Molino De Los Duranes

Ranchos de Taos, NM

Structural Evaluation of Molino
September 30th, 2014



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TABLE OF CONTENTS

EXECUTIVE SUMMARY	Page 3
HISTORICAL BACKGROUND	Page 4
STATE REGISTER OF CULTURAL PROPERTIES	Page 6
THE ARCHAEOLOGY OF THE MOLINO	Page 6
PRESERVATION & RESTORATION	Page 8
DESCRIPTION OF ASSESSMENT	Page 8
SITE DESCRIPTION	Page 9
PHYSICAL DESCRIPTION	Page 10
FOUNDATION - EXISTING CONDITIONS	Page 11
FOUNDATION - RECOMMENDATIONS	Page 12
FLOOR - EXISTING CONDITIONS	Page 13
FLOOR - RECOMMENDATIONS	Page 13
WALLS - EXISTING CONDITIONS	Page 14
WALLS - RECOMMENDATIONS	Page 15
ROOF - EXISTING CONDITIONS	Page 16
ROOF - RECOMMENDATIONS	Page 16

APPENDIX A
APPLICATION FOR REGISTRATION, NEW MEXICO STATE REGISTER OF CULTURAL PROPERTIES

APPENDIX B
DR. RON TOWNER REPORT, ARIZONA TREE RING LABORATORY

APPENDIX C
DR. WINDES' DOCUMENTATION

APPENDIX D
PHOTOGRAPHS

APPENDIX E
PHOTOGRAPHS, DETAILED SHOTS

APPENDIX F
USGSA HISTORIC PRESERVATION TECHNICAL PROCEDURES
NATIONAL PARK SERVICE: PRESERVATION TECH NOTES & BRIEFS
PRODUCT INFORMATION

APPENDIX G
EXISTING DRAWINGS

APPENDIX H
PROPOSED DRAWINGS

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EXECUTIVE SUMMARY

This Condition Assessment and Preservation Plan has been prepared for the Taos County Historical Society through a National Park Service Historic Preservation Fund Grant in partnership with the State Historic Preservation Division of the Department of Cultural Affairs. The Molino de los Duranes is located in Ranchos de Taos on Camino Abajo de la Loma. The mill was built around 1850 and was abandoned in 1938. The Taos County Historical Society has been working with the owners of the property which have expressed a desire to restore the mill in its entirety. The Preservation Chair of the Taos County Historical Society, Charles C. Hawk, has provided a description of the historical background, the structure's status on the state register of historical properties, and the archeology of the Molino. Druc Engineering was hired to conduct a structural evaluation of the existing structure in order to document the existing conditions and provide recommendations for potential restoration and preservation strategies.

The Molino de los Duranes was built in similar fashion to other mills in the area and consists of a main floor built on grade and a raised floor where water previously flowed under. The structure is partially bermed into a south facing slope with stone walls laid in a cementitious mortar on the northeast side and partial stone walls on the southeast and northwest sides. The existing structure is approximately 321 square feet with a square building footprint of approximately 18'-0" x 18'-0". The mill is a flat roofed timber frame structure with cut log walls supported on wood log posts and stone walls and piers. It is likely that the wood log posts are original and that the stone walls and piers were built at a later date as they include a mortar consisting of some type of cement mixture. The walls are made up of rectangular wood log members laid on top of each other and lap jointed at the corners. The raised floor is made up of rectangular wood members butted against each other with an earthen finish floor on top. The roof is made up of round wood vigas and 2x4 latilla decking. The roofing appears to have been originally an earthen roof which has since been covered with some type of asphalt roofing membrane. The mill is currently in poor condition. Extensive settling is present along the southwest side of the Molino. The roof is in very poor condition and is nearly collapsing due to a deteriorated roof membrane and roof joist failure. The roof is temporarily being covered by plastic sheets as an emergency measure to prevent further deterioration.

This report includes a description of the existing site conditions and includes a site plan to orient the reader about its location and general site layout. As the structure itself consists of a single space, the report includes a detailed description of each building component, i.e. foundation, walls, roof etc. Each building component's existing condition is described along with applicable recommendations for preservation and/or restoration.

Where applicable, emergency recommendations are included. In addition, certain recommendations are further separated into categories of least and most impact. Through various meetings among parties, any decisions made on which approach to take are also identified in the report.

Photographs of the general structure that were taken during site visits are included in Appendix D. Detailed photographs of important building components and/or wood members are included in Appendix E. Various documents detailing technical procedures for recommended restorations as well as product information are included in Appendix F for reference. Full 24x36 existing drawings and proposed renovation drawings are provided to the Taos County Historical Society for their archives. The same existing and proposed renovation drawings are provided in Appendix G and Appendix H respectively.

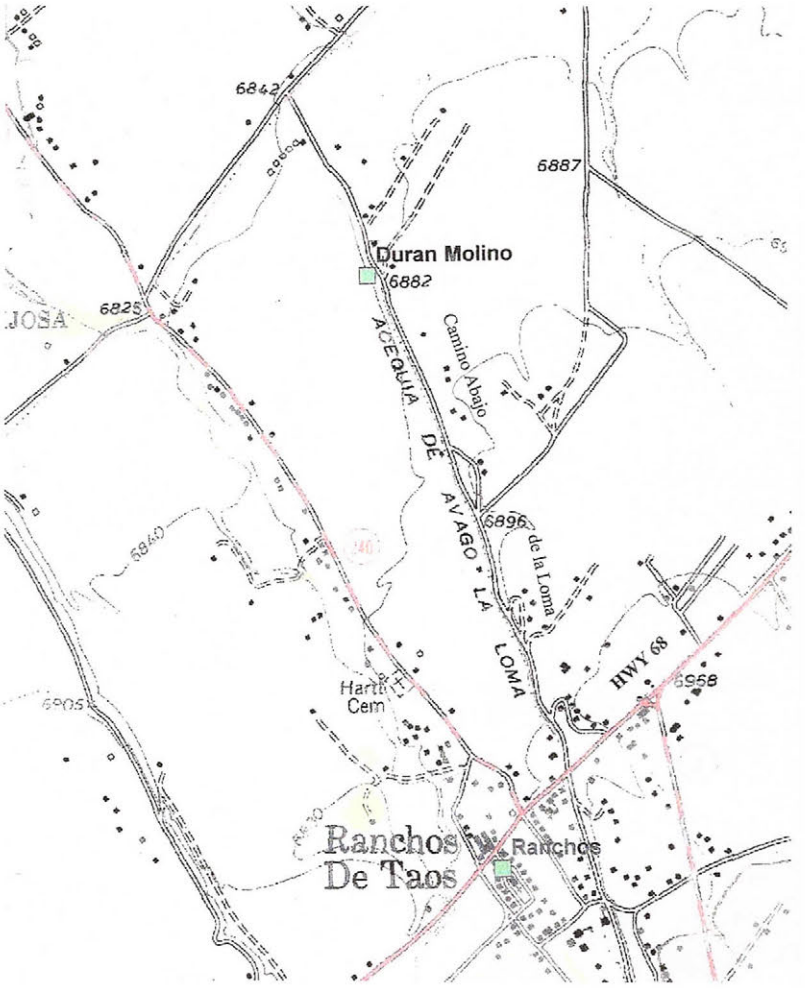
The purpose of this report is to provide guidance to the Taos Historical Society for immediate and long tern stabilization measures to preserve one of the area's last surviving mills.

HISTORICAL BACKGROUND

The Molino was a water-powered grist mill built in 1879. As far as we can determine, it was built and operated by the Duran family from that time until the 1930s. It served farmers in the valley of the Rio Rancho del Rio Grande, grinding both wheat and corn into flour and other products for both home use and sale.

The land on which the Molino is located is owned by Carl Velarde of Ranchos de Taos, New Mexico. His mother, Annabelle Duran Velarde was the grand-daughter of Innocencio Duran, the last member of the Duran family to actually operate the Molino. We believe the Molino was built by Innocencio Duran's father and possibly other family members. Unfortunately, Annabelle died in May, 2014.

The Duran Molino is located on Camino Abajo de la Loma, which runs west from NM Highway 68 in Ranchos de Taos, NM. The structure is less than a mile west of the intersection of Camino Abajo de la Loma and Highway 68. To the right is a portion of the USGS Ranchos Quadrangle map showing the exact location.



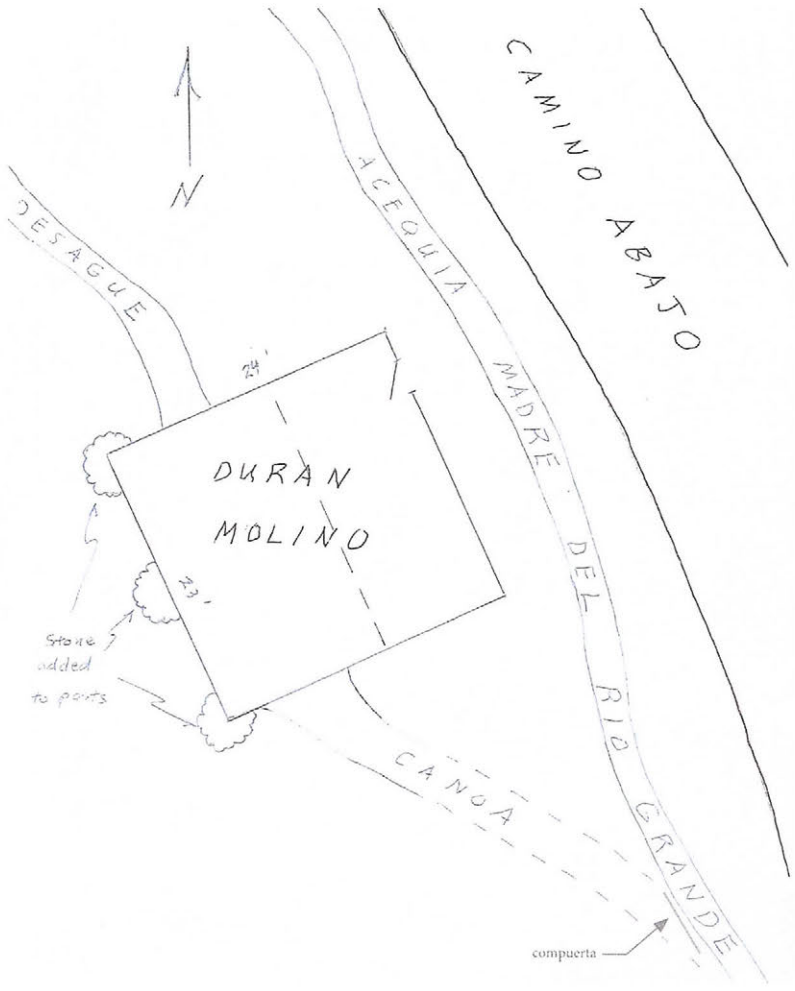
During most of the nineteenth century, milling of grain was the most important

industrial activity in Taos Valley. Its only distant rival was distilling. Grist mills, in the early days all water powered, were a critical part of the nineteenth century agricultural economy. They were the way that the abundant wheat and corn grown in Taos Valley was ground into flour and related products for Taos residents and for export outside the valley.

From early photos of other molinos, it appears that these early mills were very similar in construction, appearance and operation. While they appear primitive, they were in reality a superb example of local technological innovation at a time when little "modern" technology of any kind was available from the outside. The Duran Molino is the only surviving water powered grist mill from its era in Taos Valley. We believe it is the only mill from any era whose structure is largely intact and has not been changed.

The Duran Molino was built next to one of the area's largest acequias, the Acequia Madre del Rio Grande. This acequia supplied the water to power the Molino. The site is also immediately adjacent to the Camino Abajo de la Loma, a local road which was likely in existence serving the local farming community at the time of the Molino's construction in 1879. The road ran along the north edge of the Rio Rancho Valley, and would have provided easy access to the Molino for local farmers. The acequia and the Camino Abajo, now paved, is shown on the diagram below.

This diagram shows the size and orientation of the structure on the site, and also shows how the Molino used water from the ditch to power its grinding stones. Whenever the mill was going to operate, water from the acequia was diverted using a *compuerta* or headgate located as shown on the diagram. The water was then directed down a very steep channel called a *canoa* which considerably increased the speed of the flow. The water, flowing very fast at this point, then hit the horizontal water wheel under the structure. The rotating wheel turned a vertical shaft that powered the mill's mechanical works. After passing through the "tunnel" under the structure and powering the wheel, the water was diverted down an outflow channel called the *desague* and flowed back into a branch of the Acequia Madre.



As shown on diagram, the northeast wall of the Molino was only a few feet from the Acequia Madre del Rio Grande. Whether the proximity of the Molino to the ditch has contributed over the years to the settling of the southwest wall of the structure is certainly a possibility.

STATE REGISTER OF CULTURAL PROPERTIES

The Taos County Historical Society has been interested in preservation of the Duran Molino since 1969. The Molino was placed on the State Register of Cultural Properties by the Taos County Historical Society in that year. Its designation is SR-405. Attached as Appendix A is a copy of the documentation filed at that time with the state. As stated above, the Molino is on private property. The location of the Molino is also on what was part of the 1710 Cristobal de la Serna Land Grant.

THE ARCHAEOLOGY OF THE MOLINO

In June, 2011, a team led by UNM archaeologist Dr. Tom Windes spent a week studying and photographing the entire structure of the Molino. Dr. Windes and his students took many wood core samples from all parts of the structure, and submitted over 40 to the University of Arizona Tree Ring Laboratory. The results of that analysis was received November 15th, 2013. Attached as Appendix B is the report from Dr. Ron Towner, director of the Tree Ring Laboratory.

Dr. Windes and Dr. Towner have been able to precisely date the construction of the Molino. Based on the results of the wood samples analyzed at the University of Arizona, the structure was built in 1879.

Dr. Windes has also documented for us very detailed information about the construction of the Molino. This documentation and respective figures are included in Appendix C. Each piece of the wood structure was given a "Field Specimen" number, beginning with "FS-1." Using these numbers, each piece was measured, catalogued and photographed. In addition, photos were taken of the corners where each of the large horizontal wall beams (FS-1 through FS-29) were joined together. Some examples of these photos are attached collectively as Figure 1. The photos show the "FS" numbers for the major wood elements in each picture. Of special interest to Dr. Windes was the different ways each beam had been cut and joined to the beams above and below it.

Finally, photos were taken of the interior of the structure, with the same numbering system used to identify each major wooden element. One example, where the west wall met the south wall, is attached as Figure 2. From the photos Dr. Windes and his students produced detailed drawings of the entire structure. Two examples are attached as Figures 3 and 4. In each drawing, all the wood elements can be identified by their "FS" numbers.

From this data, and from close observation, Dr. Windes was able to reach some conclusions about the construction process used by the Molino's builders. The large horizontal beams are Ponderosa Pine. They were hand cut with axes in the mountains, probably up Miranda Canyon to the southeast. Each beam was squared with adzes at the cutting site and then dragged by horse or mule to the site of the Molino. Dr. Windes can identify the individual adze "signatures" of some of the workmen. Many of the beams also have both the drag marks and hand cut notches to secure dragging ropes or chains.

The large beams, averaging 16 inches by 10 inches, had their ends notched at the building site. Where needed when assembling the walls, small shims and wooden pins were used to level and secure beams in

place. Most of these have survived and are still performing their intended functions. There was no effort to "dress" the beam ends to any uniform length. The structure was totally practical.

The structure was supported by eight very large vertical pine posts set in the ground at each corner and in the middle of each wall. Three of these vertical supports, the ones along the northeast wall, are shown as FS-99, FS-102 and FS-104 in Figure 5. Dr. Windes could not determine if any kind of footings were used to support these posts. Because of the serious settling of the building on the southwest side, footings were probably only river cobbles, if that.

In addition to the main vertical posts supporting the frame of the building, there were six additional posts that supported the "working floor" of the mill. These posts held large horizontal floor joists running NW-SE. Across these joists were placed abutting smaller pine beams that formed the base of the "working floor." A schematic drawing of the placement of these structural elements is attached as Figure 9. Thus separate sets of vertical posts supported two separate structural frames: one was for the four exterior walls, and the other for the working floor above the water wheel and the "tunnel."

Above the floor beams the builders added about eight inches of adobe mud, which was compacted and formed the surface of the interior floor. There appears to have been an interior floor in only half of the structure; that floor held the mill machinery located directly above the mill water wheel in the "tunnel" below. The other half of the inside of the mill, on the northeast side and entered by the exterior door low in the northeast wall, was open from the ground to the ceiling. We believe this large open area was for storage of both grain and the flour produced by the mill. The Velarde family installed a partial wood floor over this area around 1970.

There were no metal fasteners, screws or nails used in construction of the original Molino. In about 1970, the wood samples taken by Dr. Windes indicate that a simple new wood roof replaced the roof which existed at that time. We do not know whether the roof replaced in 1970 was the original or a successor. Nails were used to install the 1970 roof, but whether nails were used in one or more earlier roofs is not known.

Prominent in all photos of the Molino is the stone and concrete reinforcement of the three vertical support posts holding up the south wall. The archaeologists who have looked at the structure have not yet been able to tell us the age of the concrete used to reinforce these posts. We do not believe that the stone and cement mortar reinforcing the three posts on the south side was part of the original Molino. This was probably added at some time after 1900, and possibly after the mill reportedly ceased operation in the 1930s. A later addition of reinforcing material would be consistent with the Velarde family's interest in preserving the old structure.

There is also a stone and mortar wall enclosing the northeast part of the interior of the building. It appears that a feature of this kind would have been needed as a retaining wall to enclose and protect the large "storage area" which comprised half of the interior space. A stone foundation wall, mortared with adobe mud, would have accomplished this purpose. An interior wall made of adobe bricks would be subject to moisture erosion below grade, and was therefore probably not used.

Enclosing the interior space in the northeast part of the Molino would have been necessary to protect both grain and flour from rain and particularly wind and dust. Our guess is that the adobe mortar was replaced years after original construction with the cement mortar now in place. Finally, there would have been no need for the door on the northeast wall to the Molino if the retaining/foundation wall was absent!

PRESERVATION & RESTORATION

This document catalogs the existing conditions of the Duran de los Molinos structure and includes a set of existing drawings to be archived. The purpose of this document is to provide and assess short term and long term preservation and/or restoration strategies and recommendations. This report will be used by the Taos County Historical Society to evaluate and implement short term recommendations along with planning to achieve overall long term preservation goals. The Taos County Historical Society intends to organize both volunteer and contract work for the necessary repairs and will seek additional project funding as necessary. It is likely that the majority of the repair work will be completed by volunteers under the guidance of local experts and this report. Where more skilled labor is required (i.e. borate treatments), such work should be performed by skilled professionals.

