grit particles to lodge in cracks of wooden elements, which will be a nuisance as the grit is loosened by vibrations and gradually sifts out. Removal of plaster will reduce the thermal and insulating value of the walls. Interior brick is usually softer than exterior brick, and generally of a poorer quality. Removing surface plaster from such brick by abrasive means often exposes gaping mortar joints and mismatched or repaired brickwork which was never intended to show. The resulting bare brick wall may require repointing, often difficult to match. It also may be necessary to apply a transparent surface coating (or sealer) in order to prevent the mortar and brick from "dusting." However, a sealer may not only change the color of the brick, but may also compound any existing moisture problems by restricting the normal evaporation of water vapor from the masonry surface.

"Gentlest Means Possible"

There are alternative means of removing dirt, stains and paint from historic building surfaces that can be recommended as more efficient and less destructive than abrasive techniques. The "gentlest means possible" of removing dirt from a building surface can be achieved by using a low-pressure water wash, scrubbing areas of more persistent grime with a natural bristle (never metal) brush. Steam cleaning can also be used effectively to clean some historic building fabric. Low-pressure water or steam will soften the dirt and cause the deposits to rise to the surface, where they can be washed away.

A third cleaning technique which may be recommended to remove dirt, as well as stains, graffiti or paint, involves the use of commerically available chemical cleaners or paint removers, which, when applied to masonry, loosen or dissolve the dirt or stains. These cleaning agents may be used in combination with water or steam, followed by a clear water wash to remove the residue of dirt and the chemical cleaners from the masonry. A natural bristle brush may also facilitate this type of chemically assisted cleaning, particularly in areas of heavy dirt deposits or stains, and a wooden scraper can be



Do not Abrasively Clean these Interiors. *Most historic residential and some commercial interior spaces contain finished plaster and wooden elements such as this stair balustrade and paneling which contribute to the historic and architectural character of the structure. Such interiors should not be subjected to abrasive techniques for the purpose of removing paint, dirt, discoloration or plaster.*

useful in removing thick encrustations of soot. A limewash or absorbent talc, whiting or clay poultice with a solvent can be used effectively to draw out salts or stains from the surface of the selected areas of a building façade. It is almost impossible to remove paint from masonry surfaces without causing some damage to the masonry, and it is best to leave the surfaces as they are or repaint them if necessary.

Some physicists are experimenting with the use of pulsed laser beams and xenon flash lamps for cleaning historic masonry surfaces. At this time it is a slow, expensive cleaning method, but its initial success indicates that it may have an increasingly important role in the future.

There are many chemical paint removers which, when applied to painted wood, soften and dissolve the paint so that it can be scraped off by hand. Peeling paint can be removed from wood by hand scraping and sanding. Particularly thick layers of paint may be softened with a heat gun or heat plate, providing appropriate precautions are taken, and the paint film scraped off by hand. Too much heat applied to the same spot can burn the wood, and the fumes caused by burning paint are dangerous to inhale, and can be explosive. Furthermore, the hot air from heat guns can start fires in the building cavity. Thus, adequate ventilation is important when using a heat gun or heat plate, as well as when using a chemical stripper. A torch or open flame should never be used.

Preparations for Cleaning: It cannot be overemphasized that all of these cleaning methods must be approached with caution. When using any of these procedures which involve water or other liquid cleaning agents on masonry, it is imperative that *all* openings be tightly covered, and all cracks or joints be well pointed in order to avoid the danger of water penetrating the building's facade, a circumstance which might result in serious moisture related problems such as efflorescence and/or subflorescence. Any time water is used on masonry as a cleaning agent, either in its pure state or in combination with chemical cleaners, it is very important that the work be done in warm weather when there is no danger of frost for several months. Otherwise water which has penetrated the masonry may freeze, eventually causing the surface of the building to crack and spall, which may create another conservation problem more serious to the health of the building than dirt.

Each kind of masonry has a unique composition and reacts differently with various chemical cleaning substances. Water and/or chemicals may interact with minerals in stone and cause new types of stains to leach out to the surface immediately, or more gradually in a delayed reaction. What may be a safe and effective cleaner for certain stain on one type of stone, may leave unattractive discolorations on another stone, or totally dissolve a third type.

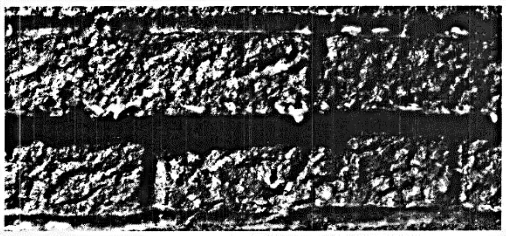
Testing: Cleaning historic building materials, particularly masonry, is a technically complex subject, and thus, should never be done without expert consultation and testing. No cleaning project should be undertaken without first applying the intended cleaning agent to a representative test patch area in an inconspicuous location on the building surface. The test patch or patches should be allowed to weather for a period of time, preferably through a complete seasonal cycle, in order to determine that the cleaned area will not be adversely affected by wet or freezing weather or any by-products of the cleaning process.

Mitigating the Effects of Abrasive Cleaning

There are certain restoration measures which can be adopted to help preserve a historic building exterior which has been damaged by abrasive methods. Wood that has been sandblasted will exhibit a frayed or "fuzzed" surface, or a harder wood will have an exaggerated raised grain. The only way to remove this rough surface or to smooth the grain is by laborious sanding. Sandblasted wood, unless it has been extensively sanded, serves as a dustcatcher, will weather faster, and will present a continuing and ever worsening maintenance problem. Such wood, after sanding, should be painted or given a clear surface coating to protect the wood, and allow for somewhat easier maintenance.

There are few successful preservative treatments that may be applied to grit-blasted exterior masonry. Harder, denser stone may have suffered only a loss of crisp edges or tool marks, or other indications of craft technique. If the stone has a compact and uniform composition, it should continue to weather with little additional deterioration. But some types of sandstone, marble and limestone will weather at an accelerated rate once their protective "quarry crust" or patina has been removed.

Softer types of masonry, particularly brick and architectural terra-cotta, are the most likely to require some remedial treatment if they have been abrasively cleaned. Old brick, being essentially a soft, baked clay product, is greatly susceptible to increased deterioration when its hard, outer skin is removed through abrasive techniques. This problem can be minimized by painting the brick. An alternative is to treat it with a clear sealer or surface coating but this will give the masonry a glossy or shiny look. It is usually preferable to paint the brick rather than to apply a transparent sealer since



Hazards of Sandblasting and Surface Coating. *In order to "protect" this heavily sandblasted brick, a clear surface coating or sealer was applied. Because the air temperature was too cold at the time of application, the sealer failed to dry properly, dripping in places, and giving the brick surface a cloudy appearance.*

sealers reduce the transpiration of moisture, allowing salts to crystallize as subflorescence that eventually spalls the brick. If a brick surface has been so extensively damaged by abrasive cleaning and weathering that spalling has already begun, it may be necessary to cover the walls with stucco, if it will adhere.

Of course, the application of paint, a clear surface coating (sealer), or stucco to deteriorating masonry means that the historical appearance will be sacrificed in an attempt to conserve the historic building materials. However, the original color and texture will have been changed already by the abrasive treatment. At this point it is more important to try to preserve the brick, and there is little choice but to protect it from "dusting" or spalling too rapidly. As a last resort, in the case of severely spalling brick, there may be no option but to replace the brick—a difficult, expensive (particularly if custom-made reproduction brick is used), and lengthy process. As described earlier, sandblasted interior brick work, while not subject to change of weather, may require the application of a transparent surface coating or painting as a maintenance procedure to contain loose mortar and brick dust. (See Preservation Briefs: No. 1 for a more thorough discussion of coatings.)

Metals, other than cast or wrought iron, that have been pitted and dented by harsh abrasive blasting usually cannot be smoothed out. Although fillers may be satisfactory for smoothing a painted surface, exposed metal that has been damaged usually will have to be replaced.

Summary

Sandblasting or other abrasive methods of cleaning or paint removal are by their nature destructive to historic building materials and should not be used on historic buildings except in a few well-monitored instances. There are exceptions when certain types of abrasive cleaning may be permissible, but only if conducted by a trained conservator, and if cleaning is necessary for the preservation of the historic structure.

There is no one formula that will be suitable for cleaning all historic building surfaces. Although there are many commerical cleaning products and methods available, it is impossible to state definitively which of these will be the most effective without causing harm to the building fabric. It is often difficult to identify ingredients or their proportions contained in cleaning products; consequently it is hard to predict how a product will react to the building materials to be cleaned. Similar uncertanities affect the outcome of other cleaning methods as they are applied to historic building materials. Further advances in understanding the complex nature of the many variables of the cleaning techniques may someday provide a better and simpler solution to the problems. But until that time, the process of cleaning historic buildings must be approached with caution through trial and error.

It is important to remember that historic building materials are neither indestructible, nor are they renewable. They must be treated in a responsible manner, which may mean little or no cleaning at all if they are to be preserved for future generations to enjoy. If it is in the best interest of the building to clean it, then it should be done "using the gentlest means possible."

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This Preservation Brief was written by Anne E. Grimmer, Architectural Historian, Technical Preservation Services Division. Valuable suggestions and comments were made by Hugh C. Miller, AIA, Washington, D.C.; Martin E. Weaver, Ottawa, Ontario, Canada; Terry Bryant, Downers Grove, Illinois; Daniel C. Cammer, McLean, Virginia; and the professional staff of Technical Preservation Services Division. Deborah Cooney edited the final manuscript.

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9 Stage IV: Metal

The José María Gil Adobe and its site has many metal objects and features. The building itself is mainly constructed out of wood and adobe; however, there are various metal fasteners and bathroom fixture components that remain. There are also remains of light fixtures. Scattered throughout the site are metal objects that once served a purpose for the building. There is also historic fencing that was once used for corrals for the ranch, as well as modern fencing used for present-day security.

9.1 Exterior metal features

The building itself has minimal metal features on its exterior. Lining the roof is a silver aluminum drip edge that was added during the 1993 roof addition to protect the existing structure and roof (Figure 156). On the upper layers of the roof is brown aluminum fascia cladding (Figure 157). The building has multiple metal stovepipes that protrude 1 to 2 ft above the roof in both the north and south wings (Figure 158, Figure 159, and Figure 160). These stovepipes are not original, but most likely added during the Army's ownership of the property post-1940. Visible in some of the wood frames are rusted nails that are exposed due to shift and failure in the wooden members (Figure 161). Some of the exterior doors have metal doorknobs that remain (Figure 162 and Figure 163).

Figure 156. Aluminum drip edge that lines the edge of the roof of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 157. Brown aluminum fascia cladding on the upper layers of the roof of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 158. Metal stovepipe on the south wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 159. Metal stovepipe on the north wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 160. Metal stovepipe in the inner corner of the intersection of the north and south wings of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 161. Rusted square nails on an exterior support frame of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 162. Metal doorknob that remains on an exterior door on the north wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 163. Brass doorknob on an exterior door on the north wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

On the site, there are two fences surrounding the José María Gil Adobe: a barbed wire fence and a chain-link fence. The barbed wire fence extends along the perimeter of the site in a loop following the inner outline of the gravel circle drive. The wooden posts of the barbed wire fence are spaced at various distances, some measuring approximately 15 ft apart. There are five strands of wire. The barbed wire fence is surrounded by a chain-link fence that is much newer (see both fences in Figure 164). The corner of fences can be strengthened by thicker bars, known as heavy corners, and one remains on the south corner of the site where two fence edges meet (Figure 165).

Figure 164. Barbed wire fence and chain-link fence surround the site of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 165. Metal heavy corner on the south side of the site of the José María Gil Adobe, 2021. (ERDC-CERL.)

There are piles of metal scraps that appear to be pipes, troughs, and old fencing material near the José María Gil Adobe. These objects were likely used during the ranch era of the site and are now piled in various locations near fence lines (Figure 166 and Figure 167). South of the site is a large metal pipe that remains near the dried arroyo (Figure 168). It is possible that this was a pump component to create water access for the building.

Figure 166. Metal scraps piled north the José María Gil Adobe, 2021. (ERDC-CERL.)