There are some major immediate repairs that will need to take place as the structure is in a high level of deterioration. In addition, there are minor restoration strategies that will need to be implemented to keep the building from further decay. Ultimately, the goal is to establish a long-term preservation plan and restore the structure to its original historic character.

DESCRIPTION OF ASSESSMENT

Structural Engineer Bill Druc, P.E., Architectural Design/Project Manager José La Cruz-Crawford, & Engineer Andrew Tumason, P.E. of Druc Engineering visited the site with Corky Hawk of the Taos County Historical Society on April 4th, 2014. Weather conditions were sunny and favorable during the visit. Druc Engineering spent several hours taking photographs of the structure and its various components to identify existing conditions and areas of concern. Dimensions were taken and sketches were made on site detailing the overall size and layout of the building and structural components. Field notes included specifying the varying sizes of wood member and general notes identifying areas of deterioration and overall structural concerns. These field observations and sketches were later converted into a digitally produced set of existing drawings which included Floor Plans, Elevations, Structural Plans and Sections & Details.

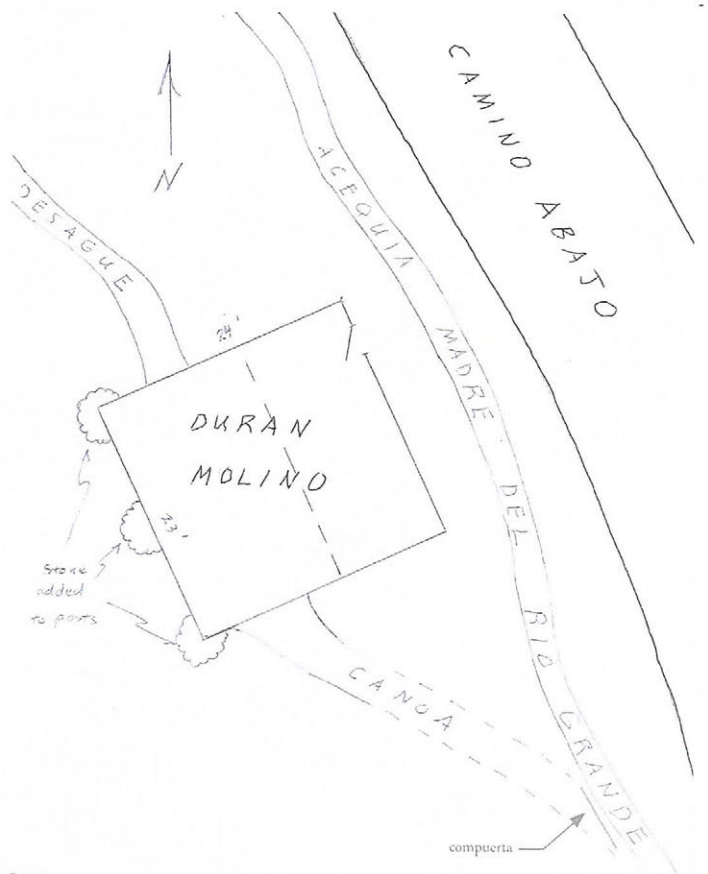
Bill Druc and José La Cruz-Crawford revisited the site along with Corky Hawk on September 16th, 2014 to further document the structure using existing conditions drawings. During this visit, additional notes and sketches were made. Additional photographs were taken to document the building's four facades and their respective wood log wall members and their level of deterioration. Other key components of the structure were photographed in order to ensure that any repair or replacement of members will match the historic character of the existing members. Further structural investigation was conducted and potential preservation and restoration techniques that were previously discussed were re-evaluated on site to determine the optimum approach.

SITE DESCRIPTION

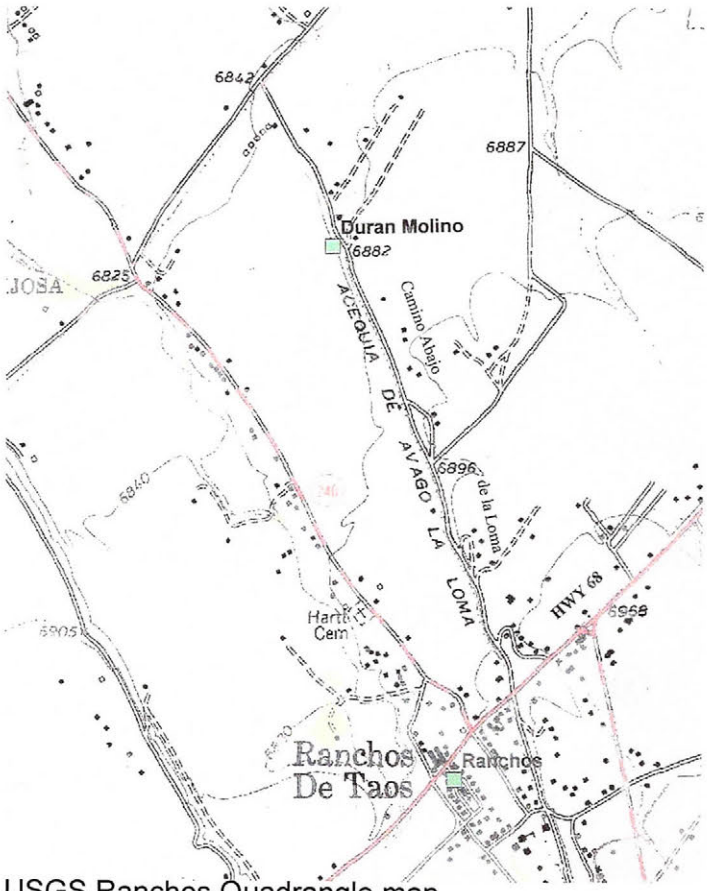
The Molino is located in Ranchos de Taos and can be accessed off of Camino Abajo de la Loma. A schematic drawing of the existing site plan showing the orientation of the structure on the site is provided below for reference. To our knowledge, a survey has never been conducted in the past. The Duran Molino was built next to one of the area's largest acequias, the Acequia Madre del Rio Grande. As indicated in the historical background section, water from the acequia was diverted into a *canoa* which would direct water through a "tunnel" under the structure before exiting through the *desague* and flowing back into a branch of the Acequia Madre. The site generally slopes downhill from Camino Abajo. Based on our site observations, there appears to be some potential grading and drainage issues around the structure which could be contributing to settlement. Druc Engineering recommends re-grading the general site to ensure positive drainage away from the structure and it's foundation system.



Aerial photograph of the site



Schematic existing site plan layout



USGS Ranchos Quadrangle map



Photograph showing the site, from Camino Abajo



Photograph showing the site, from the south



Photograph showing the site, from the southwest



Photograph showing the site, from the west

PHYSICAL DESCRIPTION

The Molino de los Duranes is a flat roofed timber frame structure with cut log walls supported on wood log posts and stone walls and piers. The structure is approximately 321 square feet with a square building footprint of approximately 18'-0" x 18'-0".

The structure is partially bermed into a south facing slope with stone walls laid in a cementitious mortar on the northeast side and partial stone walls on the northeast and northwest sides. There is a central 'stem wall' made up of stone on the interior and wood logs on the exterior that supports a raised floor system. The southwest side of the structure is raised above grade and supported by three wood log posts encased by stone piers which also support the floor system.

The walls are made up of rectangular ponderosa pine wood log members laid on top of each other and lap jointed at the corners. The raised floor is made up of rectangular wood members butted against each other with a previously existing earthen finish floor on top.

The roof is made up of round wood vigas and 2x4 latilla decking. The roofing appears to have been originally an earthen roof which has since been covered with some type of asphalt roofing membrane.

FOUNDATION - EXISTING CONDITIONS

Extensive settlement is present along the southwest side of the Molino. Over the years the southwest facade has settled approximately 16". Due to settlement and other structural deficiencies found during the site visit, Druc Engineering did not conduct any extensive exploration or digging to determine the type or size of footing (if any). Extensive exploration could result in further deterioration and was not warranted at the time.



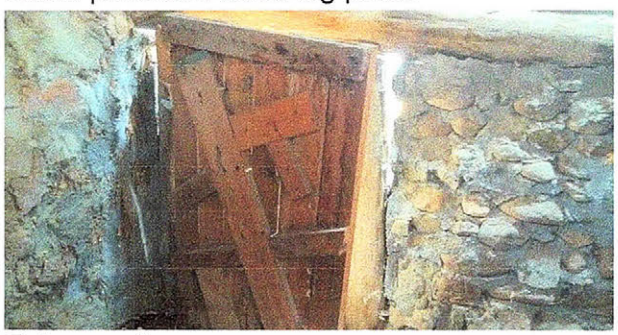
Photo showing extent settlement

Wood log posts were found at all corners of the structure with intermediate posts throughout. The wood log posts may have served as the original piers in the past. It is anticipated that at some point in time, a series of stone walls and/or stone piers were erected around the wood log posts. The stone walls and piers do not appear to be original as they include a mortar made up of some type of cement mixture.



Stone piers and wood log posts

The southwest part of the structure is elevated on three stone piers erected around a series of wood log posts. The stone & wood piers support a wood log beam which in turn supports a wood log floor.



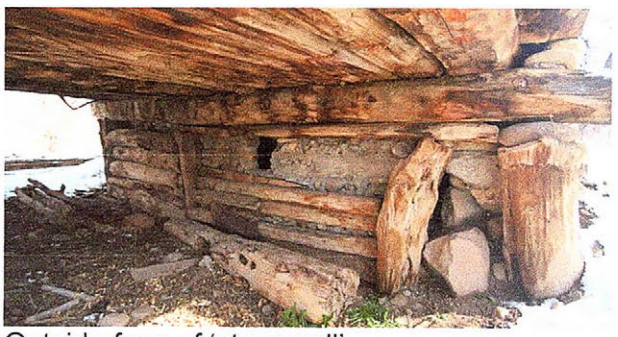
Entrance door

The wood log floor is supported on the opposite side by a stem wall made up of wood logs with some sections of stone and mortar. This wall did show signs of more extensive deterioration. Sections of the wood log members are rotting or have fallen off. The mortar is in poor condition and the wall shows sign of settlement which could lead to potential collapse.



Inside face of 'stem wall'

The northeast half of the structure (approximately 151 sq. ft.) consists of three stone walls with an approximate height of 5'-0" supporting the wood log walls above. An entrance door made of wooden planks is located on the northern corner of the space and is currently not operable due to soil and debris. A ladder at ground level provides access to the adjacent elevated space.



Outside face of 'stem wall'

SETTLEMENT

Least Impact:
Although extensive settlement has taken place throughout the years, there is a possibility that the structure may have reached an equilibrium. However, there is always a chance that further settlement can occur and this can be exacerbated by weather conditions, soil saturation, and the existence or non-existence of a solid effective foundation. An extensive exploration was not performed, and at this time no conclusive determination is assumed. One of the simplest recommendations would be to monitor the structure over a series of 3 to 5 years to determine whether settlement is continuing to occur. This can be accomplished by installing datum points on opposite sides of the structure and shooting and documenting those points through surveying equipment in order to establish the current elevation points. The same points can be re-surveyed in subsequent years to determine if any changes has occurred.

Intermediate Impact:
The existing stone and wood post piers on the southwest side can be underpinned to prevent future settlement and stabilize the structure. This would require shoring and bracing of the wall and floor structure. The existing stone piers would then be shored and properly engineered footings would be installed with new deep founded underpinning helical piers to ensure that future settlement does not occur. The stonework can be repaired as necessary. This solution would ensure that further settlement does not occur. The structure would continue to show visible signs of the previous settlement. In addition to stabilizing the southwest side of the structure, new structural bracing strategies should be installed to keep the structure from racking. ***It was decided that this intermediate option should be employed and proposed drawings are included within the report.***

Most Impact:
Based on our inspection and knowledge of the building condition and joinery, it is our opinion that the structure can carefully and safely be brought back to its original level position. The structure can be slowly raised using hydraulic jacks and steel cribbing techniques. This technique requires shoring and bracing supports for the exterior walls. The structure would need to be inspected periodically through the leveling process to ensure that it was not adversely stressing the structure. The existing wood posts would need to be raised and supported on a new properly designed foundation after the structure is brought back to its original level. The existing stonework (which is not original) would need to be repaired as necessary. This would allow installation of properly engineered footings throughout to prevent future settlement. The stonework would be replaced to conceal the new footing materials.

STEM WALL

The wood log and stone stem wall that is supporting the log floor framing members is in poor condition and we recommend that the wall be repaired. Some of the existing logs have fallen or show signs of deterioration and moisture damage. This wall should be repaired and rebuilt and a new wooden post and footing installed per the proposed drawings. Any logs to be replaced will be required to match the existing historical character of the members and will need to match the logs in size, material, and placement.

FLOOR - EXISTING CONDITIONS

The southwest half of the structure (approximately 170 square feet) is built on a raised floor framing system consisting of log beams generally 12" deep spanning from a stem wall to a log beam on the southwest side supported by the wood log posts and stone piers.

The floor logs are butted against each other and no decking was visibly present during the site visit. The floor logs appear to have been finished with an existing earthen floor. About seventy percent of the earthen floor has been removed or is no longer present.

The wood log flooring system is generally in poor condition. About twenty percent of the wood floor joists are missing. The majority of the floor joists that remain are in poor condition due to moisture and rotting. The northwest portion of the floor joists are very rotted and will require replacement.

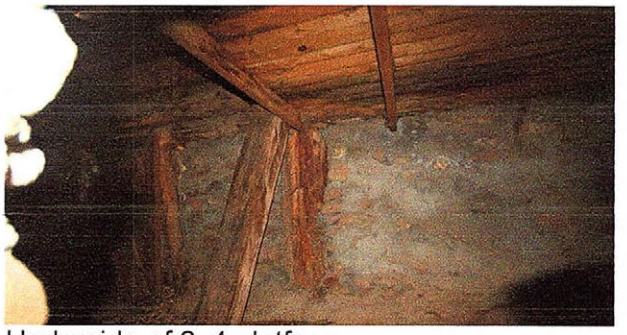
The northeast half of the structure (approximately 151 square feet) has a lower floor made up of undisturbed grade and a ladder at this level provides access to the adjacent elevated space. There is a small 57 square feet platform on the East corner of the space made up of 2x4 framing that was apparently installed around 1970.



Underside of log floor system



Underside of log floor system

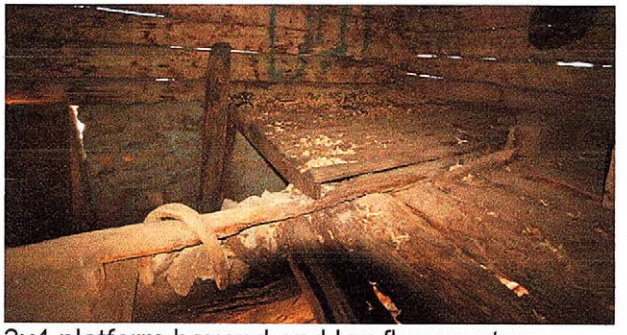


Underside of 2x4 platform

FLOOR - RECOMMENDATIONS

Several floor log members are missing and will need to be replaced. The northwest section of the floor logs are rotting and this entire section should be removed and replaced. Wherever possible the original logs should be preserved for historical purposes, although it may be necessary to replace the majority of the floor logs. Any floor logs which will be replaced will need to match the existing historical character of the members and will need to match the logs in color, size, material, composition, and placement.

As the intent is to re-establish the historic character of the structure, a new earthen floor should be installed over a new moisture resistant barrier. The new earthen floor shall be approximately 3" in depth and tamped and sealed with linseed oil as necessary to match the original flooring system.



2x4 platform beyond and log floor system



2x4 platform

WALLS - EXISTING CONDITIONS

The existing Molino structure is roughly 321 square feet, with a building footprint of approximately 18'-0" x 18'-0". The walls are neither plumb nor level and each facade dimension varies.

The height of the structure from grade varies and ranges between 9'-6" and 12'-0" in height. The northeast half of the structure has a full ceiling height of almost 12'-0" with stone walls on three sides approximately 5'-0" in height with wood logs above.

The walls of the Molino consist of 7" to 8" wide rectangular cut wood log members varying in depth from 8" to 15". The rectangular wood log members are laid on top of each other and lap jointed at the corners.

The wood log walls are generally in fair condition, however approximately ten to twenty percent of the members show signs of deficiencies on the exterior. The interior of the members do not show extensive signs of decay as they have generally been protected from the elements. However, the compromised roof has allowed moisture to enter and it is anticipated that the interior of the walls may begin to show signs of decay if repairs are not performed.

The log members on the northeast facade are showing the majority of the decay and show varying signs of potential moisture problems. Some members have extensive dry rot while some have moss growing on the members or show other signs of saturation over the years. The log members located at the top of the structure are in the worst condition. Some of these members will require replacement.



View of interior side of wall logs



View of typical wall logs from the exterior



Log members near top of structure



Typical lap joints at corners



Visible decay on wall logs

WALLS - RECOMMENDATIONS

Approximately ten to twenty percent of the wood log walls are experiencing more extensive signs of decay and rotting. Existing building elevations have been provided which identify the particular problem areas.

Treatment of the compromised wood members will include the use of some form of wood preservative. A form of borate treatment will likely be the preferred option as borate treatments are colorless, odorless, and have very low toxicity. Borate treatments can be applied as liquids, pastes, gels, and rods. A major limitation of in-place treatments is that they cannot be forced deep into the wood. However, they can be applied into the center of large members via treatment holes. The final decision on which type of treatment and how it should be applied will vary depending on the condition and the member itself. It may ultimately be decided that certain treatment options may not be justified even after treatment has been recommended due to the historic character of the building.

There are areas where extensive decay has occurred and wood preservation treatments would not be a sufficient solution. At these areas, it is necessary to completely remove the problematic sections of the log members and replace these sections with new wood using a dutchman splice or other approved technique. Where extreme decay has occurred throughout a log member, the splice solution may not be an option and the entire log member will need to be replaced. Any wall logs which will be replaced will need to match the existing historical character of the members and will need to match the logs in color, size, material, composition, and placement. It may be beneficial to seal the wood walls with an appropriate product to prevent future decay of wood members.

We recommend a maintenance plan be employed to properly maintain the structure over the years. A maintenance plan is necessary to ensure that the structure does not fall back into decay after repairs have been completed. Due to the varying deficiencies found throughout the wood members, we recommend a multi-faceted approach. The following is a list of recommended treatment options based on particular issues found.

1. Natural aging and weathering: Seal all wood members with non-toxic water repellent preservative or commercially available water repellent preservative finish such as 'X-100 Natural Seal' or approved equal.
2. Termite, insect or fungi infestation: Treat affected wood members with "Bora-Care" or approved equal.
3. Wood decay/dry rot: Treat affected areas with a fluid borate injection product such as "Jecta" or approved equal. Where applicable, treat affected areas with borate rods such as "Cobra rods" or approved equal.
4. Medium to extensive wood decay: Repair damaged areas with Con Serv (T) Flexible Consolidant 100" or "Con Serv (T) Flexible Patch 200" or approved equal.
5. Extensive wood decay: Selectively replace damaged areas with new wood to match using splicing techniques and epoxy adhesive and fiberglass reinforcing rods.
6. Compromised wood members: Where wood members are compromised due to severe decay, members shall be removed and replaced.

No matter what the treatment option being followed is, chemical or physical treatments, if determined to be appropriate, must use the gentlest means possible. See Appendix F for technical specifications, notes, and briefings, as well as product information.

ROOF - EXISTING CONDITIONS

The existing roof structure consists of 8" to 10" diameter wood vigas spaced at approximately 32" on center. The vigas span a full 18 feet with viga ends extending to the exterior. The vigas are in very poor condition. The northern viga member has collapsed and is currently being shored. The center viga is missing and had already collapsed. The remaining vigas are rotting and are also on the verge of failure. The ceiling is made up of 2x4 latilla decking on top of the vigas. Approximately ninety percent of the latilla decking is damaged and is caving in and nearing failure.

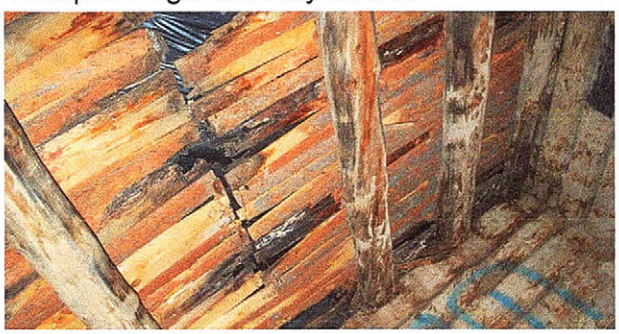
The roof is currently being covered by a sheet of black plastic to temporarily protect the structure. We were able to pull back the plastic and determine that the roofing membrane is some form of asphalt rolled roofing. It is unknown what type of roofing was originally installed. The roll roofing has delaminated from the wood log 'parapets' and there are holes and gaps present along the wall/roof joint. We were unable to remove the entire plastic at the time to determine the extent of roof damage. However, it was clear that the roof membrane is severely compromised and that the entire roof structure is in critical condition and needs to be rebuilt.



View of ceiling



Collapsed viga currently shored



Missing viga

ROOF- RECOMMENDATIONS

The roof system is in need of immediate repair. The roof is severely compromised and is a safety concern. The entire roof should be removed and rebuilt with new appropriate viga roof joists, latilla decking, roofing membrane, and improved waterproofing strategies.

Any roofing members (i.e. vigas and decking) will need to match the existing historical character of the members and will need to match the members in texture, color, size, material, composition, and placement.

As the intent is to re-establish the historic character of the structure, an earthen roof should be installed. The new earthen roof should be installed over a fully adhered 90mm EPDM roofing membrane. Note that if desired, other options are available to give the appearance of an earthen roof.



Viga extensions in decay



Roofing membrane has separated

APPENDIX A

Application for Registration
New Mexico State Register of Cultural Properties

SR- 405

MOLINO DE LOS DURANES

APPLICATION FOR REGISTRATION
NEW MEXICO STATE REGISTER OF CULTURAL PROPERTIES
STATE PLANNING OFFICE, SANTA FE

FORM A

1. Name of Property: Molino de los Duranes

2. Location of Property: On south bank of Acequia Madre del Rio Grande Chiquito, along Middle Cordillera Road - 9/10 mile west-northwest from junction of above ditch and road with U.S. Highway 64, Taos to Santa Fe; said junction being near center of Village of Ranchos de Taos as shown on accompanying map.

3. Nature of Property:
Building(s) (x) District or Area ( ) Object ( ) Other ( )
Description and present condition. Early day water powered flour and grist mill previously used to make harina de trigo, harina de maiz concho, maiz azul, harina de panocha y de semita; for bread baked on outside earthen ovens. The remains of this mill are presently a log building about 24 feet long, 14 feet wide and 8 feet high in a poor state of repair. Mill race is still plainly visible but water wheel and grinding stones are missing. Original grinding stones are, however, available for reconstruction of the mill.

4. Owner, name and address: Owned by members of the Duran family whose representative is Mrs. Telesforo Duran Velarde, Ranchos de Taos, New Mexico. 87557

5. Present use of Property: No use is presently being made of the property other than grazing the surrounding area.

6. Has property been:
a. listed in a municipal or other register? Yes ( ) No (x)
b. plaqued or otherwise designated as worthy of preservation? Yes ( ) No (x)
c. recorded in the Historic American Buildings Survey? Yes ( ) No (x)
If any of above questions answered, yes, give details.
Property has not knowingly been listed, plaqued or recorded in any way.

7. Name and address of organization or individual submitting this application:

Taos County Historical Society
P.O. Box 398
Taos, New Mexico 87571

8. Tell why property is important. List documentary sources, etc.

The Taos County Historical Society has quite carefully selected this property as being typical or representative of the old mills and fields responsible for the Taos Valley being known as the bread basket of the west over a period of many years. Corn has been a staple food in the southwest and was ground into meal by Indian women for centuries using hand operated stones; namely, the mano and metate. This method of grinding food was improved upon by the Spanish settlers when they introduced the use of water power and circular mill stones, of which this property is an excellent example. The owners of the property appear to be very cooperative and have expressed a desire to restore the mill in its entirety. The mill was built about 1850 and was abandoned in 1928. Documentation on this property has been done by Jacob M. Bernal, Ranchos de Taos, material obtained from Mrs. Telesforo Duran Velarde and other members of the Duran Family.

9. Names and addresses of persons preparing this application material:

(a) Inventory data by Jacob M. Bernal and Ernest Lyckman — Date: February 13, 1969

(b) Recent photograph by Helen G. Blumenschein — Date: December, 1968

(c) Recent map by Ernest Lyckman as shown on accompanying New Mexico Highway Dept. map, — Date: February, 1969

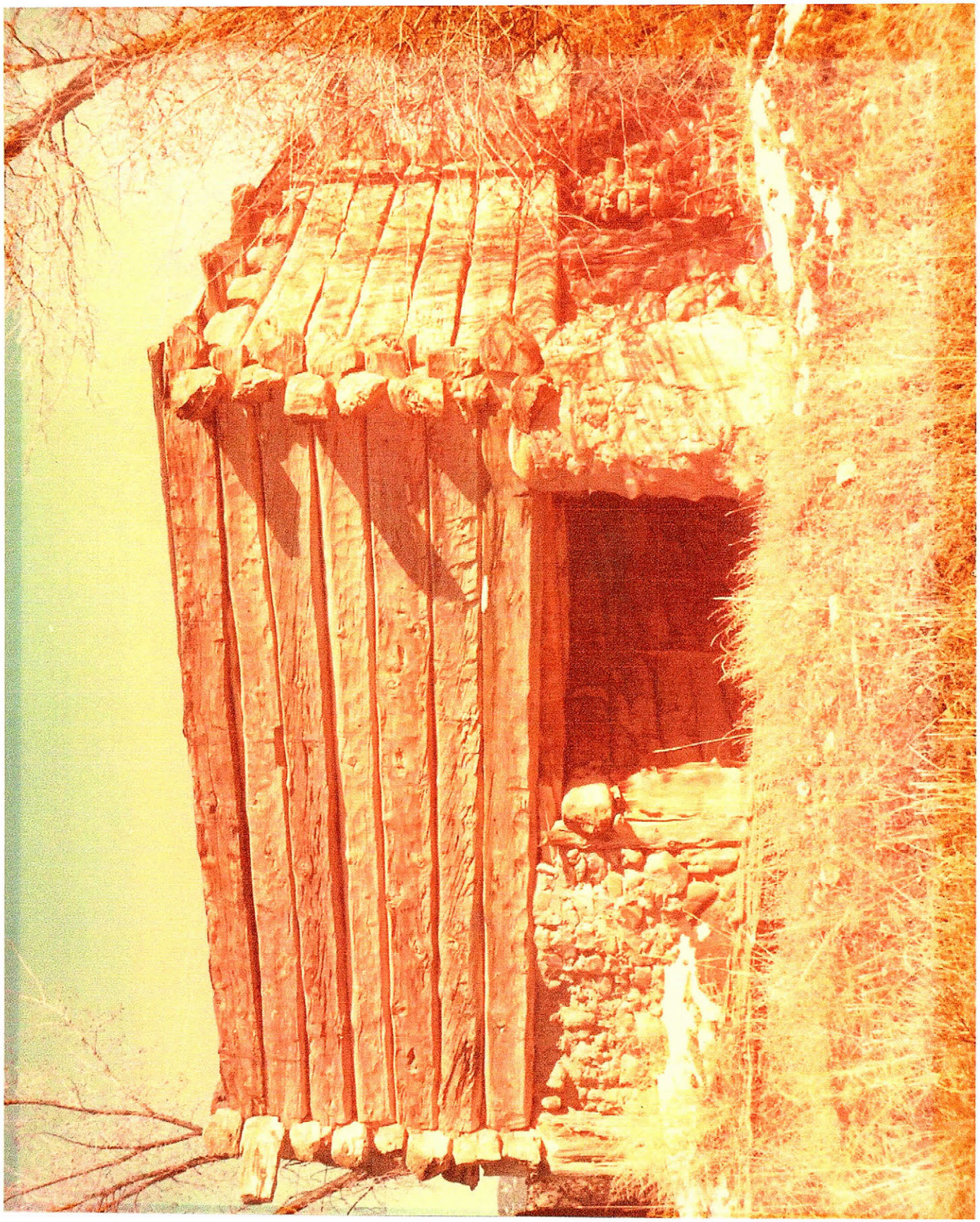
---------- SPACE BELOW FOR PLANNING OFFICE USE ----------

Date Form A received _____ Initial application complete ( ) Incomplete( )

Action of Review Committee and date _____

Date applicant advised of Committee action _____

Nominated to National Register Yes ( ) Date _____ No ( ).



MOLINO DE LOS DURANES RANCHOS DE TAOS, NM

APPENDIX B

Dr. Ron Towner Report
Arizona Tree Ring Laboratory

Laboratory of Tree-Ring Research
104 W. Stadium
The University of Arizona
Tucson, AZ 85721

15 November 2013
Mr. Tom Windes
305 Richmond SE
Albuquerque, NM 87106

Dear Tom:

At long last, enclosed are the results from our analysis of A-1979, samples from the Anabelle Velarde Molino place near Taos. Enclosed are the date list and work notes.

All 47 samples we analyzed have been catalogued into our permanent collection.

These dates almost—but not quite—conform to Rick Ahlstrom's "perfect" date distribution! As you can see, almost everything dates to 1879, with a couple of notable exceptions: the 1839v date (TNM-513), the 1880 dates (TNM-529 & 531) from the Tunnel, and the two 1970 dates (TNM-547 & 549) from the 2nd story roof. My only comment would be it looks like a Summer/Fall 1879 construction—most of the ponderosas were still growing, but two (TNM-504 & 508) have complete terminal rings; the complete terminal ring on TNM-532 suggests it is a stockpiled timber used in the Tunnel a year later.

If you have any questions, feel free to contact me at 520-621-6465 or rtowner@ltrr.arizona.edu

Thank you,

Sincerely,

Ronald H. Towner, Ph.D.
Associate Professor of Dendrochronology and Anthropology
Agnese and Emil Haury Endowed Chair in Archaeological Dendrochronology
Laboratory of Tree-Ring Research and School of Anthropology
The University of Arizona
Tucson, AZ 85721

Table . Tree-ring dates (n=37) from the Annabelle Velarde molino, Rancho de Taos, NM.

Location/use	FS #	TRL# TNM-	Species[a]	Age / Size (max.dia./cm)	Outer ring condition[b]	Inside date[c]	Outside date[c,d]
South wall, wall log 2nd from bottom	25	513	PP	52 / 19.3x31.6	Complete	1788 p	**1839 v**
East wall, wall log bottom	1	503	PP*	246 / 20.4x31.8		1628 np	**1873 ++vv** r
North wall, wall log 4th from bottom	11	507	PP	164 / 23.4x24.4		1715 p	**1878 vv** r
South wall, wall log 2nd from bottom	24	512	PP	216 / 20.3x33.8		1663	**1878 vv**
S wall-to-center wall, floor log 5th from west side	43	521	PP	234 / 19.5		1645 p	**1878 vv** r
East-to-west walls, floor joist south	62	526	PP	198 / 25.9		1681 np	**1878 vv** r
East-to-west walls, floor joist north	63	527	PP	262 / 31.5		1617 np	**1878 vv** rG
North tunnel wall (W½), wall log 3rd from top	76	534	PP	202 / 24.0		1677 p	**1878 vv** r
North wall (W½), post west	82	536	Jun	123 / 17.2		1757 p	**1879 +vv** vG
East wall, wall log 2nd from top	6	505	PP	161 / 18.0x27.0		1719 np	**1879 vv** r
South wall, wall log 3rd from top	27	515	PP	238 / 19.5x28.4		1642 np	**1879 vv** v
S wall-to-center wall, floor log west end	39	520	PP	170 / 24.4	Incomplete	1710 np	**1879 vv** r
S wall-to-center wall, floor log 17th from west end	55	523	PP	104 / 25.4		1776 np	**1879 vv** r
S wall-to-center wall, floor log 18th from west end	56	524	PP	184 / 26.5		1696 np	**1879 vv** r
S wall-to-center wall, floor log 20th from west side	58	525	PP	148 / 18.3		1732 ±p	**1879 vv** r
North tunnel wall (W½), wall log 2nd from tog	75	533	PP	175 / 25.0		1705 p	**1879 vv** r
North tunnel wall (W½), wall log 4th from top	77	535	PP	88 / 21.5		1792 np	**1879 vv** r
Interior, ladder pole west	106	543	PP	217 / 21.8		1663 p	**1879 vv** r
Interior, ladder step bottom	107	544	PP	109 / 10.1x17.3		1771 p	**1879 vv** r
Interior, ladder step 3rd up	109	545	PP	180 / 16.0x23.8		1700 np	**1879 vv** r
East wall, wall log 3rd from top	5	504	PP	217 / 19.0x28.4	Complete	1663	**1879 +v** r
North wall, wall log top	14	508	PP	209 / 20.3x29.4		1671 p	**1879 +v** r
North tunnel wall	74	532	PP	58 / 9.5x16.0	Complete	1822 p	**1879 +v** r

North tunnel wall (W½), wall log top, loose	74	532	PP	58 / 9.5x16.0	Complete	1822 p	**1879 +v r**
North wall, wall log bottom	8	506	PP	208 / 23.2x25.5	Incomplete	1672	**1879 v r**
West wall, wall log 3rd from bottom	18	509	PP	217 / 20.3x34.7	Incomplete	1663 fp	**1879 v r**
West wall, wall log 4th from bottom	19	510	PP	204 / 20.7x33.9	Incomplete	1676 np	**1879 v r**
West wall, wall log 5th from bottom	20	511	PP	134 / 21.2x29.4	Incomplete	1746 p	**1879 v r**
South wall, wall log 2nd from bottom	29	516	PP	79 / 21.3x26.4	--	1801 fp	**1879 v rL**
N/S walls, roof viga east side	32	517	PP	110 / 19.8x26.4	--	1770 ±p	**1879 v r**
N/S walls, roof viga 2nd from east	33	518	PP	181 / 21.0x22.0	Incomplete	1699 np	**1879 v v/r**
N/S walls, roof viga west side	36	519	PP	118 / 26.0x32.5	Incomplete	1762 np	**1879 v r**
S wall-to-center wall, floor log 11th from west	49	522	PP	108 / 12.4x16.0	Incomplete	1772 p	**1879 v r**
Interior, ladder pole east	105	542	PP	154 / 18.0	Incomplete	1726 ± np	**1879 v r**
North tunnel wall (E½), wall log 4th from top	67	529	PP	47 / 12.5	Incomplete	1834 p	**1880 +B**
North tunnel wall (E½), wall log 6th from top	69	531	PP	45 / 13.0	Complete	1836	**1880 +B**
Roof board	130	547	PP	110 /	Complete	1861 ± fp	**1970 v rB**
Roof board	132	549	PP	79 /	Complete	1912 ± fp	**1970 +B**

Notes:

[a] **Species** = Douglas-fir or unidentified spruce/fir.

[b] **Outer ring condition** = **Complete** ring indicates tree death during non-growing season (late fall-winter-early spring). **Incomplete** ring = indicates tree death during growing season (i.e., late spring-summer-early fall). Growing seasons vary by species.

[c] **Date subscripts** are author's inner and outer ring field observations ***if*** they differ from the laboratory analysis.

[d] **Outside dates** in **bold** are tree death date or near death date (when cut).

FS #= Field Speciman number; TRL # = Tree-ring Laboratory number, New Mexico Quadrant T (TNM).

Diameters have not yet been recorded.

Table 6.3. List of tree-ring symbols and abbreviations.[a]

Sample type:

¼, ½, e, f, 1-inch = core sample diameters.

cc = charcoal (specimen is carbonized)
frag = fragment (broken or rotted piece)
V-cut = sample taken as a V-cut in side of element
wedge = sample is a wedge-shaped cutting from side or end of element.
xs = cross-cut sample, often resulting in a complete cross section of element. Provides analyst with the best sample possible.

Species:

DF = Douglas-fir
Jun = juniper
Pnn = piñon
PP = ponderosa pine
SF = spruce or fir
Pop = *Populus* sp. (aspen or cottonwood)
non-conf = non-coniferous

Ring condition:

Complacent = Little patterning is evident in the sample so that dating is difficult if not impossible. Common among trees with a plentiful precipitation supply (e.g., cottonwood and high-altitude conifers).