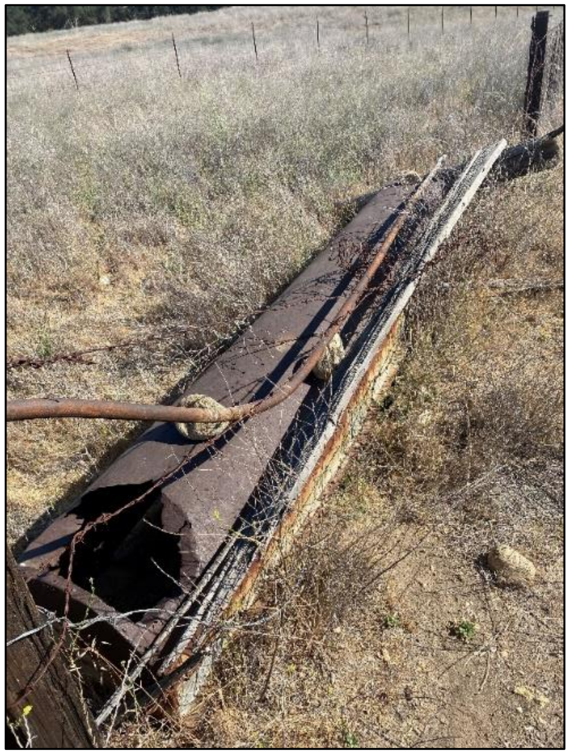


Figure 167. Metal trough and fencing material piled northwest of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 168. Metal pipe that is near the dried arroyo south of the José María Gil Adobe, 2021. (ERDC-CERL.)

9.2 Interior metal features

The José María Gil Adobe has metal features throughout the interior spaces. Much of the metal features were added by the Army, but some smaller features could date back to the building's early history.

In the north wing of the building are two square, metal shower floors (Figure 169). The shower squares as well as the floor itself is saturated in dirt and guano (Figure 170). In the same room are metal toilet plumbing connections (Figure 171).

Figure 169. Square, metal shower floors in the north wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 170. Square, metal shower floor covered in guano in the north wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 171. Metal toilet plumbing connection near the shower floors in the north wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

Metal doorknobs remain on the doors or in various locations inside the building. A doorknob was found lying on the stone fireplace in the south wing of the José María Gil Adobe (Figure 172). Interior doors have metal hinges that remain (Figure 173). These hinges are quite ornate and could date back to the Hearst ownership or before. Another small metal feature is a metal key socket that remains (Figure 174). Resting on the hearth of the stone fireplace is a metal firewood rack (Figure 175).

Figure 172. Metal doorknob found on the stone fireplace in the south wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

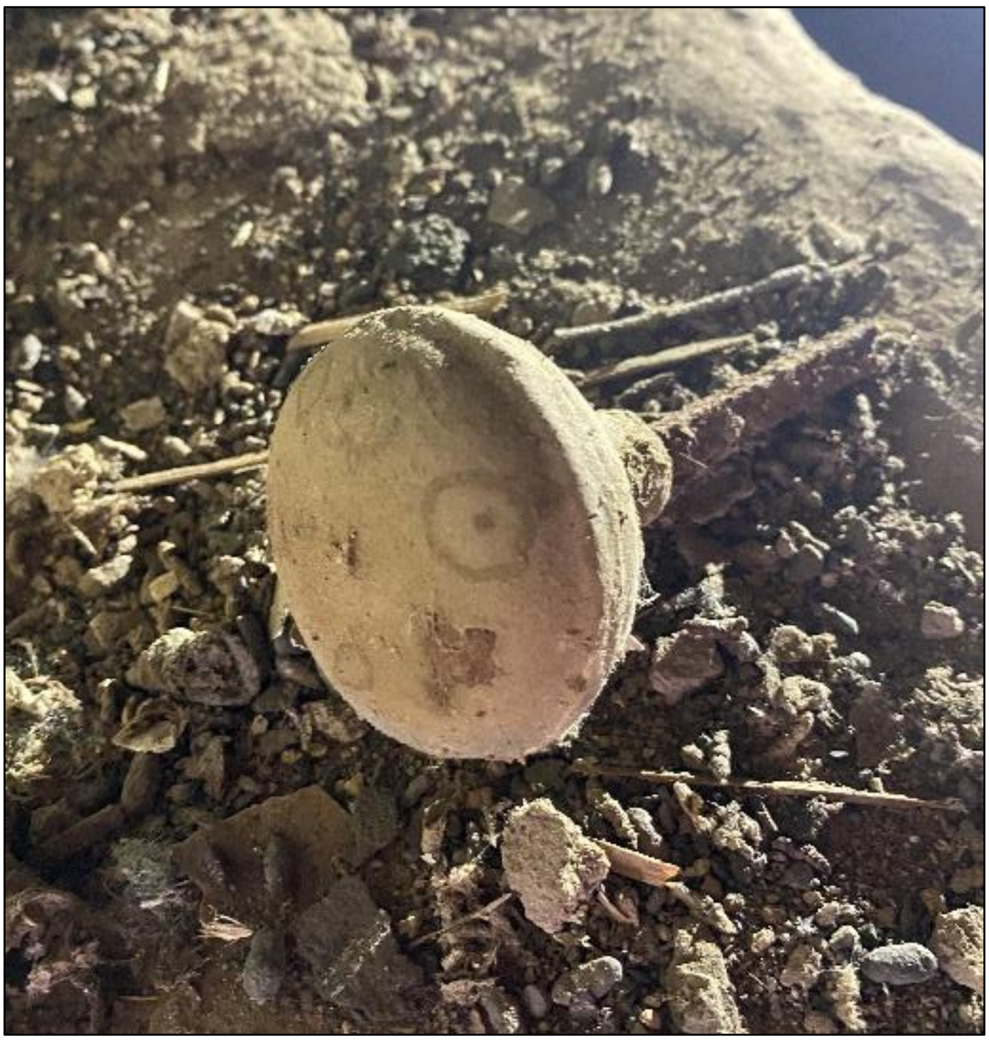


Figure 173. Stylistic metal door hinges that remain on interior doors of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 174. Metal key socket that remains in an interior door of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 175. Metal firewood rack that remains on the hearth of the stone fireplace in the south wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

The connections for the metal stovepipes and chimney pipes remain on the interior of the building despite there being no remaining stoves in the building. The pipes protrude from the ceiling and the wall in multiple locations (Figure 176, Figure 177, and Figure 178). Some stovepipes have been removed and are now stacked inside the building (Figure 179).

Figure 176. Metal stovepipe connection remaining in the south wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 177. Metal stovepipe connection remaining on a wall and a chimney pipe remaining in the ceiling in the north wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 178. Metal stovepipe protruding from the wall in the north wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

Figure 179. Metal stovepipe now on counter in the north wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

In various locations on the ceiling, there are light fixture attachments that remain. None of these attachments are intact. These were most likely added during the Army's ownership of the property, around the same time when the bathroom fixtures were installed. See a light fixture attachment in Figure 180.

Figure 180. Remaining light fixture attachment in the south wing of the José María Gil Adobe, 2021. (ERDC-CERL.)

9.3 Treatment measures

The following document offers treatment measures for door hardware from the General Services Administration.

9.3.1 "Cleaning Door Hardware," 2017[84]

An official website of the United States government

GSA

Cleaning Door Hardware

Procedure code:
870002S
Source:
National Capitol Region Specifications
Division:
Concrete
Section:
Hardware
Last Modified:
06/08/2017

Technical Procedures Disclaimer

Prior to inclusion in GSA's library of procedures, documents are reviewed by one or more qualified preservation specialists for general consistency with the Secretary of Interior Standards for rehabilitating historic buildings as understood at the time the procedure is added to the library. All specifications require project-specific editing and professional judgement regarding the applicability of a procedure to a particular building, project or location. References to products and suppliers are to serve as a general guideline and do not constitute a federal endorsement or determination that a product or method is the best or most current alternative, remains available, or is compliant with current environmental regulations and safety standards. The library of procedures is intended to serve as a resource, not a substitute, for specification development by a qualified preservation professional.

Rewrite

We've reviewed these procedures for general consistency with federal standards for rehabilitating historic buildings and provide them only as a reference. Specifications should only be applied under the guidance of a qualified preservation professional who can assess the applicability of a procedure to a particular building, project or location. References to products and suppliers serve as general guidelines and do not constitute a federal endorsement nor a

84. This section reproduces US General Services Administration, "Cleaning Door Hardware," Historic Preservation Technical Procedures, 2017, https://www.gsa.gov/real-estate/historic-preservation/historic-preservation-policy-tools/preservation-tools-resources/technical-documents. Public domain.

determination that a product or method is the best alternative or compliant with current environmental regulations and safety standards.

PART 1---GENERAL

1.01 SUMMARY

A. This procedure includes guidance on cleaning door hardware associated with the restoration of the finish on wooden doors.

B. See 01100-07-S for general project guidelines to be reviewed along with this procedure. These guidelines cover the following sections:

1. Safety Precautions
2. Historic Structures Precautions
3. Submittals
4. Quality Assurance
5. Delivery, Storage and Handling
6. Project/Site Conditions
7. Sequencing and Scheduling
8. General Protection (Surface and Surrounding)

These guidelines should be reviewed prior to performing this procedure and should be followed, when applicable, along with recommendations from the Regional Historic Preservation Officer (RHPO).

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's product literature and instructions to the Contracting Officer's Representative for all cleaning materials.

1.03 PROJECT/SITE CONDITIONS

A. Environmental Requirements: Daily dispose of all used solutions, finishing products, solvent residue and soiled rags in sealed noncombustible containers to prevent a fire hazard.

PART 2---PRODUCTS

2.01 MATERIALS

A. Solvent: Mineral spirits, turpentine, or denatured alcohol.

Mineral Spirits:

1. A petroleum distillate that is used especially as a paint or varnish thinner. It was developed as an inexpensive replacement for the vegetable-based turpentine, and is a light version of kerosene. It comes in three grades, and cost rises as refining quality increases.

2. Other chemical or common names include Benzine (not Benzene); Naphtha; Petroleum spirits; White spirit; Varisol; Solvent naphtha; Stoddard solvent.

3. Potential Hazards: TOXIC AND FLAMMABLE.

4. Safety Precautions:

a. Work in a well ventilated area.

b. ALWAYS wear proper PPE such as rubber gloves, safety glasses/goggles and a properly rated respirator when handling any solvent such as mineral spirits.

c. AVOID REPEATED OR PROLONGED SKIN CONTACT. If any chemical is splashed onto the skin, wash immediately with soap and water.

5. Available from construction specialties distributors, hardware store, paint store, or printer's supply distributor.

Turpentine:

3. Potential Hazards: TOXIC AND FLAMMABLE. Due to the fact that turpentine can cause spasms of the airways particularly in people with asthma and whooping cough, it can contribute to a worsening of breathing issues in persons with these diseases if inhaled.

4. Safety Precautions:

a. Work in a well ventilated area.

b. ALWAYS wear proper PPE such as rubber gloves, safety glasses/goggles and a properly rated respirator when handling any solvent such as mineral spirits.

c. AVOID REPEATED OR PROLONGED SKIN CONTACT. If any turpentine is splashed onto the skin, wash immediately with soap and water.

d. Observe safety rules as turpentine is flammable, and the fumes can trip an ionization smoke detection system.

e. Store soiled cloths in a metal safety container to guard against spontaneous combustion.

f. Available from hardware store or paint store.

Denatured Alcohol:

1. Denatured Alcohol is ethanol or ethyl alcohol that has additives added to it which intentionally make it poisonous and not consumable. Some of these additives can include acetone and MEK (methyl ethyl ketone).

2. Other chemical or common names include Methylated spirit.

3. Potential hazards: TOXIC AND FLAMMABLE.

4. Available from hardware store, paint store or printer's supply distributor.

5. Denatured alcohol should be a satisfactory substitute for ethyl alcohol for stain removing purposes.

B. Cloths: Clean, soft, lint-free cotton.

C. Mild Soap: "Ivory Liquid", "Joy", or equal.

D. Silicon carbide abrasive pads such as "Scotch-Brite" (3M Company) or standard commercially available pumice stone; or stainless steel wool. Do not use steel wool, which may promote discoloration of the bronze.

E. Oxidizing Agent: If prescribed by a qualified conservator, oxidizing agents such as Aluminum Chloride or liquid sulphur may be used under controlled conditions by trained and experienced personnel.

1. Danger: Oxydizing agents such as Aluminum Chloride are corrosive, can cause burns to any area of contact, and inhalation of its vapors can be fatal in some cases. Oxydizing agents are water reactive and under the right conditions they can be explosive. These agents require special training and handling precautions. Proper PPE MUST be worn when dealing with any Oxydizing agent.

Further information on Aluminum Chloride in particular may be found at
http://hazard.com/msds/mf/baker/baker/files/a2790.htm

http://hazard.com/msds/f2/bkz/bkzqx.html

http://www.sciencestuff.com/prod/Chem-Rgnts/C1176

1. A distilled wood-product, typically used as a solvent and thinner.
2. Other chemical or common names include spirits of turpentine, turps, and wood turpentine.

2.02 EQUIPMENT

A. Brushes: Soft, natural animal hair bristle.

PART 3---EXECUTION

3.01 PREPARATION

A. Surface Preparation: Carefully remove hardware. Store in a secure location for reinstallation after refinishing is complete. All refinishing actions on hardware should take place after it has been completely removed from the wooden door.