Compressed = Outer rings are so narrow that distinguishing patterning or the absence of rings is not possible. In dated samples, a "++" symbol would be used. This commonly indicates that the element was deadwood when collected.

Erratic = Ring growth is erratic and difficult to match patterning for dating purposes. Common for juniper growth and may include partial, double, or missing rings.

Missing rings = Two or more growth rings are absent, which can be attributed to erratic growth and/or to drought conditions.

Short = The number of rings is too few to adequately date and cross reference. Usually less than 30–50 rings.

Terminal Ring:

I = Incomplete outer ring (tree died during growing season). Growing season varies by species and area.

C = Complete outer ring (tree died during dormant season). Dormant season varies by species and area.

Date symbols for the inside date: Field observation by author noted in a subscript.

p = pith present

np = near actual pith (old usage).

fp = far from actual pith (old usage).

∀p = pith ring is present but because of the difficult nature of the specimen, an exact date cannot be assigned to it (common among juniper specimens).

∀ = the innermost ring is not the pith ring and an absolute date cannot be assigned to it. A ring count is involved.

Date symbols for the outside date: Field observation by author noted in a subscript.

+ = Cannot be dated with certainty because one to five outer rings may be missing.

++ = The outermost rings of a sample cannot be dated. Typically, the rings are uniformly small, making it impossible to recognize patterning in ring widths or to identify missing rings. This pattern reflects very slow growth and is the mark of a dying tree. Dates with this symbol are considered derived from deadwood.

vv = Definite evidence for a cutting/death date is absent and it is unknown how many outer rings have been lost.

v = A subjective judgment that the outer ring is at or is within 1-5 years of the actual tree death date. Typically considered a death or near death date, but weakest in confidence.

r = Less than a full section is present but the outermost ring is continuous around the available circumference. Considered a death date, but more confident than above.

c = The outermost ring is continuous around the entire circumference. Considered a death date but more confident than above.

L = A characteristic surface patination and smoothness, which develops just under the bark, is present. Considered a confident death date.

G = Beetle galleries are present on the surface of the specimen. Considered a death date of greater confidence than above.

B = Bark is present. Considered the strongest affirmation of the actual death date, unless a "+" or "++" is also present for this symbol or those above.

---

[a] Symbols after Ahlstrom (1985) and Windes and McKenna (2001).

APPENDIX C

Dr. Windes' Documentation



FIGURE 1



FIGURE 1 (continued)



FIGURE 1 (continued)



FIGURE 2

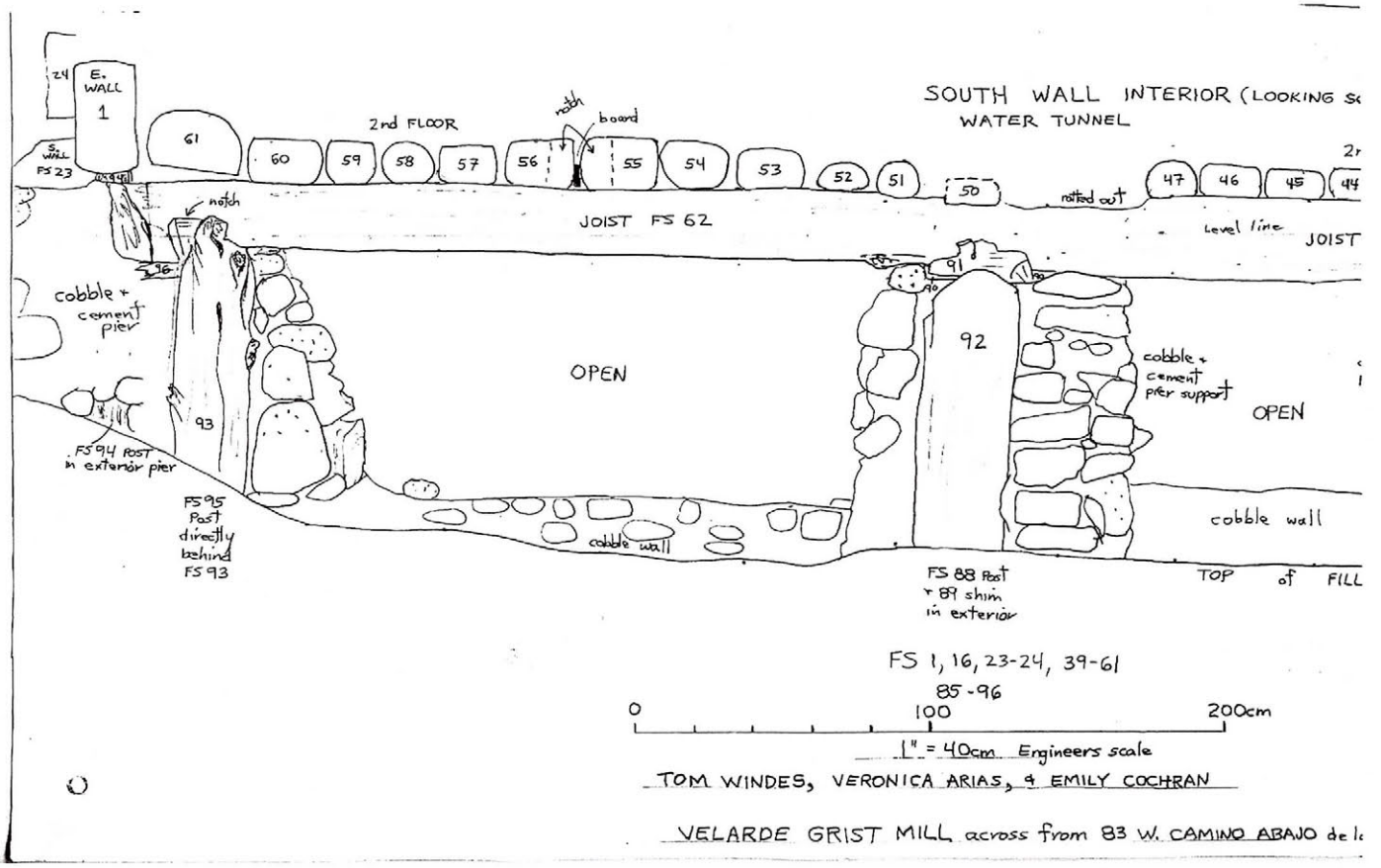


FIGURE 3

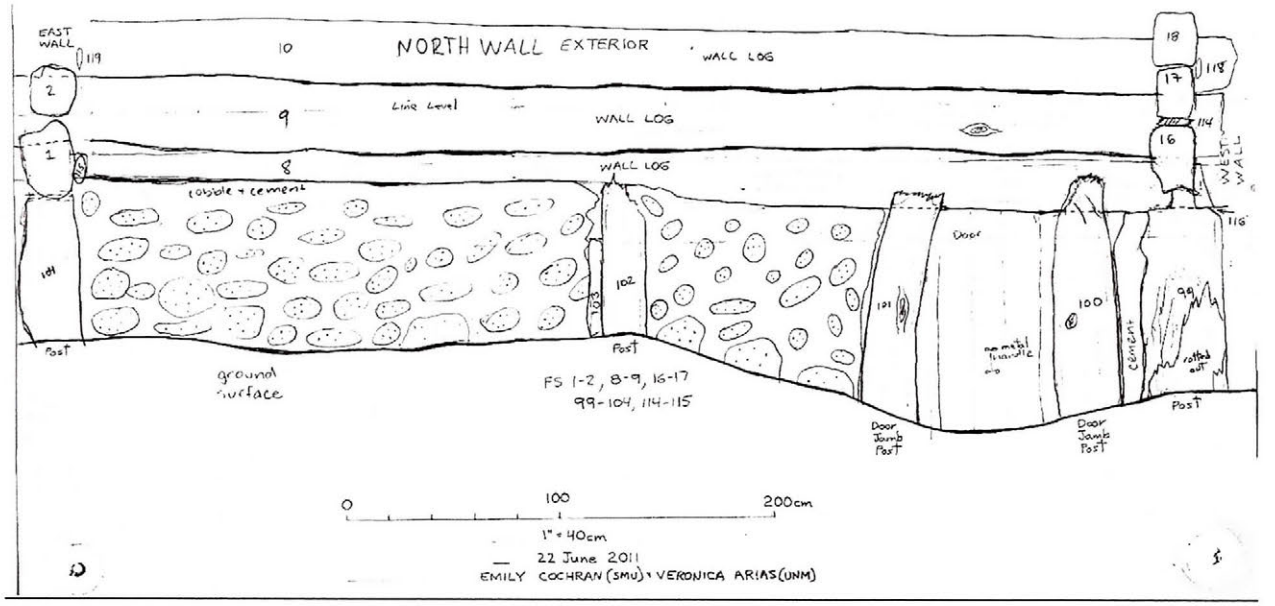


FIGURE 4

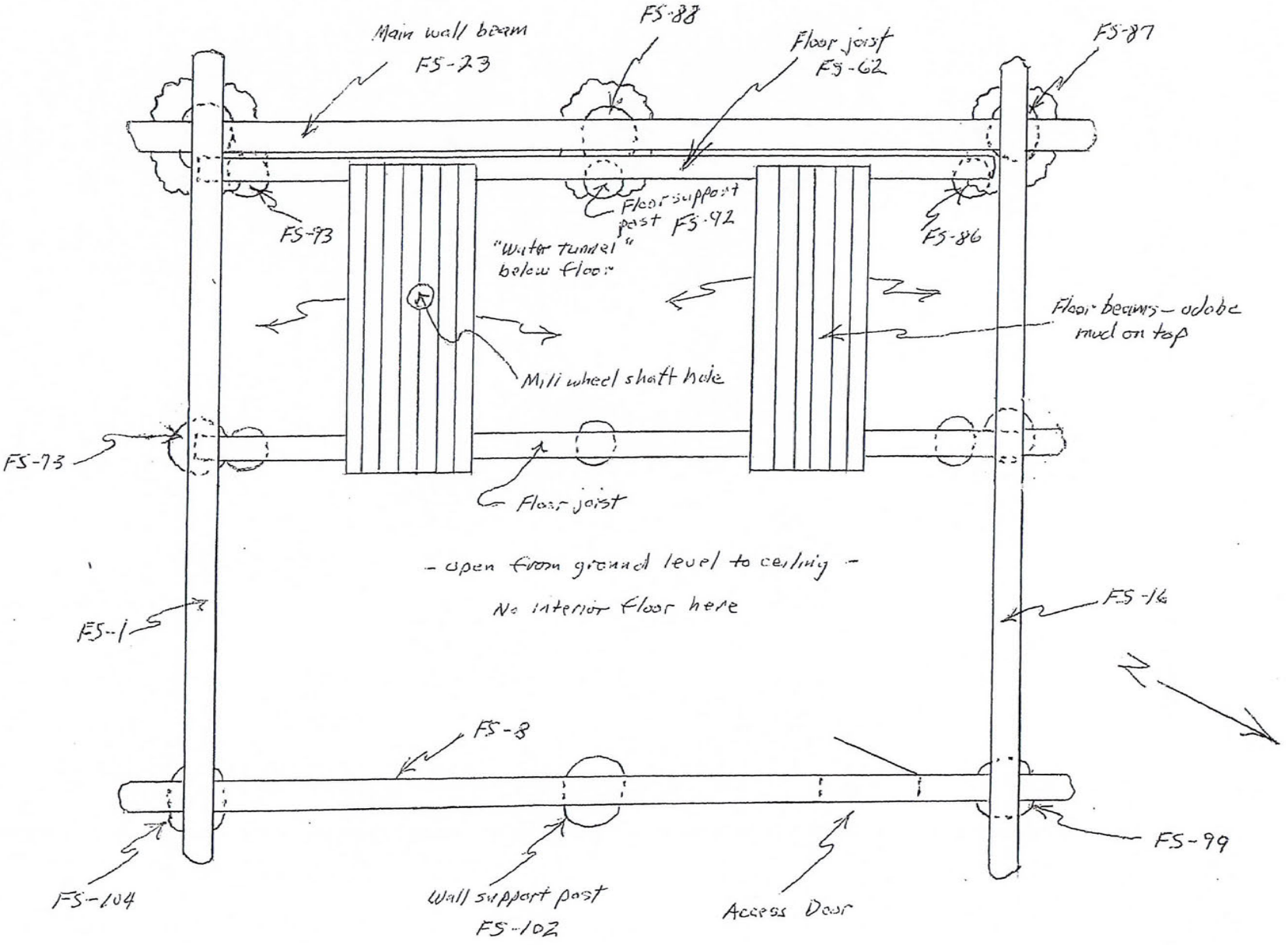
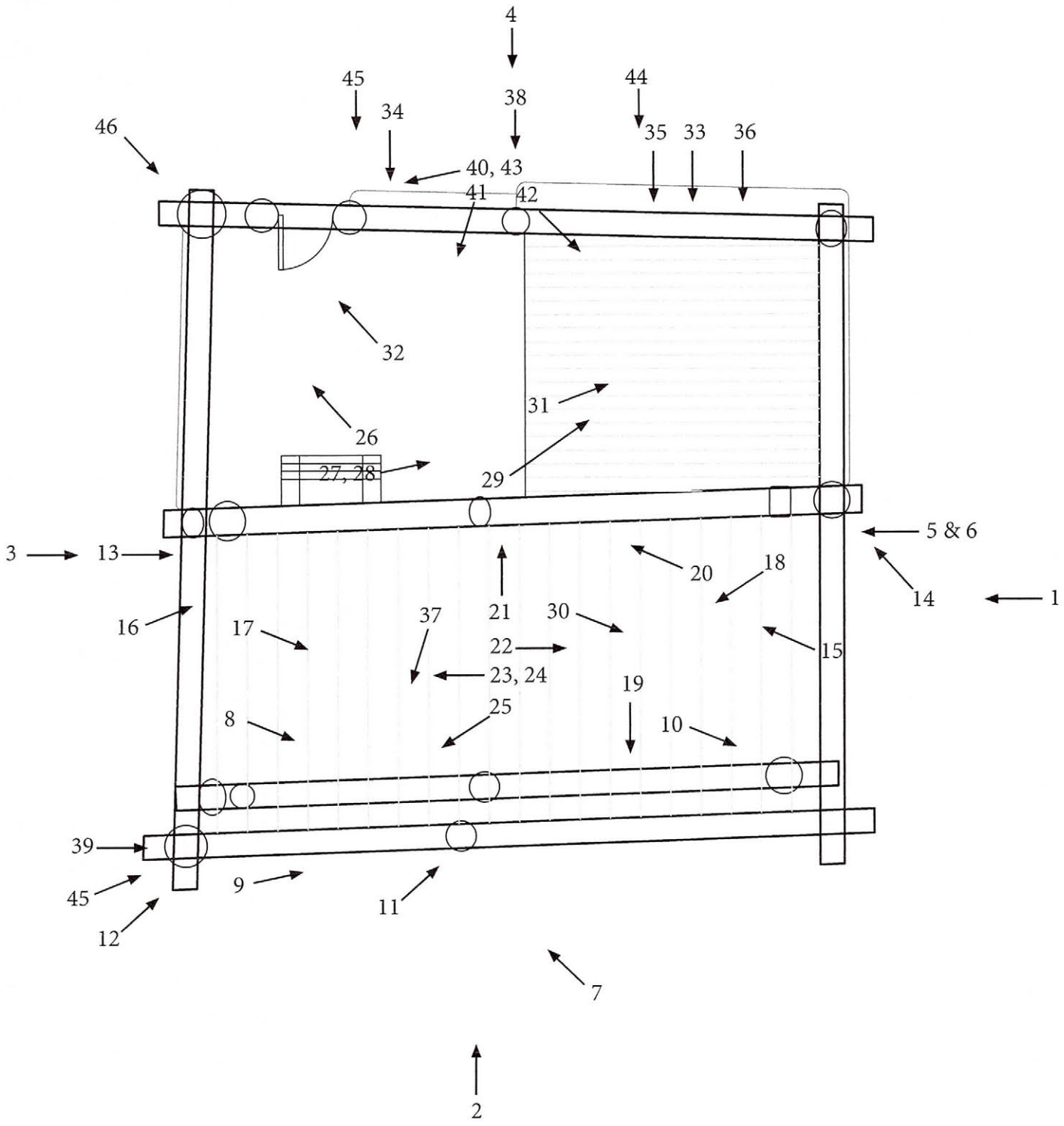

Main wall beam
FS-23
FS-88
Floor joist
FS-62
FS-87
FS-93
Floor support post FS-92
"Water tunnel" below floor
FS-86
Floor beams – adobe mud on top
Mill wheel shaft hole
FS-73
Floor joist
– open from ground level to ceiling –
No interior floor here
FS-1
FS-16
FS-8
FS-99
FS-104
Wall support post
FS-102
Access Door

FIGURE 5

APPENDIX D

Photographs



KEYED PHOTOGRAPH FLOOR PLAN

SCALE: ¼"=1'-0"

N

NOTE: Plan shows approximate location where photos were taken and may differ slightly.



1. Photo of southeast elevation of Molino. The road is located to the right. Water which turned the grinding wheel entered from this location.



2. Photo of southwest elevation of Molino. The road is located to the northeast, or the right of the photo. It is not known when the stone pillars were built and repaired.



3. Photo of northwest elevation of Molino. The road is located to the northeast or the left of the photo. The water stream exited the Molino on this side.



4. Photo of northeast elevation of Molino. The photo is taken from the road looking southwest. The most serious deterioration to the wood walls is present on this side.



5. This is the southeast elevation which slopes toward the southwest at about 1" per foot approximately 16" total. The yellow level is held level and it is apparent that the wall logs have shifted.



6. Close-up view of level.



7. Photo of stone pillars at southwest side. It is unclear at this time when the stone pillars were built and when repairs were made.



8. Photo of all three stone pillars and the wood beam sitting on wooden posts. Shoring was added to prevent total collapse of the roof structure.



9. Photo of stone foundation tie between stone pillars. 1990 photos show higher stone walls at these locations, up to 1'-6" high.



10. Photo of south corner stone pillar and wood posts.



11. Photo of intermediate stone pillar and wood posts.



12. Photo of West corner stone pillar and wood post.



13. Photo of northwest stone wall and post connection.



14. Photo of southeast stone wall and double post corner condition.



15. Photo of stone and log wall foundation looking north.



16. Photo of stone and log wall foundation looking from the West.



17. Photo of temporary shoring and stone pillars beyond.



18. Photo showing bottom of log flooring system and damage. Logs are in various states of decay.



19. Close-up photo of southwest beam and log flooring system.



20. Close-up photo of beam at northeast stone & log wall.



21. Panoramic view of interior, looking towards northeast wall showing extensive roof damage to the vigas and to the decking.



22. Panoramic view of interior, looking towards southeast wall.



23. Panoramic view of interior, looking towards northwest wall. Notice the twisted failed viga.



24. View of damaged viga and gaps in log wall beyond.



25. View of damaged viga and temporary shoring.



26. Photo of damaged roofing at north corner of ceiling.



27. View of missing viga at center of ceiling space.



28. Close-up view of missing viga and damaged roofing members. Currently the structure is prevented from exposure to excessive moisture by plastic sheeting.



29. View of platform on east corner of interior space.



30. View of platform on south corner of interior space.



31. Close-up view platform.



32. Photo of existing doorway on northeast of building. Door is inoperable due to surrounding soil and debris.



33. Close-up view of moss growing on log members. This is accelerating the decay and deterioration of the structure.



34. Close-up view of deterioration visible on log members. The level of deterioration varies from minimal to extensive.



35. Close-up view of severe deterioration visible on log members.



36. Close-up view of deterioration visible on log members. If the deterioration is too severe a member may need to be replaced.



37. Close-up view of deterioration visible on log members.



38. Close-up view of deterioration visible at top members and missing viga.



39. Close-up view of deterioration visible at the end of a log member.



40. Close-up view of top of viga members. When snow and rain are able to stand on top of a member it causes severe deterioration.



41. Close-up view of existing roofing.



42. Close-up view of existing roofing.



43. Overall view of roofing and vigas on northeast side of building.



44. View existing roofing.



45. View existing roofing.



45. Photo showing typical joint connections at corners.



46. Photo showing typical joint connections at corners and varying extensions.



47. Close-up view of typical joint connections at corners.

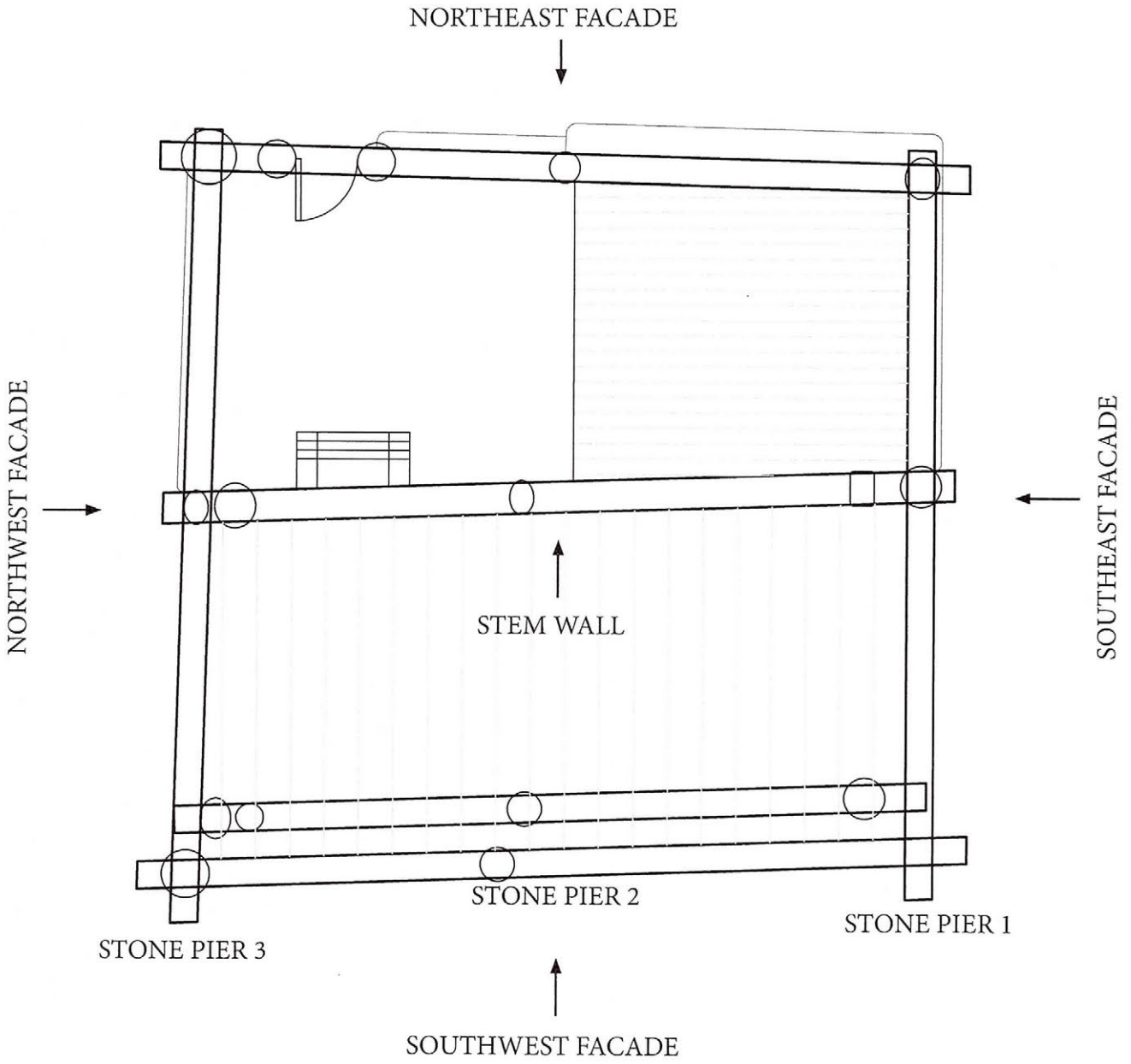


48. Close-up view of typical joint connections at corners.

APPENDIX E

Photographs
Detailed shots

The following photographs are detailed shots of various components of the structure. Each of the building's facades were photographed to document the wood log wall members. Each series of photos starts at the bottom left of each facade and pans right and then left across each wood member, starting from the bottom member to the top member. Note that some members were not photographed. The stem wall was also photographed, panning from northeast corner to southeast corner. Each of the stone piers were photographed to create a 360 view of each of the piers and are identified in the plan below.

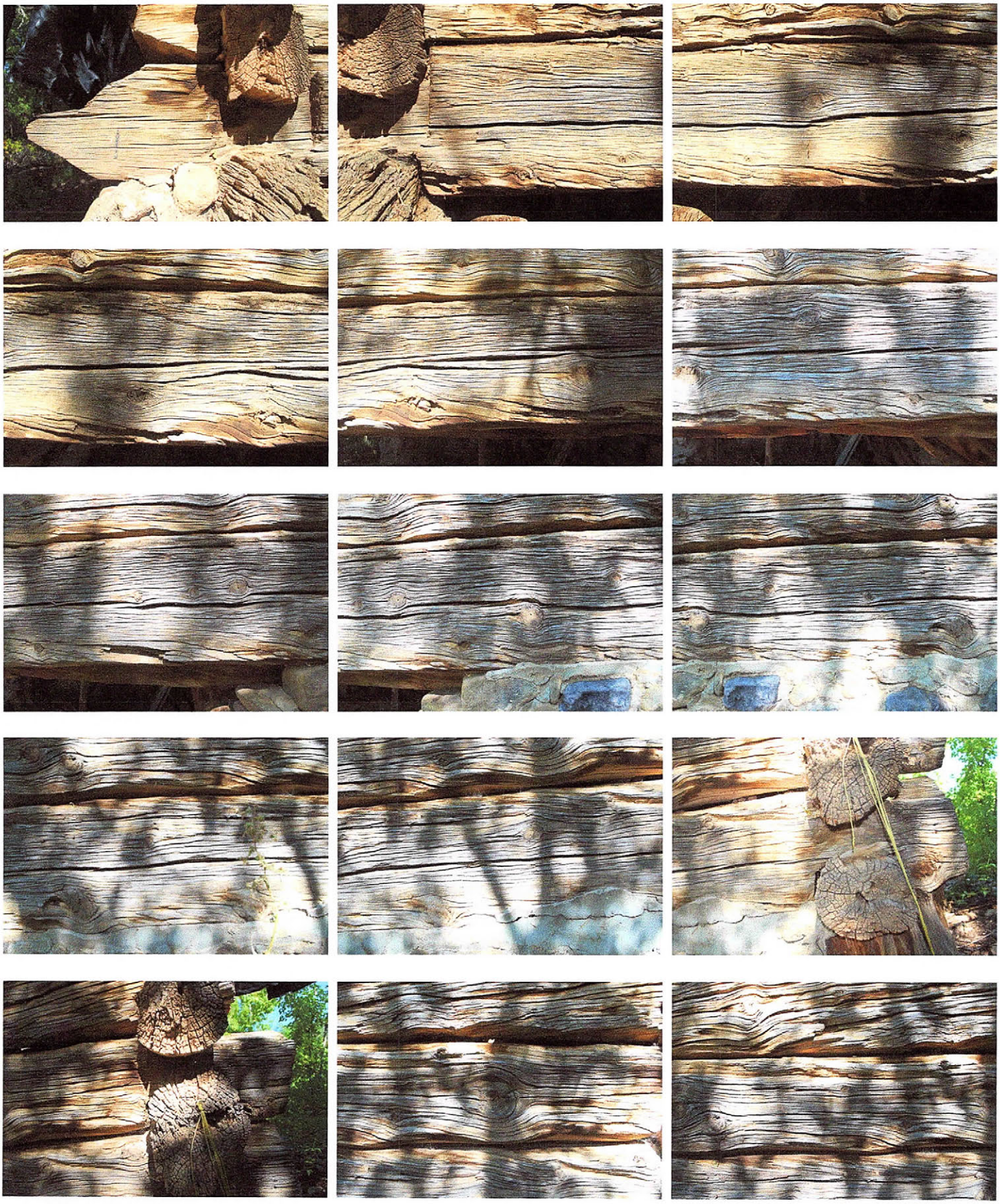


KEYED PHOTOGRAPH FLOOR PLAN

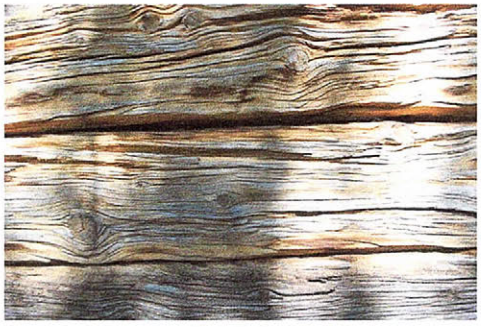
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SOUTHEAST FACADE











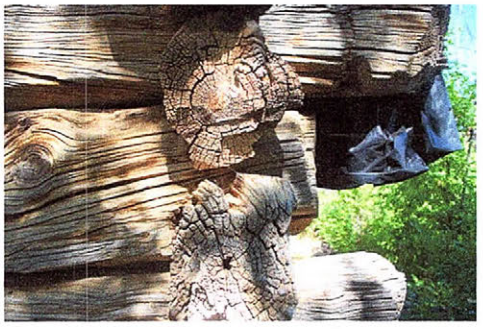








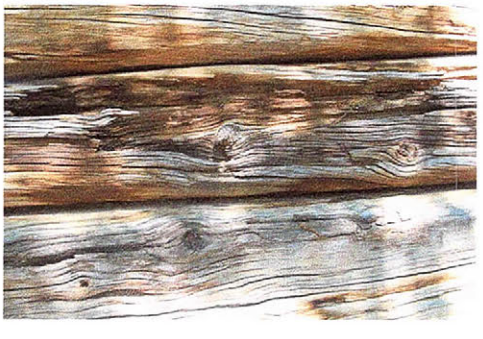
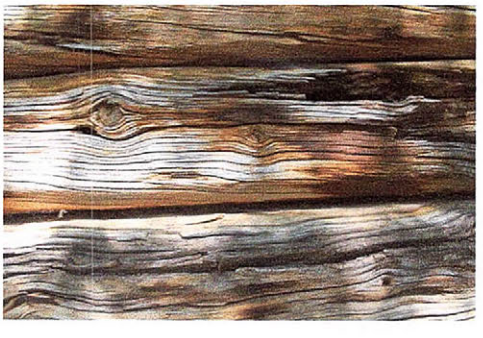


















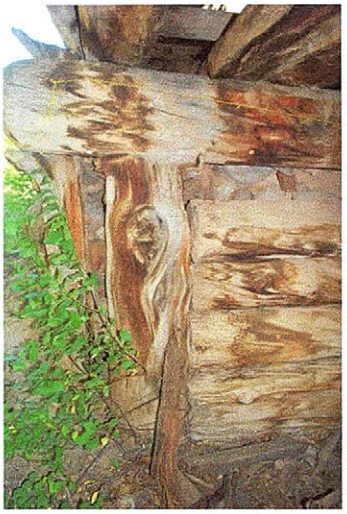
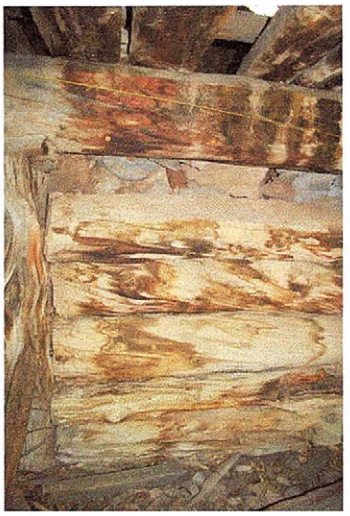
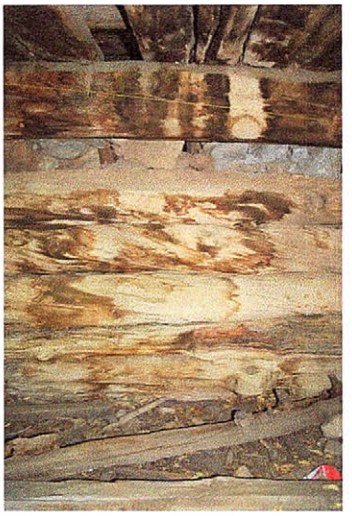
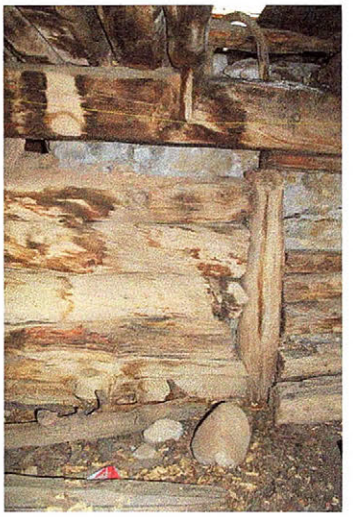


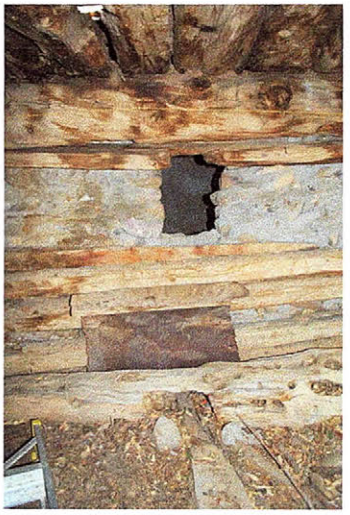






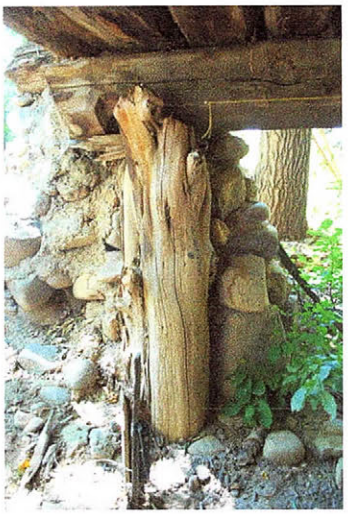
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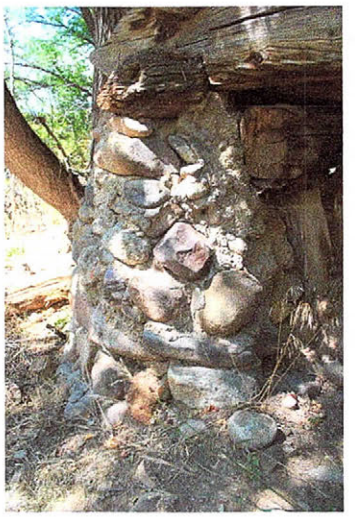