3.02 ERECTION, INSTALLATION, APPLICATION

A. Carefully remove adhesive residue, and paint and varnish drips using paint stripper applied with soft cloths. If necessary, apply light pressure using natural bristle brush.

B. Retain statuary finish on door bronze knobs. Do not apply solvents which may remove patina.

C. Clean bronze and stainless steel door knobs, escutcheon plates, and kickplates using mild soap and water.

D. For stubborn dirt and hard to clean areas, apply detergent with "Scotch-Brite" pad. Under the direction of a qualified conservator, areas of bright metal work may be refinished with a suitable oxidizing agent to match existing patinas. Rinse thoroughly and buff dry with soft cotton cloths.

E. Re-install hardware after it has been refinished. If the wooden door itself is also being refinished do not replace the hardware until that process has been completed.

Last Reviewed: 2017-09-28

10 Additional Material Sampling and Analysis

Researchers collected 24 material samples during a site visit to the José María Gil Adobe structure during July 2021 from locations identified in Figure 181. Of these samples, 9 were collected from the exterior (Table 9), 11 were collected from the interior (Table 10), and 4 were collected from the outbuilding (Table 11). Identification numbers 16 and 17 were inadvertently repeated during collection; these 4 samples have subdesignators *a* and *b*.

Table 9. Exterior material sample descriptions.

ID	Location	Material Type
1	Northwest (NW) perimeter wall top, broken segment	Hardened, likely Portland cement
2	North (N) perimeter wall, inner mortar	Hardened, likely lime
3	South (S) patio, top tile	Hardened, likely Portland cement
13	West (W) exterior wall, mortar	Adobe
14	W exterior wall, stucco	Adobe
15	W exterior wall, brick	Adobe
16b	S columns	Hardened, likely Portland cement
17b	S exterior, new stucco	Adobe
18	S exterior, old stucco	Adobe

Table 10. Interior material sample descriptions.

ID	Location	Material Type
4	S wall, plaster	Hardened, likely lime
5	N wall, inner stucco	Adobe
6	N wall, outer paint chip	Peeling coating
7	Southeast (SE) corner, paint chip	Underlying coating
8	East (E) wall, paint chip	Peeling coating
9	W wall, brick	Adobe
10	W wall, mortar	Adobe
11	W room, interior brown coat	Adobe
12	N wall, old jamb backing	Adobe
16a	E room, brick	Adobe
17a	E room, mortar	Adobe

Figure 181. Site plan notations indicating material sampling locations.

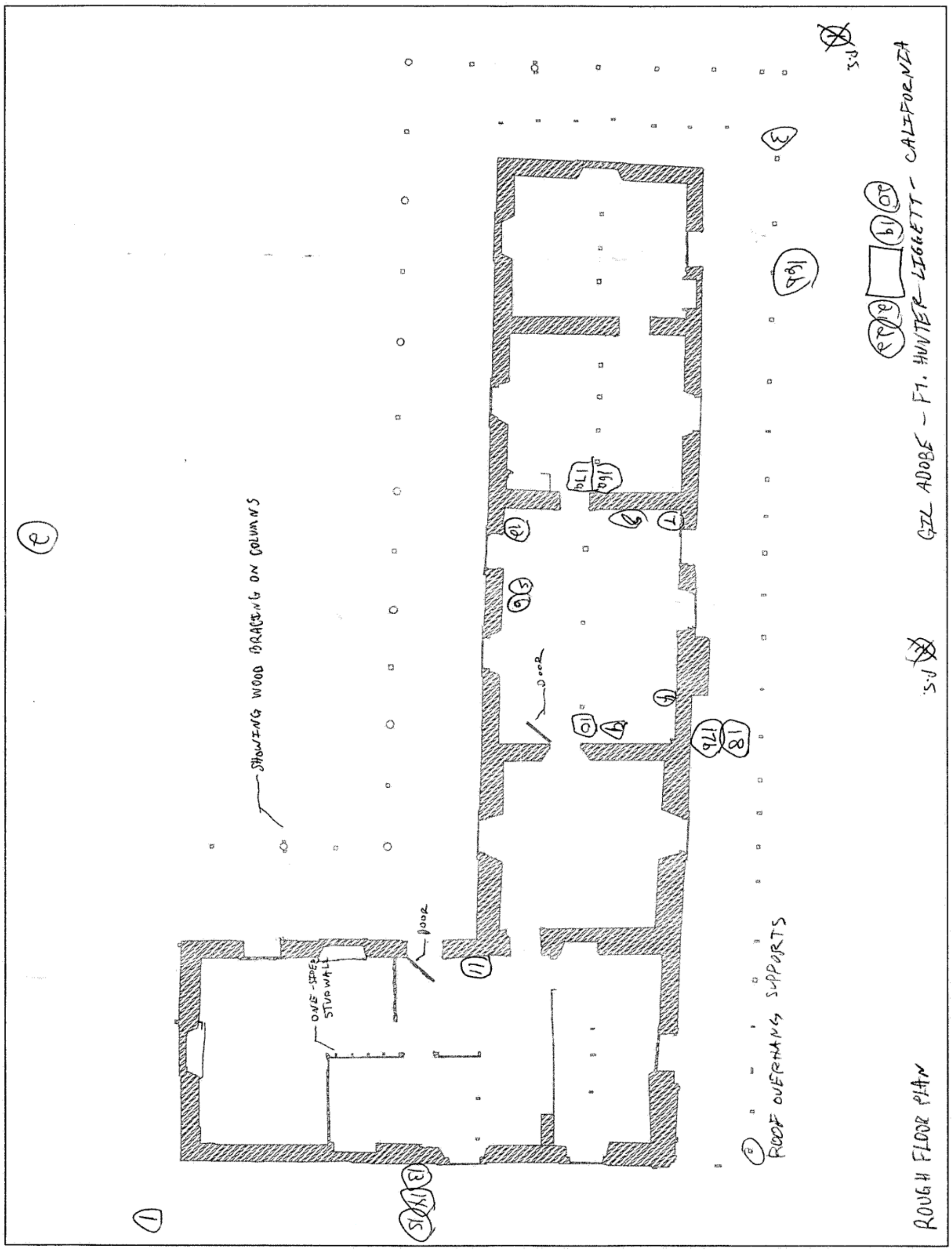


Table 11. Outbuilding material sample descriptions.

ID	Location	Material Type
19	E outbuilding, wall	Adobe
20	E outbuilding, stucco	Adobe
21	W outbuilding, wall	Adobe
22	W outbuilding, stucco	Adobe

A material analysis approach was developed in consideration of Preservation Brief 43, Section, "Materials Investigation and Testing," and Preservation Brief 2, *Repointing Mortar Joints in Historic Masonry Buildings*.[85] The depth and fidelity of the overall analysis was adjusted to match the scope of the project. It was not possible to perform all possible analytical techniques on all 24 samples due to limited time and personnel resources.

10.1 Thermogravimetric analysis and X-ray fluorescence

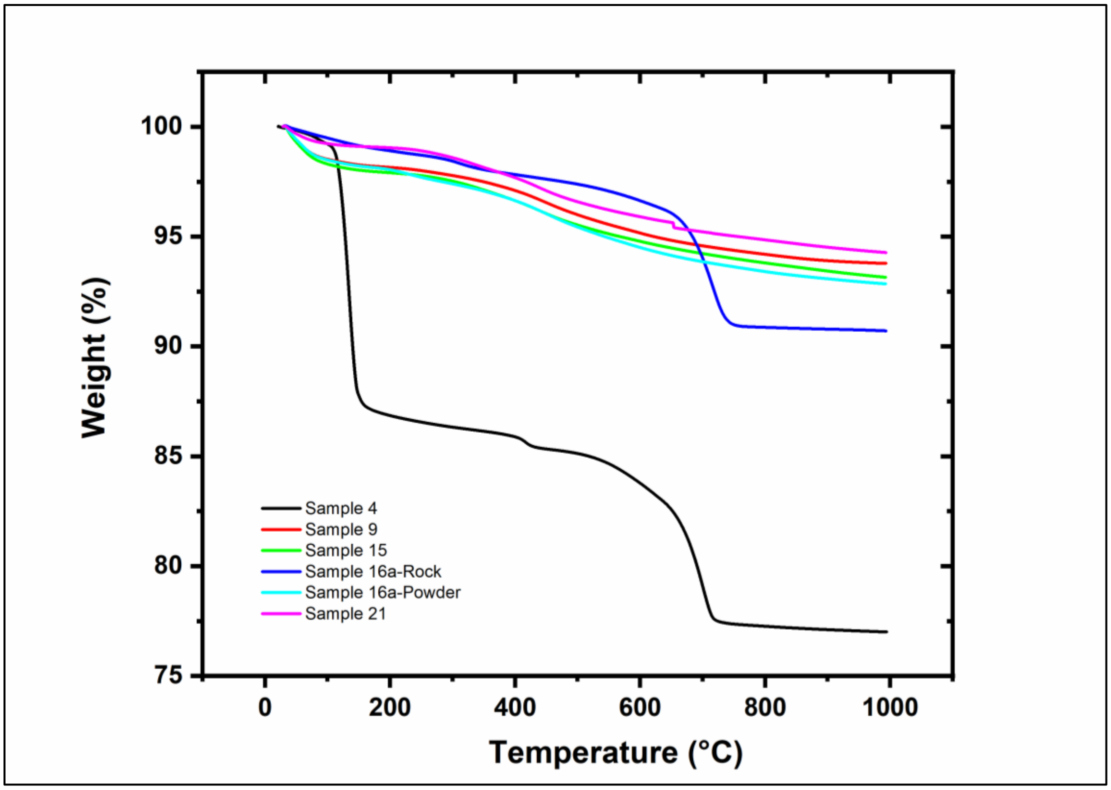
Thermogravimetric analysis (TGA) helps to identify lime content by measuring the decomposition of portlandite and calcium carbonate (calcite, vaterite, aragonite, etc.) at elevated temperatures (Figure 182). TGA can also easily quantify gypsum dehydration. Portlandite and calcium carbonate were not detected in the brick samples 9, 15, and 16a that we tested. Small stones present in brick 16a present a mass loss in the calcium carbonate decarboxylation temperature range, which indicates the presence of a limestone mineral in the stone.

Similarly, the bond concentrations determined by X-ray fluorescence (XRF) can help to determine the calcium content of binder materials. The XRF technique can also indicate the silicon-to-aluminum ratio, which is typically 2:1 for montmorillonite clays. The bond ratios of silica to alumina found for most of the binders tested here are indicative of such a clay binder. The exceptions are sample 4, which appears as a modern gypsum- or lime-based plaster, and sample 15, a gray-colored binder used for bricks composing the west wing of the structure. It is clear from both the color of the binder and the XRF data that bricks in the west wing used a different

85. Deborah Slaton, *The Preparation and Use of Historic Structure Reports*, Preservation Brief 43 (Washington, DC: National Park Service, 2005), 9–10, https://www.nps.gov/orgs/1739/upload/preservation-brief-43-historic-structure-reports.pdf; Robert C. Mack and John P. Speweik, *Repointing Mortar Joints in Historic Masonry Buildings*, Preservation Brief 2 (Washington, DC: National Park Service, 1998), https://www.nps.gov/orgs/1739/upload/preservation-brief-02-repointing.pdf.

clay than bricks in the eastern areas of the structure. Table 12–Table 14 show the bond concentrations.

Figure 182. Thermogravimetric analysis of five samples.



Samples 9, 15, and 16a-powder show similar responses with a total mass loss of about 7%. Sample 21 is similar to those three, but with less water loss and a few hundredths of a percent loss at 650°C. Sample 4 shows a rapid 13% mass loss at 180°C and a *slower* loss to 76% of the reference mass between 600 to 700°C. Sample 16a-rock shows a gradual loss to 96% between 25 to 650°C, then drops to 91% by 750°C, and finally remains constant until 1,000°C.

Table 12. Bond concentrations of brick binders determined by X-ray fluorescence.[86]

Bond	Concentration (%)			
	Sample 9	Sample 15	Sample 16a	Sample 21
SiO_2	49.76	63.99	48.64	51.72
Al_2O_3	17.22	10.23	16.89	17.76
Fe_2O_3	6.175	3.482	6.614	4.969
K_2O	2.852	2.097	2.688	3.146
MgO	3.167	1.056	3.155	2.739
CaO	2.274	1.528	2.411	2.311
TiO_2	1.128	1.177	1.052	1.141

Table 13 Bond concentrations of plaster binders determined by X-ray fluorescence.

Bond	Concentration (%)			
	Sample 4	Sample 5	Sample 11	Sample 12
SiO_2	3.258	56.48	56.44	51.57
Al_2O_3	0.4979	17.16	17.55	17.36
Fe_2O_3	0.1999	5.046	4.917	7.290
K_2O	0.0259	3.156	3.143	2.885
MgO	0.302	3.062	3.208	4.113
CaO	41.28	2.239	2.438	3.055
TiO_2	0.05121	1.211	1.139	1.316

Table 14 Bond concentrations of stucco binders determined by X-ray fluorescence.

Bond	Concentration (%)		
	Sample 14	Sample 17b	Sample 18
SiO_2	53.73	56.42	53.18
Al_2O_3	17.59	18.83	18.51
Fe_2O_3	4.486	4.553	5.246
K_2O	2.606	2.881	3.010
MgO	2.742	2.441	3.176
CaO	3.712	2.424	3.105
TiO_2	0.7296	0.8142	1.060

86. For a full list of the spelled-out forms of the chemical elements used in this document, please refer to *US Government Publishing Office Style Manual*, 31st ed. (Washington, DC: US Government Publishing Office, 2016), 265, https://www.govinfo.gov/content/pkg/GPO-STYLEMANUAL-2016/pdf/GPO-STYLEMANUAL-2016.pdf..

10.2 Exterior material analysis

10.2.1 Samples 1, 2, 3, and 16b (exterior hardened materials)

The collection sites for samples 1, 2, and 3 are shown in Figure 183–Figure 185. Sample 2 had a mostly uniform gradation between the no. 16 and no. 100 sieves that was heavy on the no. 30 sieve (Table 15). The sand was primarily a light tan or cream color, though this may be imparted by the binder phase.

Table 15. Gradation of sample 2.

16	30	40	50	100	200	Pan	Total (g)
7.23	12.72	3.40	1.74	2.18	2.51	0.39	30.17

Figure 183. Broken top pieces of perimeter wall (sample 1).

Figure 184. Inner mortar within stone wall (sample 2).

Figure 185. Tile surrounding main structure (sample 3).

10.2.2 Samples 13, 14, and 15 (west exterior wall)

Mortar (13) and brick (15) collection sites are shown in Figure 186. Samples 13, 15, 16a, and 17a during preparation for electron microscopy are shown in Figure 187. Figure 188 shows an electron micrograph of adobe mortar sample 13. Figure 189 shows an electron micrograph of brick sample 15. The stucco (14) collection site is shown in Figure 190. Thermogravimetric analysis of brick sample 15 shows a similar profile as brick samples 9 and 16a, lacking a lime signature.

Sample 14, an exterior stucco, had a few small stones on the no. 8 and no. 10 sieves, with a mostly uniform gradation between the no. 16 and no. 100 sieves that was heavy on the no. 100 sieve (Table 16). The sand was primarily brown to dark tan. The no. 200 sieve and pan materials were combined for analysis in XRF to determine calcium content of the binder phase.

Table 16. Gradation of sample 14.

16	30	40	50	100	200	Pan	Total (g)
1.48	6.92	4.90	5.51	9.34	8.76	11.44	48.35

Figure 186. West exterior wall bricks (sample 15) and mortar (sample 13.)

Figure 187. Samples 13, 15, 16a, and 17a during preparation for electron microscopy.

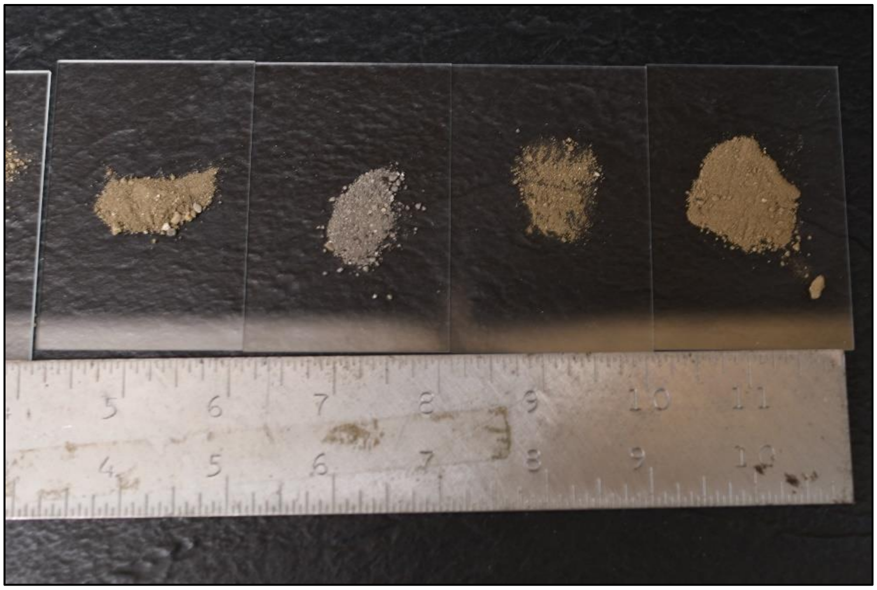


Figure 188. Electron micrograph of adobe mortar sample 13.

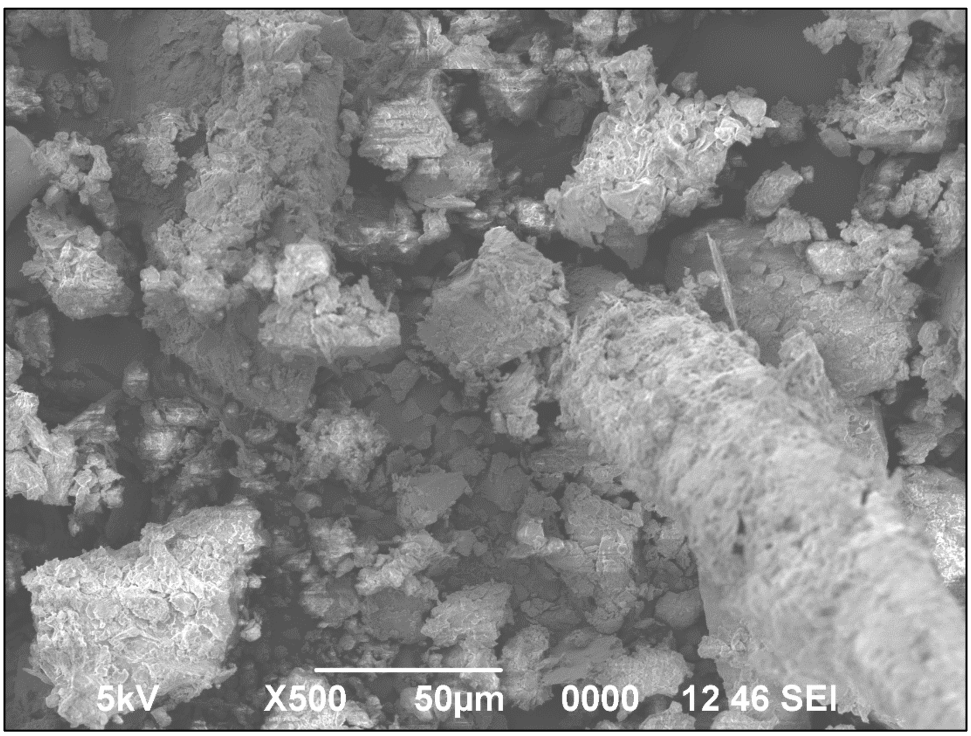


Figure 189. Electron micrograph of brick sample 15.

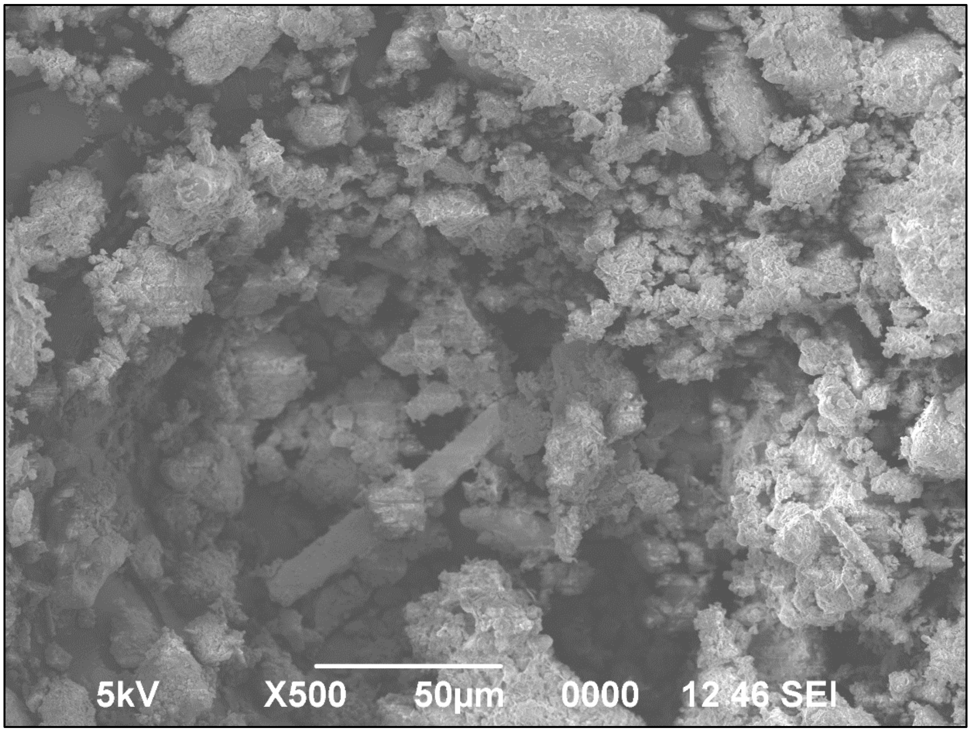


Figure 190. West exterior wall stucco (sample 14.)

10.2.3 Samples 17b and 18 (south exterior stuccos)

The collection sites for samples 17b and 18 are shown in Figure 191 and Figure 192. Sample 17b had a dense gradation between the no. 16 and no. 100 sieves that was well graded across all sieves (Table 17). The sand was primarily light tan. The no. 200 sieve and pan materials were combined for analysis in XRF to determine calcium content of the binder phase.

Table 17. Gradation of sample 17b.

16	30	40	50	100	200	Pan	Total (g)
0.22	1.55	1.31	1.73	3.07	3.77	3.46	15.11

Sample 18 had a few small stones on the no. 8 and no. 10 sieves and was heavy on the no. 200 sieve but otherwise expressed a mostly uniform gradation between the no. 16 and no. 100 sieves (Table 18). The sand was primarily tan colored. The no. 200 sieve and pan materials were combined for analysis in XRF to determine calcium content of the binder phase.

Table 18. Gradation of sample 18.

16	30	40	50	100	200	Pan	Total (g)
1.80	5.03	2.73	2.85	5.91	8.79	3.40	30.51

Figure 191. Two stuccos (*top* and *bottom*) (samples 17b and 18) of different color and edge quality on the south exterior wall, indicating different time periods of application.

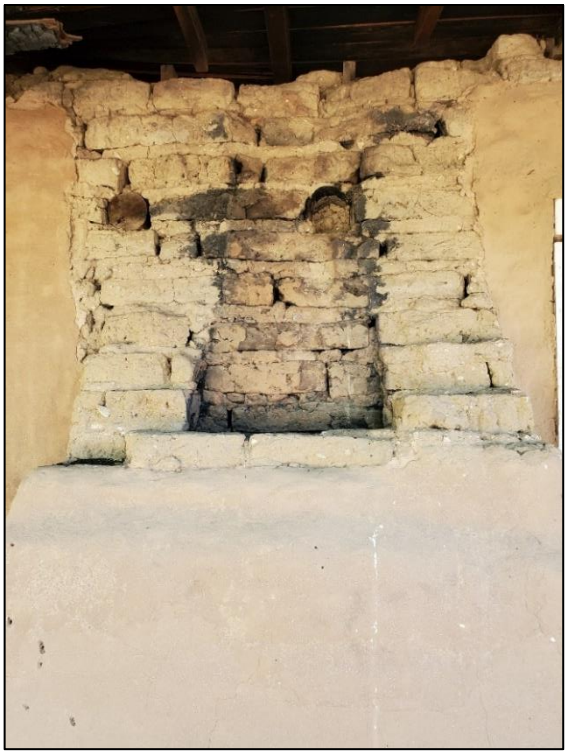


Figure 192. Stucco on wire lath (sample 17b) over different color stucco having better edge quality (sample 18.)