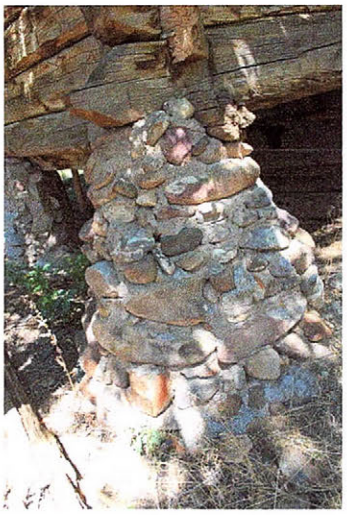
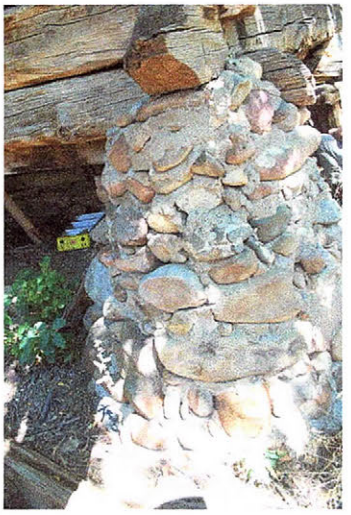
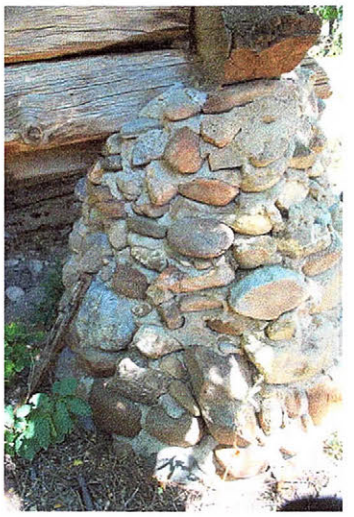
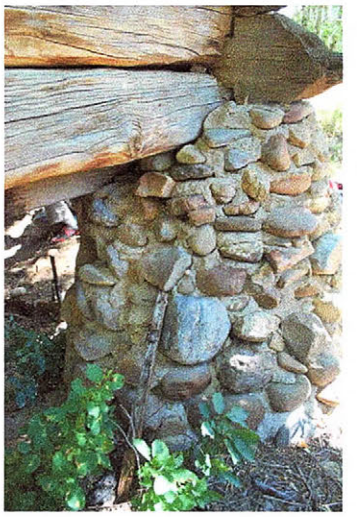
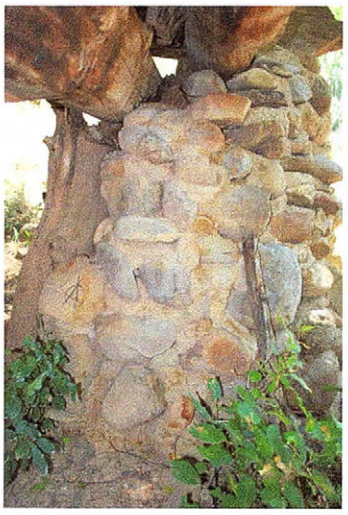
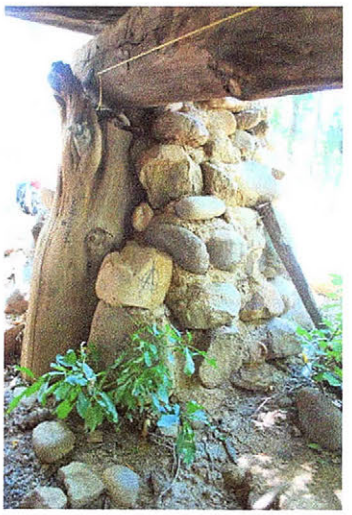
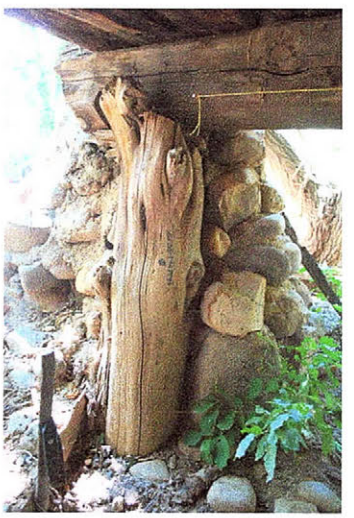




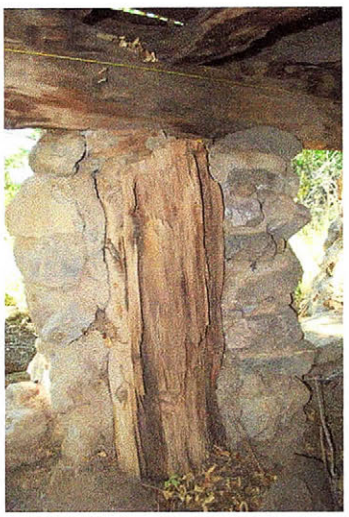
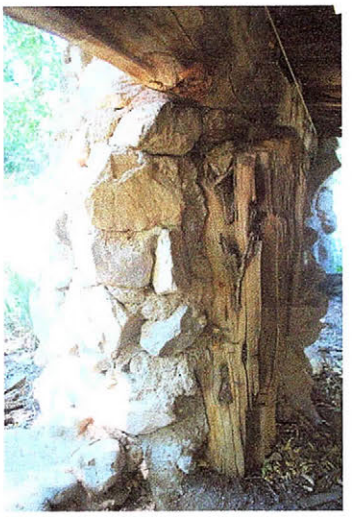
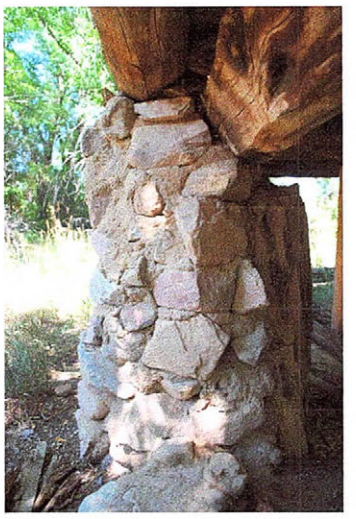
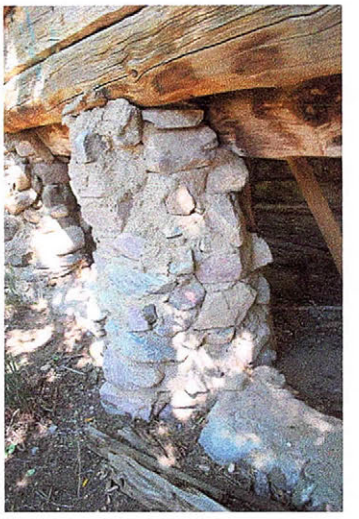
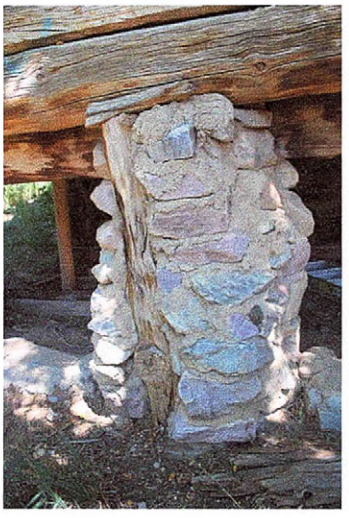
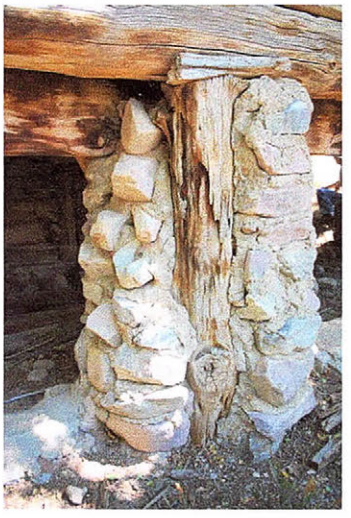
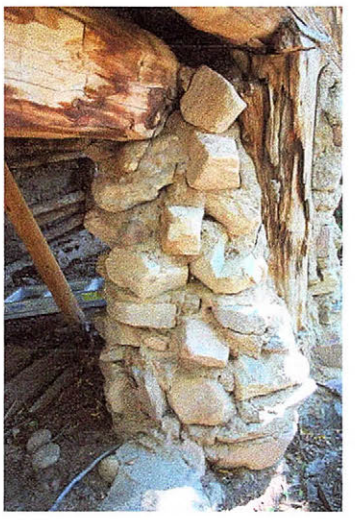
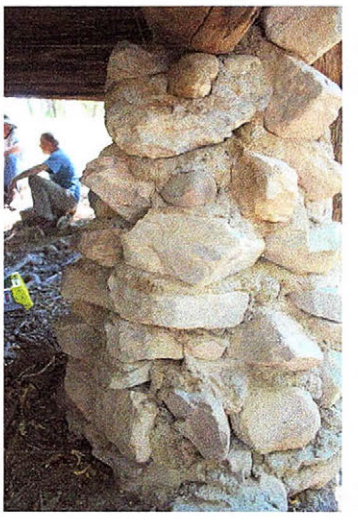
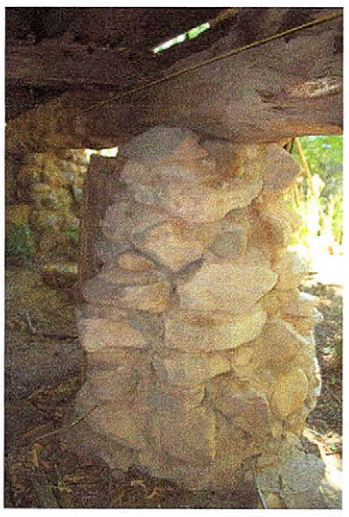
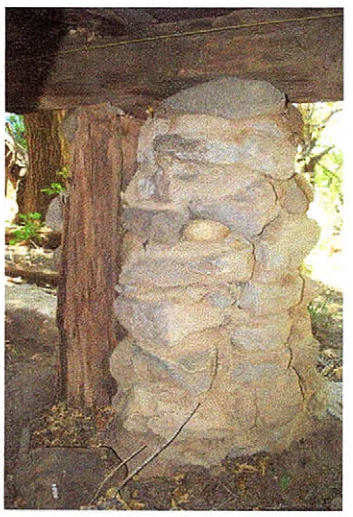
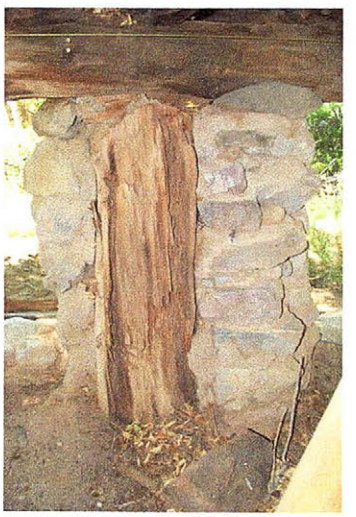
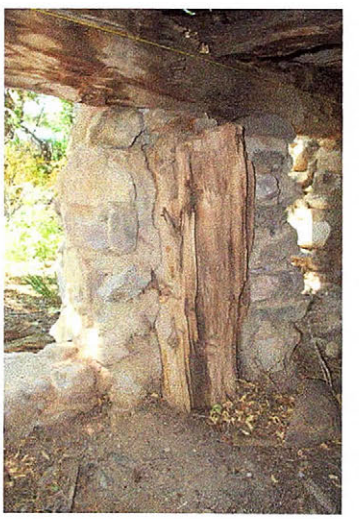

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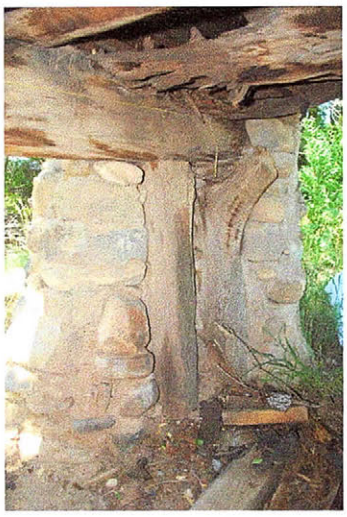


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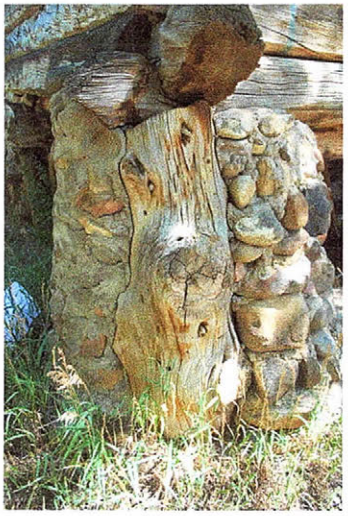
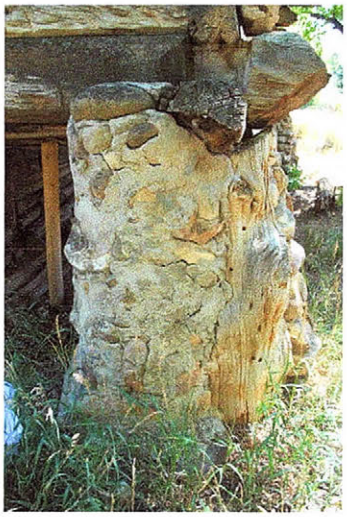













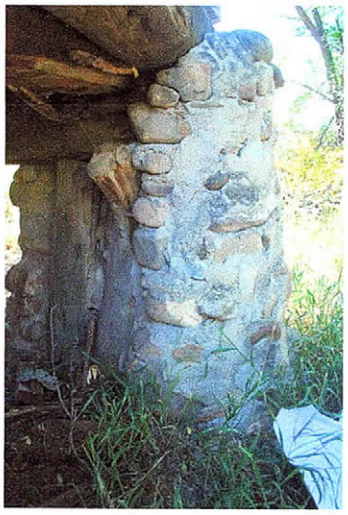
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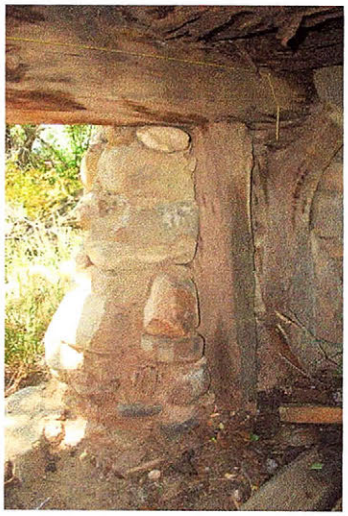










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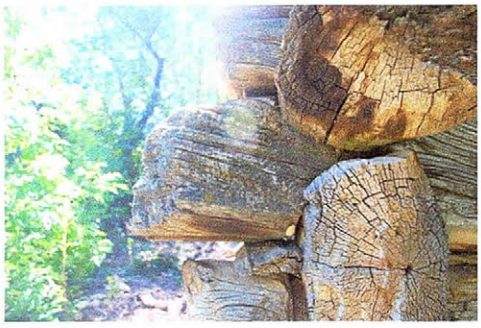




































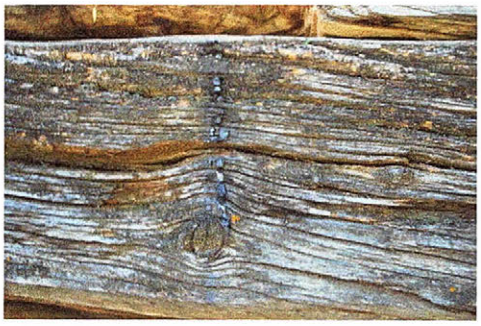



















NORTHEAST FACADE















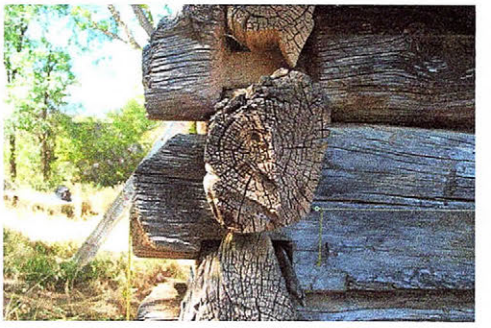










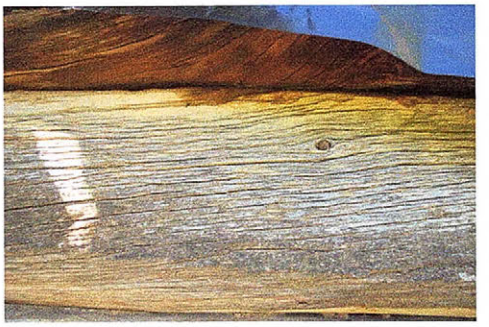




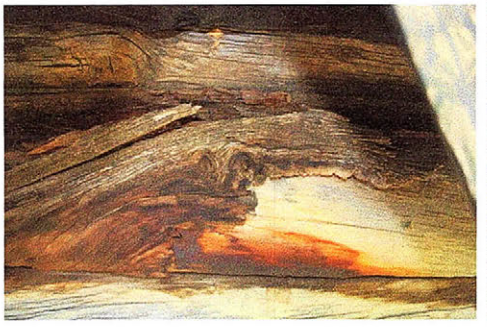




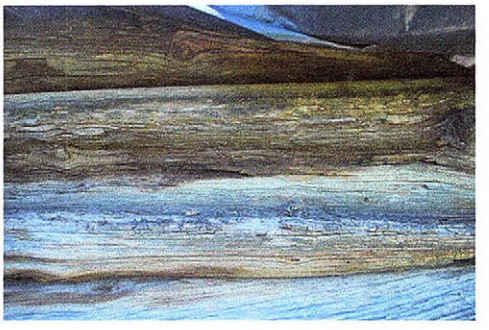






















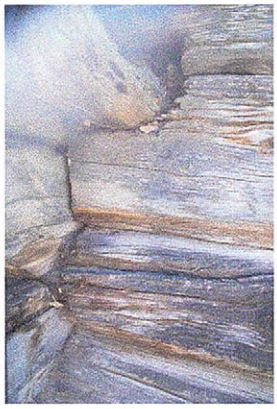


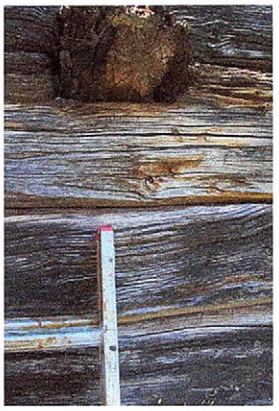


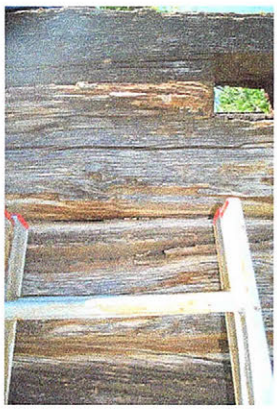
























APPENDIX F

USGSA Historic Preservation Technical Procedures
National Park Service: Preservation Tech Notes & Briefs
Product Information

Back to original

pectitle:	Preparing A Non-Toxic Water-Repellent Preservative
ocedure code:	0631001S
ource:	Developed For Hspg (Nps - Sero)
vision:	Wood And Plastics
ection:	Preservative Treatment
ast Modified:	02/24/2012
etails:	Preparing A Non-Toxic Water-Repellent Preservative

PREPARING A NON-TOXIC WATER-REPELLENT PRESERVATIVE

PART 1---GENERAL

1.01 SUMMARY

A. This procedure includes guidance on preparing a non-toxic water-repellent preservative. It is a formula provided by the United States Department of Agric= ulture Forest Products Laboratory.

PART 2---PRODUCTS

2.01 MANUFACTURERS

A. United States Department of Agriculture
Forest Products Laboratory
P.O. Box 5130
Madison, WI 53705
608/231-9200

2.02 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 adequa= te for stain removal work, and these products should be purchas= ed when available, as they tend to be less expensive. Com= mon names are indicated below by an asterisk (*).

A. Mineral spirits:

NOTE: MINERAL SPIRITS SHALL BE CLEAN AND COLORLESS SO THAT IT WILL NOT ADVERSELY AFFECT THE TEXTURE OR DURABILITY OF THE STAIN.