10.3 Interior material analysis

It appears that three different types or ages of bricks exist in the walls of the structure (Figure 193, Figure 196, and Figure 197). Sample 9 from the easternmost regions of the structure presents as brown in color with low fractions of straw reinforcement (Figure 193 and Figure 194). Another brick composition with a dark gray color, rounded aggregates, and high fractions of straw reinforcement is present in certain areas where structural enhancements might have occurred, such as lintels and sills (Figure 196). A third light-gray brick, such as sample 15, exists only in the westernmost regions of the structure. This light-gray brick lacks straw reinforcement and contains highly angular aggregates. The XRF data show a significantly higher silica-to-alumina ratio for the binder phase of sample 15, which indicates a different clay was used for these bricks. Further electron micrograph images are show in Figure 195, Figure 198, and Figure 199.

Figure 193. Bricks (sample 9) on the west side of the main structure, having light-gray color with angular aggregates and lacking straw reinforcement.

Figure 194. Electron micrograph of brick sample 9, lacking hexagonal portlandite and cubic calcite particles.

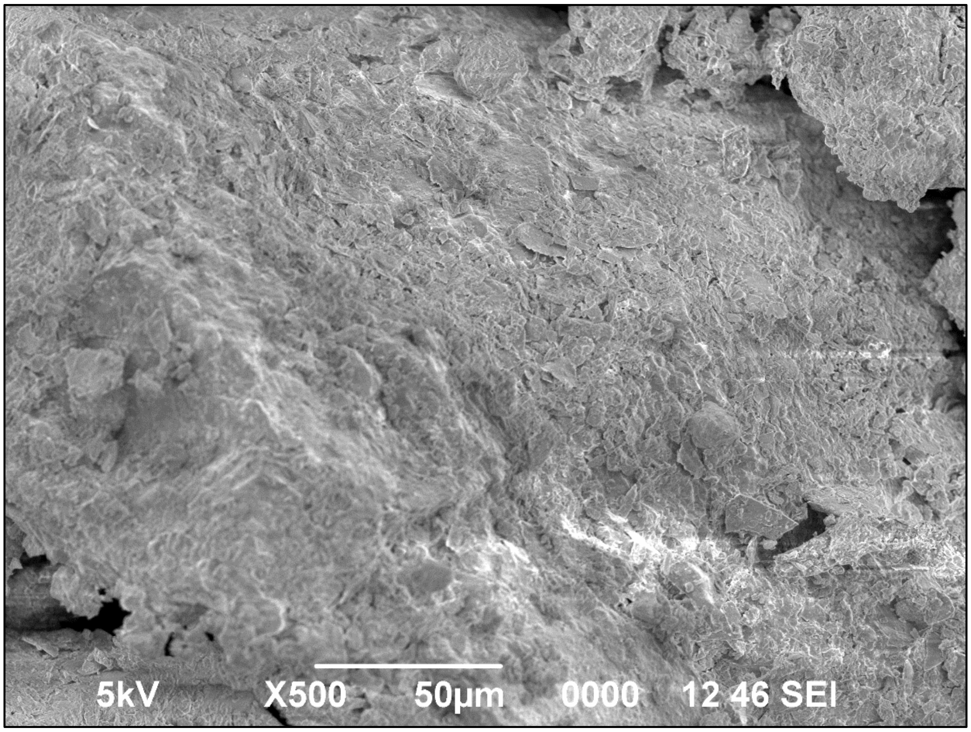


Figure 195. Electron micrograph of earthen mortar sample 10.

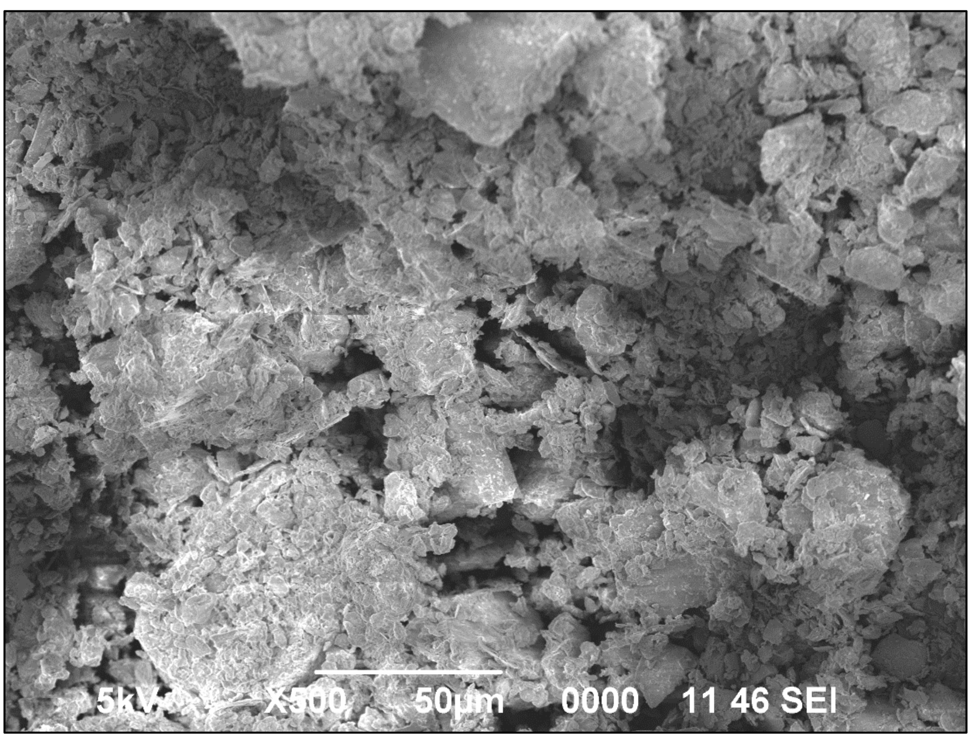


Figure 196. Bricks having dark gray color with rounded aggregates and a high fraction of straw reinforcement.

Figure 197. Bricks (sample 16a) in the east room having brown color and a low fraction of straw reinforcement.

Figure 198. Electron micrograph of brick sample 16a.

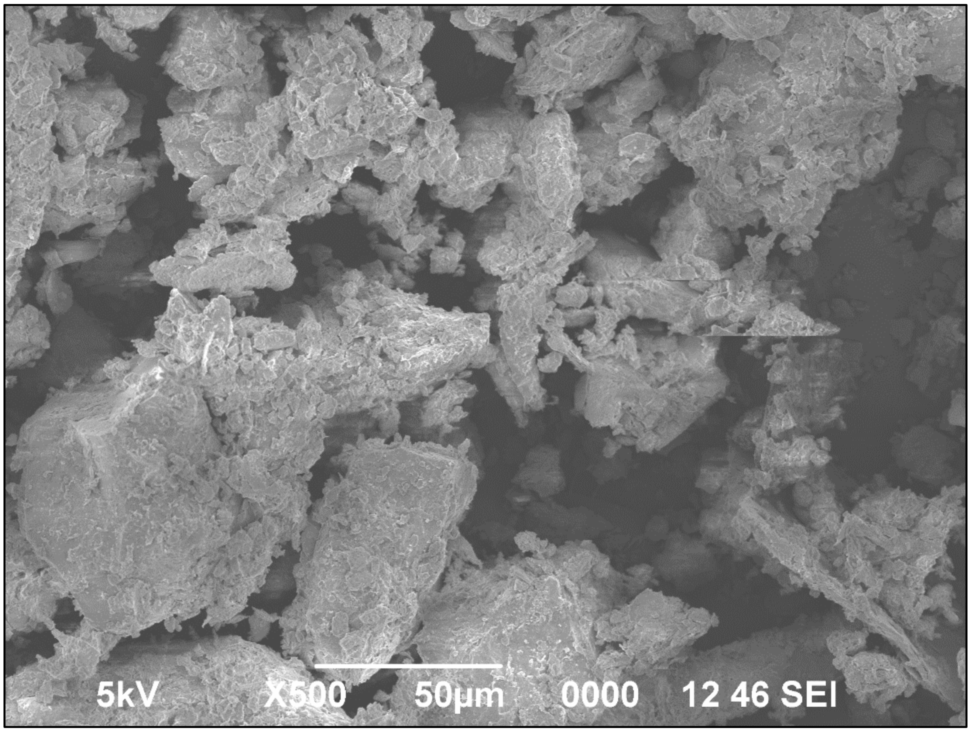
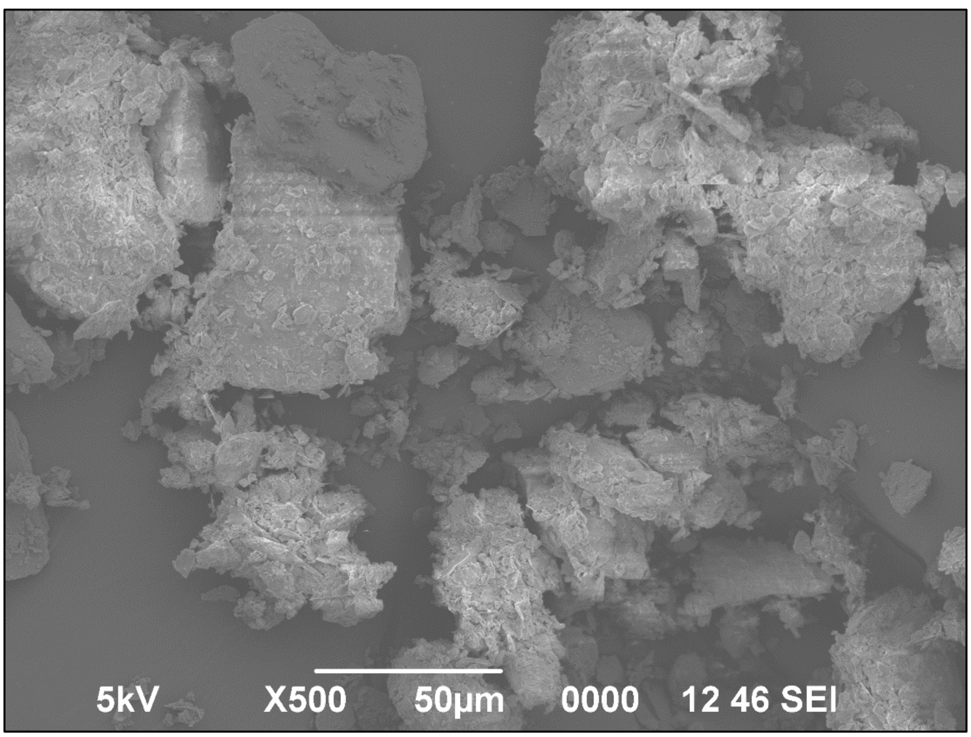


Figure 199. Electron micrograph of adobe mortar sample 17a.



10.3.1 Samples 4, 5, 11, and 12 (interior plasters and fillings)

Sample 4 is a plaster fill material surrounding only certain parts of the hearth. We found a small quantity of this material. According to TGA, this sample contained moderate amounts of calcium carbonate, which decarboxylized between 600°C to 720°C in the test presented in Figure 182. We also observed a small quantity of portlandite ($Ca(OH)_2$) dehydroxylating at the characteristic temperature of 415°C. Approximately 12% of the total sample mass evolved at 150°C, which is characteristic of gypsum dehydration. These results are consistent with a plaster product containing both gypsum and slaked lime that is almost completely cured.

Samples 5 and 11 are representative of plastering materials in the central room and western rooms, respectively (Figure 201 and Figure 202).

Sample 5 had one or two small stones on the no. 4, no. 8, and no. 10 sieves, with a mostly uniform gradation between the no. 16 and no. 100 sieves that was heavy on the no. 30 sieve (Table 19). The sand was primarily brown to tan with a few black grains. These characteristics are representative of a natural river sand. The no. 200 sieve and pan materials were combined for analysis in XRF to determine calcium content of the binder phase.

Table 19. Gradation of sample 5.

16	30	40	50	100	200	Pan	Total (g)
1.62	9.31	2.70	2.72	6.10	5.29	5.50	33.24

Sample 11 had a few small stones on the no. 4, no. 8, and no. 10 sieves, with a mostly uniform gradation between the no. 16 and no. 100 sieves that was heavy on the no. 30 sieve (Table 20 and Figure 200). The sand was primarily brown to tan with a few black grains. These characteristics are representative of a natural river sand. The no. 200 sieve and pan materials were combined for analysis in XRF to determine calcium content of the binder phase.

Figure 200. Sieves during analysis of sample 11.

Table 20. Gradation of sample 11.

16	30	40	50	100	200	Pan	Total (g)
5.65	18.83	5.76	4.46	7.72	7.86	3.46	53.74

Sample 12 had one or two small stones on the no. 4, no. 8, and no. 10 sieves, with a mostly uniform gradation between the no. 16 and no. 100 sieves that was heavy on the no. 100 sieve (Table 21). The sand was primarily brown to tan with a few black grains. The no. 200 sieve and pan materials were combined for analysis in XRF to determine calcium content of the binder phase. The collection site for sample 12 can be seen in Figure 203.

Table 21. Gradation of sample 12.

16	30	40	50	100	200	Pan	Total (g)
0.40	3.00	5.23	9.85	13.64	6.85	6.71	45.68

Figure 201. Stucco (sample 5) and coatings (sample 6) in the entry room.

Figure 202. Coating, stucco (sample 11), and bricks in the west rooms.

Figure 203. East room wall material. (*right*, samples 16a and 17a) with smooth, white coating (*center*, sample 12) against entry door jamb filler with gray bricks and mortar (*left*, samples 9 and 10).

10.3.2 Samples 6, 7, and 8 (interior coatings)

Samples 6 (Figure 201) and 8 (Figure 204) are similar coating materials from the same room. Sample 7 may be the same material as sample 4, which we infer from the data is a modern gypsum or slaked lime plaster. We also found what appears to be a whitewash coating on sample 5, but we did not perform deeper composition analysis on this sample.

We performed Fourier transform infrared (FT-IR) spectroscopy on samples 6, 7, and 8 to determine the material composition of the green coating. An automatic search-match function returned results for ethylene propylene rubber (EPR), butyl rubber, chlorobutyl, and neoprene. We conclude that this is a rubberized coating, but we could not determine why this type of coating was selected for use in this application, as it is uncommon to use such coatings for the walls of interior living spaces.

Figure 204. Underlying (sample 7) and peeling (sample 8) coatings in the entry room.

10.4 Outbuilding analysis

We collected four samples from the exterior of the outbuilding. Both walls sampled are of similar construction with a monolithic fill material and stucco of similar color as sample 15 taken from the west exterior wall. Nails are visible, used for either original reinforcements or repairs (Figure 205). The TGA of wall sample 21 shows slightly less water dehydration than the bricks in the main structure, which could indicate the presence of different clays in the mixture. Sample 21 also shows a slight decarboxylation of calcium carbonate at 650°C, indicating the presence of a small quantity of either slaked lime or limestone in the mix.

Figure 205. Outbuilding earthen wall and stucco with reinforcing nails.

10.5 Conclusions and recommendations

Recommendations for rehabilitation material recipes are considered in the historical context of this structure as well as National Park Service's Preservation Briefs 2 and 43.

10.5.1 Adobe bricks—East end

See Section 5.4.

10.5.2 Adobe bricks—West end

See Section 5.4.

10.5.3 Interior plaster

We collected gradation data for the filler fraction and elemental data for the binder fraction of samples 5 and 11. The elemental data indicate only a small quantity of calcium in the binder and a silicon-aluminum ratio that is representative of clay materials. The evidence indicates that this plaster has a soil-based binder. The gradation and color of the filler are consistent with a well-graded, natural river sand, a material which is prevalent in the surrounding wilderness. Sample 12 appears older than samples 5 and 11 due to the placement within the door jamb. Sample 12 similarly has low calcium content in the binder with natural sand filler, but the sand gradation is finer with a high fraction of particles retained on the no. 100 sieve.

Our recommended recipe for a historically accurate rehabilitation of the interior plaster would borrow from the brick-and-mortar recipe. Portland cement should not be used. The plasterer or stucco mason might use a similar clay-based binder, but for the filler, they should use a well-graded river sand with a nominal maximum particle size of no. 16 (1.18 mm). If a smoother surface finish is desired by the architect, it would be acceptable to use a coarse masonry sand gradation with a large fraction retained on no. 100. It may be difficult to commercially procure large quantities of natural river sand for construction purposes due to environmental restrictions in the region. The filler-to-binder ratio by weight should range between 2.25 to 2.75 in order to achieve a smooth, spreadable consistency that will not slough under self-weight. Water should be added slowly and carefully; the mixture will rapidly become unworkable with too much water added.

It appears that a modern repair material (sample 4) was used around certain sections of the hearth. We recommend against using gypsum or slaked lime binders for a historically accurate restoration of the interior plasters throughout the structure. Furthermore, gypsum and slaked lime plasters could quickly and broadly crack due to three key environmental stressors: (1) differences in material stiffness between the harder plaster and softer soil-based bricks and mortar during minor seismic events, (2) differential thermal expansion, or (3) the prevention of appropriate moisture transfer through the soil-based structural components.

10.5.4 Exterior stucco

Samples 17b and 18 are pieces of the exterior stucco near the chimney. Sample 18 has a slightly coarser filler material with a flatter gradation, though both filler materials appear as natural river sands. Sample 18 came from a layer closer to the brick, meaning it is either an older coating or a purposeful brown coat. Sample 14 from the exterior of the west wall has a similar appearance, gradation, and elemental composition as sample 18, so it is possible that these surfaces were coated at the same time. Sample 17b has expanded wire lath support embedded within the stucco. Expanded wire lath is common for this application during a broad timeframe between the 1920s until present day. It is not possible to precisely date the stucco based on the presence of expanded wire lath.

Our recommended recipe for a historically accurate rehabilitation of the exterior stucco, similar to the interior plaster, would borrow from the brick-and-mortar recipe. Portland cement should not be used. The plasterer or stucco mason might use a similar clay-based binder, but for the filler, they should use only a well-graded river sand with a nominal maximum particle size of no. 16 (1.18 mm). A finer, poorly graded mason sand would not allow adequate moisture transfer for the underlying soil-based structural components. It may be difficult to commercially procure large quantities of natural river sand for construction purposes due to environmental restrictions in the region. The filler-to-binder ratio by weight should range between 2.75 to 3.25 in order to achieve a rough yet spreadable consistency that will not slough under self-weight. This increase in filler fraction above the interior plaster recipe will provide a slightly rougher surface finish. Water should be added slowly and carefully; the mixture will rapidly become unworkable with too much water added. Using less water for the exterior stucco than the interior plaster should produce a harder, more resilient coating.

10.5.5 Concrete veranda floor and columns

Samples 3 and 16b came from the concrete tile on the veranda and one of the concrete columns, respectively. A steel rod protrudes from the top of each column to transfer horizontal loads from the veranda roof down to the foundation.

Due to the surface characteristics of the broken floor sections, it appears that the concrete tile was poured monolithically with the underlying foundation but using a different mixture design. The foundation contains larger, rounded aggregates of up to 3/8 in., while the surface tile aggregates are limited to approximately no. 8 sieve in order to achieve a particular architectural style at the surface. We observed a tortuous fracture surface where several columns have fallen, rather than a cold joint line at the base of the columns. This leads us to believe the columns were also poured monolithically with the foundation. The columns appear to have similar aggregates and gradation as the foundation. Unfortunately, it is not feasible to precisely determine the gradation of aggregates in hardened concretes.

Aggregates in all of these mixtures appear as primarily siliceous, having a clear to off-white color, along with a variety of colorful feldspars, which is indicative of a manufactured, architectural concrete aggregate blend. It appears that the blend is composed of both rounded particles and fractured, angular particles. It may be possible to source a similar decorative aggregate blend commercially in the vicinity of the structure. However, it would be improper design practice to specify unreinforced architectural concrete as a structural support for roofing over the veranda. A licensed professional engineer should validate the designed load path for roof loads through structural elements and down to the foundation. In the interest of occupant safety, it may be advantageous to completely remove the existing concrete foundation and columns in favor of enhanced structural designs.

After the appropriate aggregates are selected by the architect, concrete and mortar mixture designs for veranda rehabilitation should follow the guidance of American Concrete Institute (ACI) PRC-211.1, *Selecting Proportions for Normal-Density and High Density-Concrete–Guide*, or ASTM C270, *Standard Specification for Mortar for Unit Masonry*. The contractor should also heed the guidance of ACI PRC-546, *Guide to Concrete Repair*, and ACI PRC-303, *Guide to Cast-in-Place Architectural Concrete Practice*.

11 Stage V: Adaptive Reuse

11.1 Heritage center and office scheme

Converting the José María Gil Adobe into a heritage center and office building would be a logical decision in response to both exterior and interior preservation and rehabilitation to its early state. The location of the building is near the entrance of Fort Hunter Liggett and would attract many campers and hunters from the nearby campground. This scheme would require less modifications as opposed to other schemes; people would not be entering most of the building besides the office space.

The José María Gil Adobe is a historically significant building that is listed on the NRHP. The building was constructed with adobe bricks, which remain; therefore, preserving the historic adobe walls of the buildings is the main objective. Any changes made that would create a potential adverse effect or changes not under "The Secretary of the Interior's Standards" must be done in consultation with the California State Historic Preservation Office.

This scheme will be a combination of a heritage display, where people will be able to view the different stages of use in a portion of the building through the windows in each room, while also allowing office space. The rooms will be staged to match the time period of their construction. The goal is to create a feeling and appreciation of the mid-to late 18th century lifestyles on a ranch in California. The north wing will be restored and turned into an office where outdoor space is dedicated to the Hunt and Fish Program to issue permits and do game checks, since many hunters camp at the campground nearby. Hunters would enter the office and meet to do the game tag drawings. The game warden could also benefit from this office space.

The areas around the exterior of the building will be cleaned up and re-landscaped for a more pleasant exterior space while preserving the historic feel of the site. The landscape features will contain the cobblestone wall, trees (such as the valley oaks, black walnuts, blue oaks, etc.), and the cobblestone fire pit. The objective is to make the exterior and the surrounding grounds appear similar to what they may have looked like when the Gil family inhabited the house and their ranch lands.

The original construction material of the José María Gil Adobe that can be reused in the modification of this building is the adobe brick exterior. If bricks are missing or need to be re-created, this should be done according to the secretary of the interior's guidelines. Replacement six-over-six, wood sash, double-hung windows need to be re-created to turn-of-the-century wood windows. The roof will also need to be replaced to the original state with wood shingles. The porch will only be present on the northeast side with the original 4 ft length. The square concrete pavers of the porch will be removed. Redwood decking will be placed along the northeast elevation. The concrete columns of the porch will be replaced with wood columns.

The interior of the José María Gil Adobe will require the installation of new wood plank flooring to match historic pre-1900 wood floors. The plaster walls must be scraped of any failing plaster or paint and re-plastered and painted after any reconstruction or rehabilitation is done to the adobe bricks, whether it is for structure or aesthetics. The interior electrical components will be updated to meet requirements. The lighting will be used to direct the public's focus onto certain details inside the staged rooms. Time-appropriate furniture, tools, or clothes will need to be found to stage the interior rooms.

Adapting the José María Gil Adobe into a heritage center and office building would require parking due to the increased number of people at the site. The exterior ground on the northeast side of the site could be modified to expand the parking area. The fence around the property will need to be removed and the grades reworked to comply with Americans with Disabilities Act (ADA) requirements and to allow for accessible parking and paved paths for safe circulation around the site.

The NRHP sign for the José María Gil Adobe will be removed, as this obstructs any views of the adobe when looking at it in any westerly direction. A NRHP plaque should be placed near what could have once been the front entrance of the house.

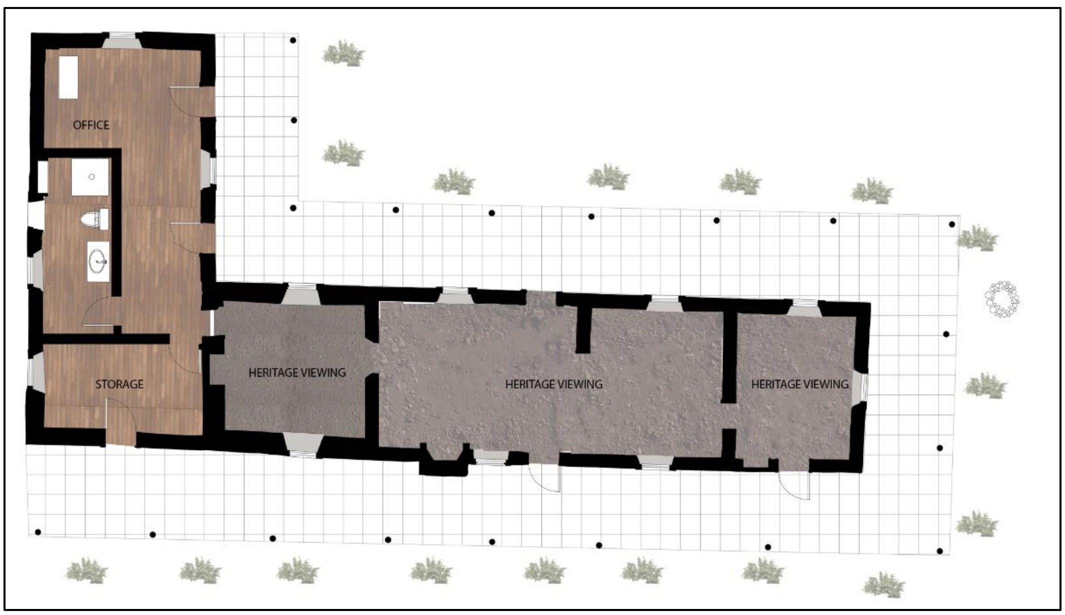
The cold storage could be used as an outhouse. This could provide tourists and those at the campground with a bathroom. The building will need to be earthquake proofed, and the roof will need to be replaced to match the José María Gil Adobe. The inside of the building will have a basic outhouse layout that is ADA accessible.