1. A petroleum distillate that is used especially as a paint or varnish thinner.=

2. Other chemical or common names include Benzine* (not Benzene); Naphtha*; Petroleum spirits*; Solvent naphtha*.

3. Potential Hazards: TOXIC AND FLAMMABLE.

4. Safety Precautions:

   a. AVOID REPEATED OR PROLONGED SKIN CONTACT.

   b. ALWAYS wear rubber gloves when handling miner= al spirits.

   c. If any chemical is splashed onto the skin, wash immediately with soap and water.

5. Available from construction specialties distributor, hardware store, paint store, or printer's supply distribu= tor.

B. Paraffin wax

C. Boiled linseed oil:

   1. Boiled linseed oil shall be used rather than raw linseed oil as raw linseed oil does not dry.

   2. The linseed oil shall be clean and colorless so that it will not adversely affect the texture or durability of the paint.

D. Clean, clear water

2.02 EQUIPMENT

A. Double boiler

B. Stiff bristle brush

PART 3---EXECUTION

3.01 ERECTION, INSTALLATION, APPLICATION

NOTE: THIS WILL MAKE 5 GALLONS OF SOLUTION.

A. Melt (1 lb.) paraffin in double boiler being caref= ul not to get it too hot as it can ignite. Temperature should range between 80 and 100 degrees F.

B. Allow to cool to about 70=F8 F before adding the preservative.

CAUTION: FUMES ARE HIGHLY TOXIC; WEAR PROTECTIVE CLOTHING INCLUDING GOGGLES; WORK OUTSIDE; USE ORGANIC VAPOR RESPIRATOR.

C. Add (3 gallons) boiled linseed oil and (1 gallon) mineral spirits, or whatever resin and solvent is being used.

D. Apply the mixture at 70=F8 to 80=F8 F. Below 40=F8 F the paraffin is not sufficiently liquid and the material cannot penetrate. Above 80=F8 F the mixture dries too fast and will not achieve sufficient penetrat= ion.

END OF SECTION

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Also of Interest: USA.gov BusinessUSA

st Reviewed 2012-02-24

GSA U.S. General Services Administration

Historic Preservation - Technical Procedures

Subtitle:	Applying A Water-Repellent Preservative To Wood
Procedure code:	0631001P
Source:	Developed For Hspg (Nps - Sero)
Division:	Wood And Plastics
Section:	Preservative Treatment
Last Modified:	02/24/2012
Details:	Applying A Water-Repellent Preservative To Wood

APPLYING A WATER-REPELLENT PRESERVATIVE TO WOOD

PART 1---GENERAL

1.01 SUMMARY

A. This procedure includes guidance on applying a water-repellent preservative (WRP) to wood. This coating will prolong the service life of wood and provide some protection against agents of deterioration.

NOTE: WATER REPELLENTS AND WATER REPELLENT PRESERVATIVES ARE ONLY EFFECTIVE ON UNPAINTED WOOD. IF IT IS APPLIED TO PREVIOUSLY PAINTED WOOD, BRUSH IT THOROUGHLY INTO ANY JOINTS OR CRACKS AND WIPE ANY EXCESS OFF PAINTED SURFACES. ALLOW PROPER DRYING TIMES.

B. Natural causes of deterioration include decay, ultraviolet degradation, insect infestation and excess moisture.

C. WRPs are often recommended for humid, southern climates. Their use can significantly reduce the problems of peeling, flaking, blistering, etc. of painted wood surfaces.

D. Some types of problems resulting from the weathering process include:

1. Fungi and/or mildew growth
2. Warped boards
3. Loose fasteners
4. Changes in surface texture resulting in cracks and checks

E. In addition to opaque paints, various so-called "natural" finishes and colored stains provide this necessary protection. And, like paints, proper surface preparation and application are vital to long lasting protection.

F. 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 DEFINITIONS

A. Water Repellent Preservatives (WRP):

1. Natural, colorless liquids which, when brushed onto, or soaked into the wood render the wood impervious to liquid water, inhibit the growth of mildew and other fungi, and provide protection against termite and other insect infestation.

2. Their use reduces warping and checking and prevents water staining at edges of boards and at the end grain. They do not, however, protect wood from water vapor or ultraviolet degradation.

3. WRP's will darken wood somewhat though in and of themselves, they contain no coloring agents. Though it varies with wood species the ultimate color is usually a golden tan.

4. WRP's can be used as a natural finish.

1.03 PROJECT/SITE CONDITIONS

A. Environmental Requirements:

1. Unless otherwise recommended by the manufacturer, the ambient temperature shall be between 50 degrees F. and 95 degrees F. when applying either a stain or WRP.

2. Do not apply when the relative humidity exceeds 85% or the moisture content of the wood exceeds 12% as measured by an electronic moisture meter.

3. Do not apply a WRP in the direct sun. They shall be applied only when the surface to be treated is in the shade and the sun is shining on the opposite elevation. The west elevation should be treated in the morning when the sun is shining on the east elevation; the north elevation should be treated around noon when the sun is shining on the south elevation; the east elevation should be treated in the afternoon when the sun is shining on the west elevation; and the south elevation should be treated late in the afternoon when it is in full shade.

4. Do not apply WRP's to damp surfaces, in misty or rainy weather, in the snow or where there is visible ice or frost on the surfaces.

1.04 MAINTENANCE

A. Water Repellent Preservative Finish (WRP):

1. On smooth wood surfaces, a water repellent preservative will remain effective for about a year. If the first application was applied to the point of refusal, it may remain effective for two years. On rough or weathered wood, expect a WRP to

remain effective from one to three years.

2. To determine if it is still effective splash some water on the surface.

   a. If the water beads up the WRP is still providing the necessary protection.

   b. If the water soaks into the wood, and/or the wood has a blotchy appearance (caused by mildew) it is necessary to retreat.

3. Before applying a new coat of WRP, clean the old surface with a nonferrous bristle brush.

4. To kill any mildew, wash with a solution of 1/3 cup of household detergent (NO AMMONIA), 1 quart 5% bleach, and 3 quarts warm water.

5. Rinse well and let dry thoroughly before reapplying the WRP.

6. After the treated wood has achieved a uniform tan color, retreatment will be required every 2 to 4 years.

PART 2---PRODUCTS

2.01 MANUFACTURERS

A. American Building Restoration Chemicals, Inc.
   9720 South 60th Street
   Franklin, WI 53132
   800/346-7532 or 414/421-4125

2.02 MATERIALS

NOTE: SIMPLE WATER REPELLENTS (WR), BY THEMSELVES, DO NOT PROVIDE ADEQUATE PROTECTION AGAINST DECAY AND ULTRAVIOLET DEGRADATION AND ARE NOT TO BE USED AS THE SOLE FINISH.

A. Commercial water-repellent preservative such as "X-100 Natural Seal" (American Building Restoration Chemicals, Inc.), or approved equal.

   -OR-

   A home-made preservative based on the USDA Forest Products Laboratory formula (see 06310-01-S for guidance on preparation).

B. Household detergent (NO AMMONIA)

C. Household Bleach:

   1. Other chemical or common names include Sodium Hypochlorite (NaOCl); Bleaching solution*; Laundry bleach*; Solution of chlorinated soda*.

   2. Potential Hazards: CORROSIVE TO FLESH.

   3. Available from chemical supply house, grocery store or supermarket, hardware store or janitorial supply distributor.

D. Clean, clear water

2.03 EQUIPMENT

A. Brushes:

   1. Use natural bristle paint brushes for oil/alkyd stains. Precondition by soaking in raw linseed oil for 24 hours. Use nylon bristle brushes for latex stains. Do not use the same brush for both types of stain.

2. For thin, runny stains, foam pad applicators can be used.

3. Stiff natural bristle scrub brushes.

PART 3---EXECUTION

3.01 PREPARATION

A. Surface Preparation: The surface should be free of all loose fibers, dust and grease before application of a WRP.

3.02 ERECTION, INSTALLATION, APPLICATION

A. Prepare the Water-Repellent Preservative (Forest Products Laboratory formula). See 06310-01-S for guidance.

-OR-

Use one of the proprietary products listed above.

NOTE: ON A SMOOTH SURFACE 1 GALLON OF WRP WILL COVER APPROXIMATELY 250 SF. IT WILL COVER APPROXIMATELY 100-150 SF ON A ROUGH SURFACE.

B. Dipping is the most effective means of treatment, especially for the ends of wood members. Brushing, to the point of refusal, is the next best method of treatment.

1. For treated lumber, dip freshly cut surfaces before installation, 10 seconds to 3 minutes.

2. For untreated lumber, dip, brush or spray with preservative. Pay particular attention to end grain and joints.

3. For wood shingles, dip before installation, with a second coat brushed onto the surface after installation.

4. On fixed surfaces, use a minimum of two successive coats.

5. For pieces that are removable, soak for 10 seconds to 3 minutes.

C. Allow adequate time to dry before repainting so that paint will adhere properly. Follow manufacturer's instructions.

1. In general, if the surfaces have been brush treated, 48 hours at 70oF. is generally sufficient drying time.

2. Longer drying times will be required if it gets colder than 70oF. at any time during this drying period.

3. Wood that has been dipped for 10 seconds will need a minimum of one week of similar, ideal drying time.

4. If work is being done late in the year and it is too cold in the evenings for a paint film to dry properly, only apply a WRP and wait until spring to prime and paint.

D. In addition to adequate drying times, some WR/WRP's must be allowed to weather before painting. Follow manufacturer's instructions. Time can vary from six months to two years.

3.03 ADJUSTING/CLEANING

A. Caulking joints is an important part of surface preparation. Also caulk after a WR or WRP has been

applied.

END OF SECTION

GSA U.S. General Services Administration

storic Preservation - Technical Procedures

ectitle:	Controlling Termites With Termicide Treatments
ocedure code:	1029001R
urce:	Tacoma Union Station Courthouse/Tacoma, Wa, 11-26-90
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ction:	Pest Control
st Modified:	02/24/2012
tails:	Controlling Termites With Termicide Treatments

CONTROLLING TERMITES WITH TERMITICIDE TREATMENT

PART 1---GENERAL

1.01 SUMMARY

A. This procedure includes guidance on treating wood construction to control termites by injecting infested areas with termiticide.

B. Termites, beetles, and carpenter ants cause less visible, but more serious problems than more visible insects.

C. Termites are wood eating insects which attack primarily soft sapwood. They are most active in locations with high moisture and usually enter the wood at or below ground level. Beetles also eat wood, even in dry areas above ground. Carpenter ants burrow into wood to make a home, not to find food; they seldom are a serious problem.

D. 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 before 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 technical data and application instructions to RHPO for approval before proceeding with treatment operations.

1.03 QUALITY ASSURANCE

A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work, including preparation of substrate and application.

B. Engage a professional pest control operator, licensed in accordance with regulations of governing authorities for application of treatment solution.

C. Use only termiticides which bear a Federal registration number of the U.S. Environment Protection Agency.

1.04 PROJECT/SITE CONDITIONS

A. Restrictions: Do not apply treatment solution except as otherwise required in construction operations. Apply in an industry standard manner such that contamination by toxic or hazardous chemicals does not occur in any adjacent or occupied areas.

1.05 WARRANTY

A. Furnish written warranty certifying that applied termiticide treatment will prevent infestation of termites and, that if termite activity is discovered during warranty period, Contractor will retreat building and repair or replace damage caused by termite infestation.

1. Provide warranty for a period of 5 years from date of treatment, signed by Applicator and Contractor.

PART 2---PRODUCTS

2.01 MANUFACTURERS

A. PRG, Inc. (Preservation Resource Group)
P.O. Box 1768
Rockville, MD 20849
301/309-2222

2.02 MATERIALS

A. Emulsible concentrate termiticide for dilution with water, specially formulated to prevent infestation by termites such as "Bora-Care" (PRG, Inc.), or approved equal.
1. A high-concentration solution containing the active ingredient disodium octaborate tetrahydrate formulated in a specially patented carrier system.

2. Provides a high-degree of repellency and rapid elimination of active infestation in a single application.

3. EPA registered for preventive and remedial treatments; odorless; colorless; long lasting.

4. Penetrates the wood, eliminates active infestations and provide long-term protection against future infestations.

NOTE: Other solutions or methods of application may be used as recommended by manufacturer or applicator if also acceptable to the RHPO and approved for intended application by jurisdictional authorities.

2.03 EQUIPMENT

A. Spray equipment for application of termiticide concentrate as recommended by termiticide manufacturer.

PART 3---EXECUTION

3.01 EXAMINATION

A. Inspect all wood portions of a building for insect damage at least once each year. Look for signs of insect activity, such as:

1. Clay tubes on pieces of wood

2. Small holes in the wood

3. Small unexplained piles of sawdust

B. If any of these signs appear between inspections, an insect control specialist should be called in to make a thorough investigation.

3.02 PREPARATION

A. Remove foreign matter which could decrease effectiveness of treatment on areas to be treated.

3.03 ERECTION, INSTALLATION AND APPLICATION

NOTE: TERMITICIDE TREATMENT WILL NOT STRENGTHEN DETERIORATED WOOD. STRUCTURAL MEMBERS THAT ARE NO LONGER SOUND MUST BE REPAIRED OR REPLACED.

A. For Spot Treatment of Infested Areas:

1. Dilute termiticide concentrate with water according to manufacturer's instructions.

   NOTE: FUEL OIL IS NOT PERMITTED AS A DILUENT.

2. Saturate the infested and surrounding area with diluted termiticide using a spray. Apply at rate recommended by manufacturer.

   NOTE: BE SURE TO TREAT THE ENTIRE INFESTED MEMBER TO ENSURE THAT THE ACTIVE INGREDIENT IN THE CONCENTRATE REMAINS AT A LEVEL HIGH ENOUGH FOR EFFECTIVE CONTROL. WOOD THAT HAS NOT BEE TREATED WILL NOT BE PROTECTED.

B. Post signs in areas of application to warn workers that termiticide treatment has been applied. Remove signs when areas are covered by other construction.

C. Reapply treatment solution to areas disturbed by subsequent construction activities following application.

END OF SECTION

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storic Preservation - Technical Procedures

ectitle:	Epoxy Repair For Deterioration And Decay In Wooden Members
ocedure code:	0630001R
urce:	Hspg Prepared For Nps - Sero
vision:	Wood And Plastics
ction:	Wood Treatment
st Modified:	02/24/2012
tails:	Epoxy Repair For Deterioration And Decay In Wooden Members

EPOXY REPAIR FOR DETERIORATION AND DECAY IN WOODEN MEMBERS

PART 1---GENERAL

1.01 SUMMARY

A. This procedure includes guidance on stabilizing decayed wood members with epoxy consolidant and filler.

B. Deterioration and decay in wood results from moisture infiltration, accompanying fungal growth and insect infestation. Paint, caulk and sealant failures are also a major cause of wood deterioration.

C. Some sources of moisture may include the original moisture in green wood, rainwater, condensation, ground water, piped water, and water released by water-conducting fungus through the process of decay itself.

D. Epoxy repair may be appropriate if:

1. the piece to be repaired is historically significant. Epoxy repair makes it possible to retain most of an original component by selectively repairing only the damaged area.

2. if the piece is decorative and replacement would be too expensive or impossible.

E. Epoxy repair may NOT be appropriate if:

1. the piece is a structural member. Epoxy has adequate compression strength, but is not the best choice to repair a member in tension. In this case, replacement is usually a better option.

2. the wood to be repaired is to remain unpainted, as the epoxy is quite different in appearance than wood. In this case, the wood should be selectively replaced.

3. if the area to be repaired is large, as epoxy repair can be expensive.

F. 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

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).

PART 2---PRODUCTS

2.01 MANUFACTURERS

A. Conservation Services
8 Lakeside Trail
Kinnelon, NJ 07405
201/838-6412

B. Abatron, Inc.
5501 95th Ave.
Kenosha, WI 53144
800/445-1754 or 414/653-2000

C. Roux Laboratories
5344 Overmyer Dr.
Jacksonville, FL 32205
904/693-1200

2.02 MATERIALS

A. Epoxy consolidant and epoxy filler, both are multiple part compounds. Purchase by the gallon unless a large amount of epoxying needs to be done. Use one of the following, or approved equal:

1. "Con Serv (T) Flexible Consolidant 100" (Conservation Services): Cures slowly with a 5 to 7 hour application time to allow deep penetration. Complete hardness is achieved in 3 to 6 days.

2. "Con Serv (T) Flexible Patch 200" (Conservation Services): A four part putty-like filler; Is not easy to mix in small amounts; Consistency and hardness are easily controlled with this material.

NOTE: The products of Conservation Services are recommended for treatment of thicker wood such as window sills. Because of its slower curing time, it allows for deeper penetration into members.

3. "Liquidwood-1" Consolidant (Abatron): Solidifies in a short period of time.

4. "Woodepox-2" Adhesive Paste (Abatron): A two-part paste mix; final hardness is determined by varying the ratio of the two parts. The LiquidWood can be used as a thinner, but this reduces the flexibility of the filler.

NOTE: These Abatron products are recommended for use on smaller members such as window sashes where deep penetration of consolidant is not required. The quick drying feature is an advantage for small, but repetitive, jobs. Abatron carries twenty different types of wood consolidants with varying degrees of penetration.

B. Oil clay that can be purchased from a hobby store -- used to keep consolidant from leaking through cracks.

C. Nitril Rubber Gloves (Abatron)

D. Disposable vinyl gloves: Available from drug store or pharmaceutical supply distributor in 50 count or larger boxes.

2.03 EQUIPMENT

A. Plastic bottles, like those used for hair dye, to apply the consolidant; having many on hand is recommended. Cleaning of the bottles for reuse is possible.

B. Applicator bottles: Available from drug store and sold for hair dye application usually in 8 fl. oz. size; Also available in bulk from Roux Laboratories. Roux Color Applicators lend themselves more easily to cleaning and reuse.

C. Rags of different sizes to wipe up spills before epoxy has a chance to harden, small rags are recommended for quick one time uses such as wiping off spouts and caps.