The cold storage building could also be a staged storage section as part of the historical reproduction. People will be able to view the inside of the building through the doorway and window and see historic farm tools and or fake meats. The roof will be replaced with wood shingles of the same kind as the José María Gil Adobe, and the cracks will be fixed on the building. This would provide tourists with an idea of how settlers lived in early Jolon.

This scheme would be ideal as a way to celebrate Jolon history and provide an office space for staff and an area for hunters and campers near Fort Hunter Liggett. It will provide another tourist location along with the San Antonio de Padua Mission and historic St. Luke's Episcopal Church.

See diagram in Figure 206.

Figure 206. Floor-plan diagram showing heritage center and office scheme, 2022. (ERDC-CERL.)



11.2 Cabin scheme and history room

In response to the nearby campground, creating cabin space would allow for campers to have a place to stay without bringing tents or trailers of any kind. José María Gil Adobe will contain two cabins, one in each wing.

To preserve some historical aspects of the building and to allow the public to learn about its history, the central room, or what is thought to be the original room, will be converted into a history room similar to the interior space discussed in Section 11.1. Having this inaccessible space between each cabin will allow for a dividing line between the two private spaces.

The areas around the exterior of the building will be cleaned up and re-landscaped for a more pleasant exterior space while preserving the historic feel of the site. The landscape features will contain the cobblestone wall, trees (such as the valley oaks, black walnuts, blue oaks, etc.), and the cobblestone fire pit. The objective is to make the exterior and the surrounding grounds appear similar to what they may have looked like when the Gil family inhabited the house and their ranch lands.

The original construction material of the José María Gil Adobe that can be reused in the modification of this building is the adobe brick exterior. If bricks are missing or need to be re-created, this should be done according to the secretary of the interior's guidelines. Replacement six-over-six, wood-sash, double-hung windows need to be re-created to turn-of-the-century wood windows. The roof will also need to be replaced to the full veranda stage (to maximize outdoor space) with wood shingles. The porch will extend around all but the northwest side of the building. The square concrete pavers of the porch will be removed. Redwood decking will be placed along the northeast and southeast elevation. The concrete porch will be reconstructed on the southwest elevation. The concrete columns of the porch will be replaced with wood columns.

The building's interior will consist of two cabin spaces and the central history room. The cabins will contain sleeping quarters, a full bath that meets ADA requirements, living space, and kitchen space. The history room will be staged to appear as if an early settler of the area was living there. The wooden floors will be replaced to match the original wood floors; however, the history room floor will be dirt.

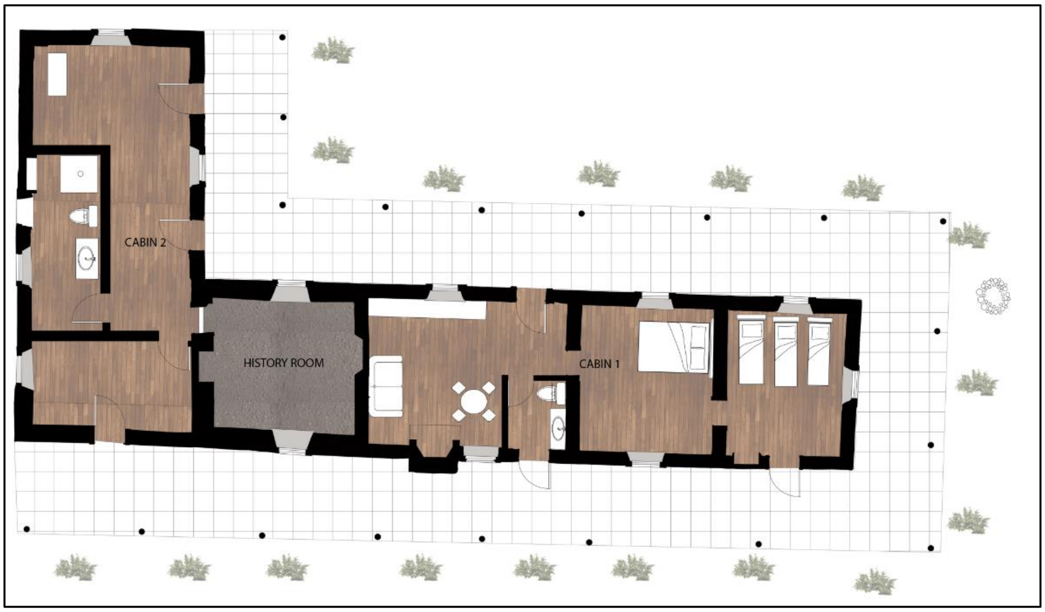
Adapting the José María Gil Adobe into a cabin scheme and history room will require parking due to the increased traffic of people. The exterior ground on the northeast side of the site could be modified to expand the parking area. The fence around the property will need to be removed and the grades reworked to comply with ADA requirements and to allow for accessible parking and paved paths for safe circulation around the site.

The NRHP sign for the José María Gil Adobe will be removed, as this obstructs any views of the adobe when looking at it in any westerly direction. A NRHP plaque should be placed near what could have once been the front entrance of the house.

This scheme will provide housing next to the campground that is used by campers throughout the year.

See diagram in Figure 207.

Figure 207. Floor-plan diagram showing central history room and cabin scheme, 2022. (ERDC-CERL.)



11.3 Recreation store

Converting the Gil Adobe into a campground general store is appropriate for the location of the building because of the campground that is in close proximity to the José María Gil Adobe. The recreation store scheme in the José María Gil Adobe would require modifications to the building as well as adapting the structure to withstand earthquakes. The José María Gil Adobe is a historically significant building that is listed on the NRHP. Therefore, preserving the adobe walls of the buildings (both the adobe and cold storage building) is the main objective. Any changes made that would create a potential adverse effect or changes not under “The Secretary of the Interior’s Standards” must be done in consultation with the California State Historic Preservation Office.

The exterior of the building will be cleaned up and relandscaped, while still containing the stone fence, trees (such as the valley oaks, black walnuts, blue oaks, etc.), and cobblestone fire pit. The concrete slabs within the lawn will be removed in order to make room for picnic tables. A planter filled with native flowers will be placed on the north face of the building under the windows. The fence around the property will need to be removed and the grades reworked to comply with ADA requirements.

The interior of the José María Gil Adobe will require modification. The interior plumbing and electrical will be updated to meet requirements. The plumbing will move from the north addition to the bathroom in the easternmost room. The flooring will be replaced to mirror the original wood flooring. The easternmost room will be converted to a bathroom that is only accessible from the outside. The interior door for the easternmost room will be sealed closed. The walls constructed to form the bathroom for the BOQ will be taken down in order to create the storeroom.

The original construction material of the José María Gil Adobe can be repaired and rebuilt in areas. Replacement six-over-six, wood-sash, double-hung windows need to be re-created to turn-of-the-century wood windows. The roof will also need to be replaced to the Hearst-era green shingles and the full veranda. The concrete pillars will need to be rebuilt or reinstalled to support the veranda. The concrete porch will need to be both rebuilt and repaired.

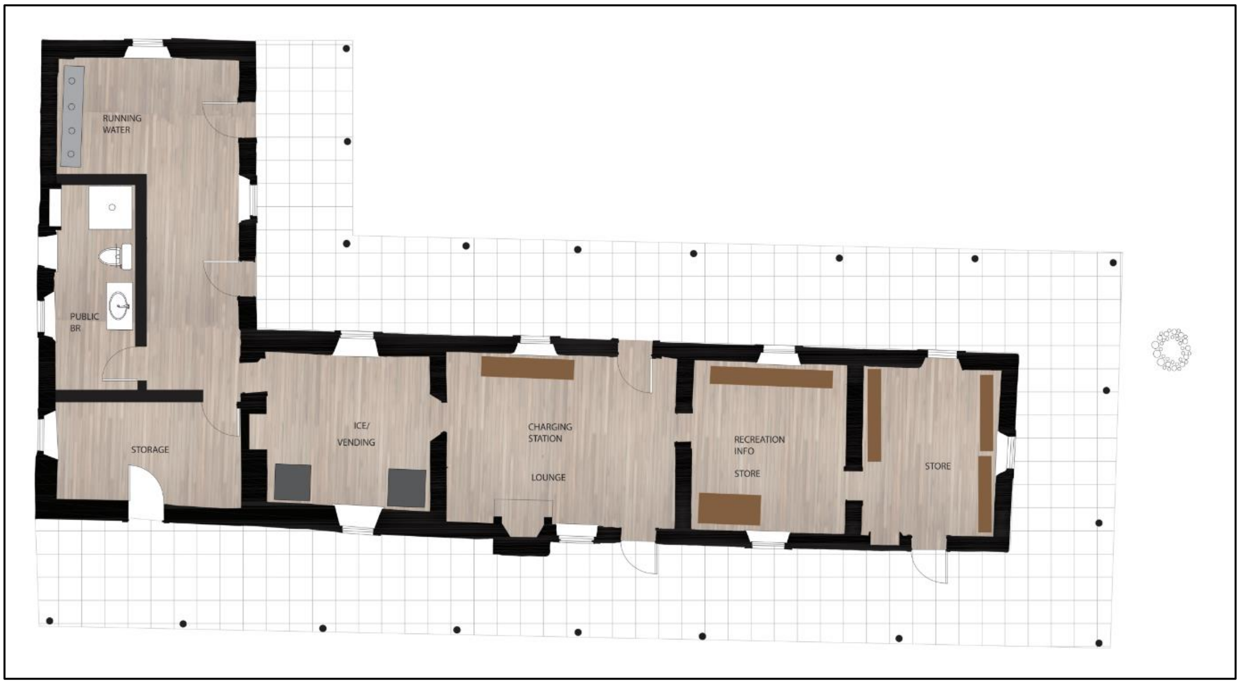
Adapting the José María Gil Adobe into a recreation store will require parking due to the increased traffic of people. The exterior ground on the northeast side of the site could be modified to expand the parking area. The fence around the property will need to be removed and the grades reworked to comply with ADA requirements and to allow for accessible parking and paved paths for safe circulation around the site .

The NRHP sign for the José María Gil Adobe will be removed, as this obstructs any views of the adobe when looking at it in any westerly direction. A NRHP plaque should be placed near what could have once been the front entrance of the house.

This scheme will be fitting in regard to the needs of Fort Hunter Liggett and the surrounding area. With a campsite, San Antonio de Padua Mission, and historic St. Luke’s Church, there are many tourists within the area. Providing a campground recreation store would provide necessities and camp gear to those camping in Fort Hunter Liggett's campground and tourists visiting Jolon, as well as become a source of income for the Army.

See diagram in Figure 208.

Figure 208. Floor-plan diagram showing recreation store scheme, 2022. (ERDC-CERL.)



11.4 Additional schemes

11.4.1 Visitor center and café

Converting the Gil Adobe into a visitor center and café is appropriate for the location of the building and because of the lack of a facility of this kind near Fort Hunter Liggett. The visitor center and café scheme in the José María Gil Adobe would require both interior and exterior modifications to the building as well as adapting the structure to withstand earthquakes as the safety of the people inside is a priority. The José María Gil Adobe is a historically significant building that is listed on the NRHP; therefore, preserving the adobe walls of the buildings is the main objective. Any other changes made that would create a potential adverse effect or changes not under the secretary of the interior's guidelines must be done in consultation with the California State Historic Preservation Office.

This scheme will be a visitor center where people in the Fort Hunter Liggett or Jolon area could stop for information, souvenirs, or the café when entering or leaving the area. This scheme also tends to the people who live or work on Fort Hunter Liggett.

The areas around the exterior of the building will be cleaned up and relandscaped for a more pleasant exterior space. The landscape will contain the cobblestone wall, trees (such as the valley oaks, black walnuts, blue oaks, etc.), and the cobblestone fire pit. The square stone pavers of the porch will be replaced.

The interior of the José María Gil Adobe will require modification. The interior plumbing and electrical will be updated to meet requirements. The flooring will be replaced to mirror the original wood. The north wing will be retrofitted to contain a coffee counter and bathroom. The wooden partition walls constructed to form the bathroom for the BOQ will be taken down.

The original construction material of the José María Gil Adobe that can be reused in the modification of this building is the adobe brick exterior. There will be areas that can be restored or repaired and areas that may need to be reconstructed. Additional materials, such as wood, will also need attention. For example, the replacement windows should match the original windows. The roof will also need to be replaced to its Hearst-era form with the full veranda.

The cold storage building will be used as storage. The building will have the cracks fixed and the roof replaced.

Adapting the José María Gil Adobe into a visitor center and cafe will require parking due to the increased traffic of people. The exterior ground on the northeast side of the site could be modified to expand the parking area. The fence around the property will need to be removed and the grades reworked to comply with ADA requirements and to allow for accessible parking and paved paths for safe circulation around the site.

The NRHP sign for the José María Gil Adobe will be removed, as this obstructs any views of the adobe when looking at it in any westerly direction. A NRHP plaque should be placed near what could have once been the front entrance of the house.

This scheme would benefit Fort Hunter Liggett and cater to the needs of the surrounding area. It will provide a facility where tourists would be able to stop and learn about the historic sites within Jolon and sell items such as pamphlets, books, art, maps, and photos about historic Jolon. It will also provide a close location for tourists, campers, and those at Fort Hunter Liggett to get food and drinks in the café. This is a needed service because the closest restaurants are those found in King City. There are no coffee shops within the Fort Hunter Liggett area, meaning the scheme would fill a needed niche within the community.

11.4.2 Restaurant

Converting the Gil Adobe into a restaurant is appropriate for the location of the building and the needs of the community. The restaurant scheme in the José María Gil Adobe would require modifications to the building as well as adapting the structure to meet earthquake requirements. The José María Gil Adobe is a historically significant building that is listed on the NRHP. Therefore, preserving the adobe walls of the buildings is the main objective. Any changes made that would create a potential adverse effect or changes not under the secretary of the interior's guidelines must be done in consultation with the California State Historic Preservation Office.

Allowing this building to become a restaurant will require parking and activity outside of the building and access to the interior of the building.

The areas around the exterior of the building will be cleaned up and relandscaped. The landscape will contain the stone fence, trees (such as the valley oaks, black walnuts, blue oaks, etc.), and cobblestone fire pit. Yard games will be added to the front of the building, making the restaurant family friendly. The pavers of the porch will be replaced. This area will be covered with the same pavers as the rest of the porch, allowing for an entrance to the building. The cold storage building can be used as storage.

The interior of the José María Gil Adobe will require modification. The interior plumbing and electrical will be updated to meet requirements. The flooring will be replaced to mirror the original wood flooring. The north wing will be retrofitted to contain a kitchen, bathroom, and storage. The walls constructed to form the bathroom for the BOQ will be taken down to fit the new uses of the north wing. All doors except the doors found in the main seating room will be closed. Interior doors will be removed, leaving open doorways to allow for a more open dining space. The only interior door that will remain is the easternmost room, which will provide a closed area for larger groups to dine.

The original construction material of the José María Gil Adobe can be repaired and rebuilt in areas. Replacement six-over-six, wood-sash, double-hung windows need to be re-created to turn-of-the-century wood windows. The roof will also need to be replaced to the Hearst-era green shingles with the full veranda. The full veranda would allow for maximizing the potential outdoor seating for the restaurant.

Adapting the José María Gil Adobe into a restaurant will require parking due to the increased traffic of people. The exterior ground on the northeast side of the site could be modified to expand the parking area. The fence around the property will need to be removed and the grades reworked to comply with ADA requirements and to allow for accessible parking and paved paths for safe circulation around the site.

The NRHP sign for the José María Gil Adobe will be removed, as this obstructs any views of the adobe when looking at it in any westerly direction. A NRHP plaque should be placed near what could have once been the front entrance of the house.

This scheme will be fitting in regard to the needs of Fort Hunter Liggett and the surrounding area. With a campsite, San Antonio de Padua Mission, and historic St. Luke's Church, there are many tourists within the area that need a place to eat. The scheme will provide a close location for these people and those at Fort Hunter Liggett to get a meal. This is a needed service because the closest restaurants to Fort Hunter Liggett are those found in King City. The scheme would fill a needed niche within the community.

12 Summary and Recommendations

In the earliest documentation of the José María Gil Adobe, we know that José María Gil lived in an adobe structure on the land that is now Fort Hunter Liggett. The building is believed to have been erected circa 1860, whereafter multiple additions were constructed. This structure was not constructed in the same L-shaped footprint that we see today. There are two theories for the original portion's construction: one, that a small adobe structure existed when José María Gil acquired the land; and two, that José María Gil constructed the small adobe structure. The building retains its original adobe bricks from the time each addition was constructed and some wooden materials. The roof and the structure thereof have been altered, rebuilt, and layered in an insufficient manner.

12.1 Treatment

"The Secretary of the Interior is responsible for establishing professional standards and providing advice on the stewardship of cultural resources listed on or as eligible for the NRHP."[87] The secretary's "Standards" describe four basic approaches to the treatment of historic landscapes.

12.1.1 Restoration approach

"Restoration is defined as the act or process of accurately depicting the form, features, and character of a property as it appeared at a particular period of time by means of the removal of features from other periods in its history and reconstruction of missing features from the restoration period. The limited and sensitive upgrading of mechanical, electrical, and plumbing systems and other code-required work to make properties functional is appropriate within a restoration project."[88]

The restoration approach is appropriate for the José María Gil Adobe if a particular era for its restoration can be chosen. Section 3.5 describes the evidence for what the building may have looked like. It is recommended if restoration is chosen to restore to Stage 5 or Stage 6 as described in

87. National Park Service, *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes*, edited by Charles A. Birnbaum and Christine Capella Peters (Washington, DC: National Park Service, 1996), 3.

88. National Park Service, "The Secretary of the Interior's Standards for the Treatment of Historic Properties: Restoration as a Treatment and Standards for Restoration," last updated October 26, 2022, https://www.nps.gov/articles/000/treatment-standards-restoration.htm.

Section 3.5. These details should be restored as this building is a fine example of an adobe ranch house constructed in the mid-19th century in California.

12.1.2 Reconstruction approach

“Reconstruction is defined as the act or process of depicting, by means of new construction, the form, features, and detailing of a non-surviving site, landscape, building, structure, or object for the purpose of replicating its appearance at a specific period of time and in its historic location.”[89] The reconstruction “Standards” establish a limited framework for recreating a vanished or nonsurviving building with new materials, primarily for interpretive purposes.

The José María Gil Adobe is not an intact building due to its structural issues. Reconstruction may be a viable path for the future of this building as the roof needs to be replaced entirely and the walls of the building need to be structurally reinforced to withstand earthquakes if this building is to be occupied.

12.1.3 Preservation approach

“Preservation is defined as the act or process of applying measures necessary to sustain the existing form, integrity, and materials of an historic property. Work, including preliminary measures to protect and stabilize the property, generally focuses upon the ongoing maintenance and repair of historic materials and features rather than extensive replacement and new construction. The limited and sensitive upgrading of mechanical, electrical, and plumbing systems and other code-required work to make properties functional is appropriate within a preservation project. However, new exterior additions are not within the scope of this treatment.”[90] The “Standards” for preservation require retention of the greatest amount of historic fabric along with the building’s historic form.

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89. National Park Service, “The Secretary of the Interior’s Standards for the Treatment of Historic Properties: Reconstruction as a Treatment and Standards for Reconstruction,” last updated October 26, 2022, https://www.nps.gov/articles/000/treatment-standards-reconstruction.htm.

90. National Park Service, “The Secretary of the Interior's Standards for the Treatment of Historic Properties: Preservation as a Treatment and Standards for Preservation,” last updated October 26, 2022, https://www.nps.gov/articles/000/treatment-standards-preservation.htm.

Preservation is a management treatment for the José María Gil Adobe only if viewed as a museum object in its location. The adobe walls are intact; however, a large amount of the other materials and construction components will need to be replaced and rebuilt even if it is going to be used as a museum object. Any other use automatically pushes the approach to one of the other three.

12.1.4 Rehabilitation approach

"Rehabilitation is defined as the act or process of making possible a compatible use for a property through repair, alterations, and additions while preserving those portions or features which convey its historical, cultural, or architectural values."[91] The rehabilitation "Standards" acknowledge the need to alter or add to a historic building to meet continuing or new uses while retaining the building's historic character.

Rehabilitation is the best option for the successful reuse of the José María Gil Adobe as it will move the building from a vacant status to an occupied status. It is highly likely that this building can again serve an appropriate use, as outlined in Section 11, reflecting the appearance in Stage 5 and Stage 6.

12.2 Management issues and recommendations

The José María Gil Adobe is owned by Fort Hunter Liggett, and the building was determined eligible for the NRHP in 1974. As such, Fort Hunter Liggett consults for all undertakings that affect the building with the State of California's California Historical Society, which serves as the State Historic Preservation Officer (SHPO) for consultation purposes.

Current issues include the following:

- The structure is unsafe for human inhabitance.
- The building is not equipped to withstand earthquakes.
- The building is currently inhabited by a bat colony.
- There are no floors that are safe to walk on.
- The interior wall materials are peeling and decaying.

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91. National Park Service, "The Secretary of the Interior's Standards for the Treatment of Historic Properties: Rehabilitation as a Treatment and Standards for Rehabilitation," last updated October 26, 2022, https://www.nps.gov/articles/000/treatment-standards-rehabilitation.htm.

- There are no intact windows.
- There are no functioning doors.
- The ceiling boards are rotten.
- The entire roof system needs to be removed and rebuilt.
- All electrical needs replaced.
- All plumbing needs replaced.
- The exterior chimney needs to be rebuilt.
- There is exposed adobe brick on the exterior.
- The porch floor is missing pavers.
- Some concrete pavers are cracked or have fallen.
- There is no accessible parking or walkway.

12.3 Historic building recommendations

The following actions are recommended to address the issues outlined above in Section 12.2 and should be written into any renovation contract for the José María Gil Adobe:

- Reinforce the adobe walls with temporary measures to prevent collapse.
- Reinforce the adobe walls with structural reinforcements such as steel.
- Properly and safely remove the bats with guidance from wildlife biologists and other trained professionals.
- Rebuild and replace wood strip flooring to match the sizes and directions of flooring that remain.
- Repair the interior adobe walls' materials as described in the treatment measures.
- Reconstruct windows as six-over-six, wood-sash, double-hung windows based on historic photographs.
- Restore original doors, rebuild rotten components, and reinstall to proper locations.
- Restore, reinstall, or replace all door hardware.
- Reconstruct ceiling with boards of same sizes and species to preserve the appearance of multiple construction stages.
- Safely remove roof layers and reconstruct roof based on desired construction stage based on historic photographs or renderings provided.
- Replace all electrical fixtures based on adaptive reuse plan selected.
- Replace all plumbing fixtures based on adaptive reuse plan selected.
- Rebuild chimney based on adobe reconstruction information provided.

- Repair exterior adobe and replaster building with proper plaster.
- Reconstruct porch floor with proper layout and materials based on the adaptive reuse plan selected.
- Replace or reconstruct porch columns with proper materials based on the adaptive reuse plan selected.
- Create parking spaces and walkways to ensure proper circulation and to meet ADA requirements.

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Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ADA	Americans with Disabilities Act
ASTM	American Society for Testing and Materials
BOQ	Bachelor officer's quarters
CERL	Construction Engineering Research Laboratory
CRM	Cultural Resources Management
E	East
EPR	Ethylene propylene rubber
ERDC	Engineer Research and Development Center
FT-IR	Fourier transform infrared
LEED	Leadership in Energy and Environmental Design
N	North
NHPA	National Historic Preservation Act
N.P.	Nonplastic
NRHP	National Register of Historic Places
NW	Northwest
RHPO	Regional Historic Preservation Officer
S	South
SE	Southeast
SHPO	State Historic Preservation Officer

TGA	Thermogravimetric analysis
USCS	Unified Soil Classification System
USDA	US Department of Agriculture
W	West
XRF	X-ray fluorescence

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14. ABSTRACT
The José María Gil Adobe, located on Fort Hunter Liggett, California, was added to the National Register of Historic Places (NRHP) in 1974. The building has been vacant since the early 1970s. It is a fine example of a small adobe ranch house possessing character-defining features of its period of significance of the mid-19th century on its exterior, interior, and within the site itself. This document is a reconstruction, repair, maintenance, and adaptive reuse report compiled with photographed, written, and drawn as-is conditions of construction materials of the José María Gil Adobe building and site. The building was 3D scanned to obtain the necessary information for the measured drawings. The secretary of the interior's guidelines on rehabilitation and repair per material are discussed to provide the cultural resources manager at Fort Hunter Liggett a guide to maintain this historic building. Rehabilitation is the best option for the successful reuse of the José María Gil Adobe as it will move the building from a vacant status to an occupied status. It is highly likely that this building can again serve an appropriate use as outlined in Section 11, reflecting its appearance in the early 20th century or WWII periods.

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