D. Thin wooden sticks, approximately 8" long for scooping out paste and mixing consolidant.

E. Goggles and a respirator for protection from fumes.

F. Putty knives for application of filler

G. Channel lock pliers for opening stuck caps

H. Allen wrench to clean out cap holes

I. Needle nose pliers to pull out hardened epoxy

J. 1/8"x8"x12" Masonite boards for mixing paste filler

K. Carbon dioxide fire extinguisher: Curing epoxy creates heat that may cause fire

L. Rotary saw

M. Air compressor

N. Drill

O. Stiff bristle brushes

PART 3---EXECUTION

3.01 EXAMINATION

A. Detect rot using the "Pick Test":

1. Insert an ice pick into the wood at a slight angle.

2. Lift the pick out. If the wood splinters in long pieces, the wood is ok. If the wood snaps where the pick is being lifted, the wood is decayed.

B. When rot is discovered:

1. Determine the source of moisture infiltration and eliminate it.

a. If rot is only present on the surface, drying is all that is necessary to stop the spread of decay and kill off any growth.

2. If source of moisture is unknown, treat the wood with a preservative.

a. Preservatives are caustic chemicals and should be handled with care.

b. A particularly dangerous wood preserving

chemical is pentachlorophenol (a.k.a. penta).
CAUTION: THIS CHEMICAL IS CARCINOGENIC AND ITS USE IS BANNED IN MANY STATES.

3. Preservatives will eliminate fungal growth, but generally do not restored strength to the deteriorated wood material.

3.02 PREPARATION

A. Surface Preparation:

1. Dry affected wood member completely to arrest further decay. Dry in place if possible -or- remove the member and keep in a cool dry place until dry.

   CAUTION: IF THIS PRECAUTION IS NOT TAKEN, THE EPOXY CAN ACTUALLY TRAP MOISTURE IN WOOD FIBERS AND ACCELERATE THE DECAY PROCESS.

2. Have all materials at hand before the mixing process begins.

3. Label all caps and lids so that a cap or lid is not placed on the wrong container or it may remain there permanently.

3.03 ERECTION, INSTALLATION, APPLICATION

CAUTION: AS EPOXIES CURE, HEAT IS PRODUCED. FOR THIS REASON, EPOXIES SHOULD BE USED IN SMALL QUANTITIES TO DETER EXTENSIVE HEAT BUILD-UP. CARE SHOULD BE TAKEN WHEN USING EPOXY ON A HOT DAY.

A. Repair decayed wood using epoxy wood consolidant:

1. Drill 1/4" or 3/16" holes in affected wood to receive epoxy consolidant:

   a. Drill holes at an angle and spaced approximately 2" on center in staggered rows. The top of one hole should line up with the bottom of the next hole.

      CAUTION: BE SURE NOT TO DRILL THROUGH THE ENTIRE SURFACE FOR CONSOLIDANT WILL LEAK OUT FROM BEHIND.

   b. Dam any surface cracks with oil clay so that epoxy will not leak.

2. Remove sawdust and dirt from drilled holes using compressed air or stiff bristle brushes.

3. Following manufacturer's instructions, mix a small amount of the consolidant components (resin and hardener) together in an applicator bottle. Stir the mixture thoroughly by hand with a thin stick for 4 minutes or with a bent coat hanger chucked into a drill for 2 minutes.

4. Using a large plastic syringe or squeeze bottle and tube spout, carefully squirt the consolidant into the pre-drilled holes. Completely saturate the wood, moving from hole to hole refilling until the wood can hold no more. More than one application may be needed.

5. Wipe off any excess consolidant or spills and cover the treated area to protect until cured as directed by epoxy manufacturer.

6. If severed pieces need to be re-attached, glue them in place with a mixture of consolidant and filler.

B. When the consolidant has cured, fill the voids in the surface with epoxy filler (wood-epoxy putty):

1. Mix the two part epoxy filler following the same procedures for mixing consolidant in Section 3.03 A.3. above. Mix filler to achieve the consistency of a glazing compound that can be worked with a putty knife.

2. Apply the filler to the surface:

   a. For large voids, apply filler in 1" thick layers. This reduces the possibility of problems associated with heat build-up.

   b. Build up filler layers slightly above the wood surface to allow for planing and sanding smooth after it has cured.

3. When the filler has cured, sand or plane the surface smooth.

4. Apply a wood preservative to surrounding wood surfaces and prime and paint the entire surface.

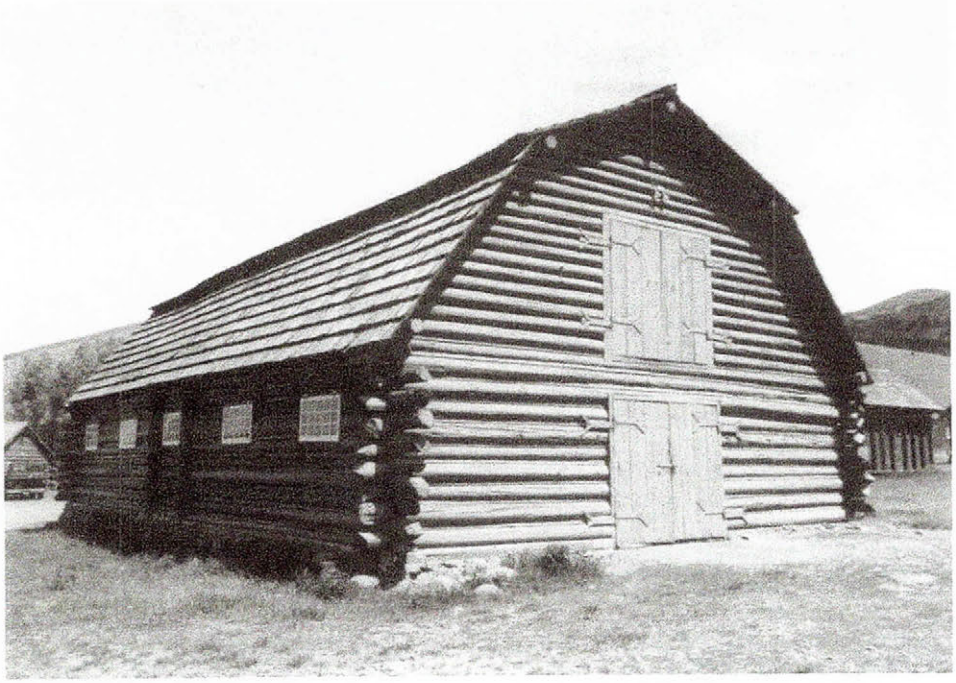
END OF SECTION

PRESERVATION
Tech Notes
NATIONAL PARK SERVICE
U.S. DEPARTMENT OF THE INTERIOR
WASHINGTON, D.C.

EXTERIOR WOODWORK
NUMBER 3

Log Crown Repair and Selective Replacement Using Epoxy and Fiberglass Reinforcing Rebars

Harrison Goodall
Conservation Services



LAMAR BARN
Yellowstone National Park
Wyoming

In the 1930s, Yellowstone National Park set out to revive the wild buffalo herd. To meet this important goal, the park set up a buffalo ranch on the northern edge of the Lamar Valley. The project saved the buffalo, but all that remains of the Lamar Buffalo Ranch are two residences, a bunkhouse (home of the Yellowstone Institute), and a horse barn.

Built in 1936, the horse barn is like thousands of other log structures constructed in the rustic style between the late teens and World War II. The two-story barn is made of Lodgepole Pine logs, daubed with mortar on the outside, chinked with wood on the inside, and set on a stone and concrete foundation. Typical of this type of building, the intersecting log wall crowns extend 12″ to 28″ from the corners of the building. The log rafters and purlins originally extended about 8″ beyond the roof eaves and rakes, but were cut back years ago. Magnificent in its massive scale and bulky appearance, this simple barn presented a major preservation problem because of its distinctive design.

Problem

An inspection of the Lamar Barn revealed few surprises. Wood protected by the roof was in good condition; portions of the logs directly exposed to the weather were deteriorated. The culprit in every case was moisture. It was easy to predict where to find the greatest pockets of decay. Log crowns extending beyond the drip edge of the roof were in the worst condition. Sill logs, particularly on the north side of the building, were also badly deteriorated. The amount and depth of decay in both instances followed a pattern: the further out from the roof they extended, the greater the deterioration (*see figure 1*).

After about sixty years, decay had taken its toll. More than half of the extending crowns were so rotten that it was possible to pull large chunks of the heartwood out of the exposed ends. In some cases, the log crowns were almost totally gone. In others, the shells of the crowns had given way and the soft mulch-like interior had fallen out. In the most severe cases, the decay had penetrated beyond the notch where the logs intersected and had traveled into the log as much as ten to twelve inches. This impacted both the visual and the structural integrity of the walls and their appearance.

Options for Repair

There are only a few ways to treat this type of deterioration: 1) replace the deteriorated logs; 2) stabilize or repair

Logs should be repaired rather than replaced in log structures whenever possible to preserve the historic structure's integrity and character.



Figure 1. Typical deterioration of log crowns is seen at the Institute Building, adjacent to the Lamar Barn. This is the condition of many of the log crowns at the Lamar Barn prior to the repair and replacement work. Logs are notched at the corners. Photo: Harrison Goodall.

the deteriorated portion of the crowns; 3) remove the deteriorated crowns and splice on replacement crowns; or 4) saw off the deteriorated portion and leave as is.

In the past, the most expedient treatment was chosen. In an attempt to stop the rot, the decayed rafters and purlins were simply sawed off. It did not work. Unfortunately, this is the most frequently chosen treatment in such situations. The greatest problem with this technique is that it irreparably alters the architectural character of this type of building, which derives much of its appearance from these extending roof and corner elements. Their removal flattens the surface and dilutes the rustic qualities of the barn. For this reason, Option #4 was immediately rejected.

Option #1, replacement, was not a viable choice either. More than half of the logs in the building were deteriorated to some degree. Such extensive replacement would have raised serious questions about the physical integrity of the historic building. Intervention on this scale would also have created other problems. It would have required dismantling many features connected to the exterior log walls. These included interior stalls and walls, windows, doors, frames and jambs. The exterior appearance of the building afterwards, and the notching in particular, would have looked entirely different because it would not have been possible to obtain logs with minimal taper like the original logs. Finally, replacing most of the logs in the building would have been costly as well as harmful to the historic character of the barn.

Option #2, patching, was also rejected. Repairing or patching decay in wood is possible only when there is enough sound wood on which to bond repair material. A good case in point is when the shell of a log is still intact. The decayed wood can be stabilized with an epoxy consolidant and filled with an epoxy patch material to make the repair. In the Lamar Barn, however, there was not enough sound wood for an epoxy patch in the extending crowns.

Option #3 involved cutting off the deteriorated log crowns at the area of greatest decay (the intersecting notches), and splicing on replacement crowns of the same size, configuration, and texture. This approach had several advantages:

- Only the deteriorated portions of the wall logs would be replaced, thus preserving sound historic material.
- There would be little disruption to the building because it would not be necessary to spread logs to withdraw or insert full replacement logs.
- The replacement crowns could be replaced when necessary (10–30 years), without further loss of material.
- Moisture would be prevented from migrating into the historic logs by incorporating a small gap into the replacement crowns.
- The replacement crowns could be blended visually into the existing wall surfaces, as the historic structure had been previously stained.
- The crown replacement system would be cheaper than extensive log replacement.

For these reasons, Option #3 was chosen over the other alternatives.

The treatment selected for the log crowns was to splice replacement sections onto sound portions of the wall logs. Additionally, one totally deteriorated sill log required replacement, a few wall logs needed facing, and some decay in checks or horizontal cracks required consolidation with a flexible epoxy. The rafters and purlins, previously cut back, were left untouched.

Preparing for the Replacement Crowns

Each of the deteriorated log crowns was carefully photographed and documented. Diameter, length from the wall and surface configuration of the cut end of the log were recorded. Then the crowns were cut off, at an angle towards the notch (*see figure 2*). Next, the original logs were drilled back to the center line of the intersecting walls, using a plumber's bit (*see figure 3*). This gave a flat surface to begin the new crowns. The recessing with a flat surface to the center line of the wall was more difficult than first anticipated because the barn builder had anchored each log with four galvanized square spikes 8″ x 3/8″. These spikes had to be chiseled and sawn back to a flat surface so the new crowns could be properly anchored.

In a few cases, deterioration penetrated beyond the center line of the wall, and more material had to be cut back to reach sound wood. A rotary rasp, not unlike a king-size dental drill, was used to remove remaining decay at the center line. The sound wood surface was treated with an epoxy consolidant to encapsulate remaining soft absorbent wood, thereby retarding future decay. Where the decay had traveled into the log walls, sufficient wood was removed and the surface flattened to permit new faces to be attached to the logs (*see figure 4*). These new faces were notched to match the log surfaces removed.

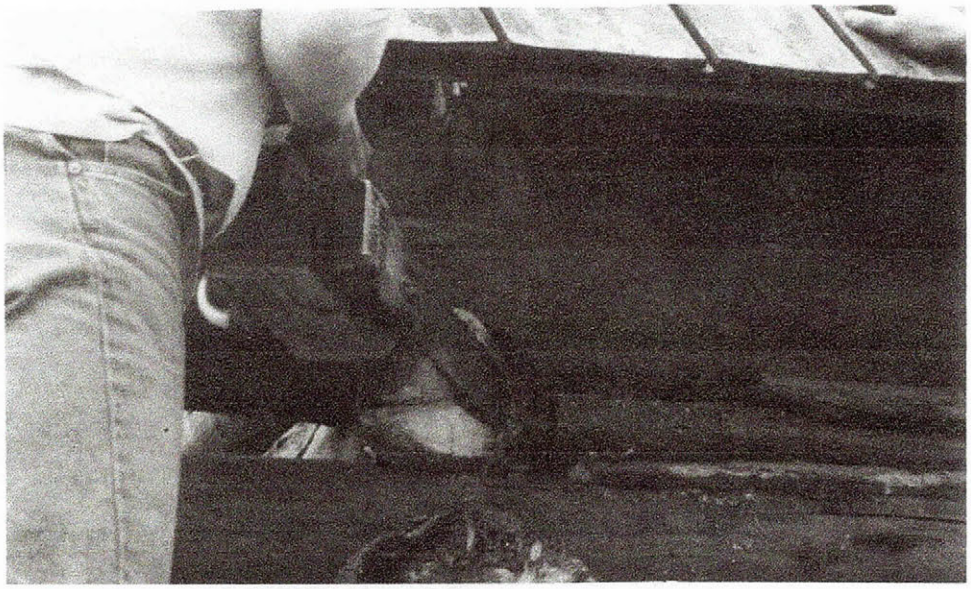


Figure 2. Small chainsaws were used to cut off deteriorated log crowns. The darker portions of wood at the log ends are the soft punky deteriorated fibers. Photo: Harrison Goodall.



Figure 3. A plumber's bit was used to recess the crown back to the center line to create a flat surface for attaching the replacement crowns. Photo: Harrison Goodall.



Figure 4. In a few cases, the deterioration had penetrated beyond the center line of the log corners and portions of the wall face were removed. Photo: Harrison Goodall.

Due to a short work schedule, it was not feasible to treat the new wood with a wood preservative such as CCA (chromated copper arsenate). Such a treatment, however, would have been desirable. Pressure-treating with CCA in a salt solution would have left the wood tinted a light green, but with aging and an applied stain, it would have been unnoticeable. A surface-applied preservative was not considered, because it would not penetrate to the center of the 9″- to 12″-diameter logs. This is the area where deterioration is likely to occur first. The logs were, therefore, left untreated.

Replacing the Log Crowns

The photographs of the deteriorated crowns were used to reconstruct the replacements. Each replacement log crown was cut and fitted until it matched the notch of the original. A wood framing not unlike cribbing was constructed at each corner to hold the replacement log crowns as they were marked, cut, and fitted in place from the bottom level up (*see figure 5*). As much as possible, checks in the wood were placed in a downward position to prevent water from collecting in the wood. As the crowns were extensions of the logs and not supported by the ground, it was necessary to provide temporary support until the replacement crowns were epoxied in place. The log crowns were not anchored until all had been stacked in place with all notching complete. They were then marked to ensure proper alignment when anchored.

The new crowns were anchored to the original logs by fiberglass reinforcing rebars (fiberglass rods that have spiral ridges to enhance bonding) embedded in epoxy bonded to the wood. Three fiberglass rebars were used for most of the connections: one long fiberglass rebar at the top of each new crown to resist the tension forces (from the weight), and two small fiberglass rebars used at the base to counteract any lateral movement. This made a three-point connection (*see sidebar*). Because buffalo sometimes rub against the building corners, an additional top tension rebar was used on the lower crowns.

The three materials making up the connection were the fiberglass rebars, the structural grade epoxy, and the pine wood of both the original wall logs and the new replacement crowns. The tensile strength of the fiberglass rebar is 80,000 psi (pounds per square inch), with the bonding shear strength



Figure 5. A framework or cribbing held the replacement crowns as they were fabricated. All the crowns had to be temporarily put in place to ensure a proper fit. Once stacked up, they were numbered to make sure they would be properly aligned at the time of anchorage. Photo: Harrison Goodall.

of the rebar at 60,000 psi. The shear strength of the epoxy is 3000 psi; thus all the new synthetic materials are substantially higher in shear strength than the pine, which has a shear strength of only 60 to 90 psi. The wood was the weakest element of the connection. Since the crowns were in effect to be cantilevered from the main wall section, it was necessary to calculate the diameter and length of the reinforcing fiberglass rebars necessary to hold the ends in place and to keep the wood from shearing away from the epoxy.

The reinforcing rebars were intended to counteract the natural force of gravity pulling the crowns away from the wall, due to the weight of the crown itself, from the accumulation of snow and ice, or from lateral loads. With a 12"-28" long log crown 9" to 12" in diameter, it was determined that a 1/2" diameter reinforcing rebar set 12" into sound wood of the upper section of the wall log and 12" into the attached crown was necessary to combat the combined forces of shear, bending moment and vertical loading. (The drilled holes were slightly longer and wider to accommodate the reinforcing fiberglass rebar and the epoxy.) In addition, for horizontal or lateral movement, two 1/2" diameter fiberglass rebars were imbedded 4" into the lower sections of the log walls and a matching 4" into the crowns. The length, diameter, and the placement of the rebars were based on calculations intended to keep the wood fibers from shearing away from the imbedded rebars. Another situation might require different dimensions.

Thus at the Lamar Barn, a 1/2" fiberglass rebar 12" deep on either side of the connecting wood was used in the tension zone (total of 24") and located within an inch of the top of the log. Two short fiberglass rebars 4" long on each side of the connection (total of 8") were used at the bottom of each log crown for lateral strength. The holes for the rebars and epoxy were 3/8" larger than the rebars, for a total of a 7/8" hole.

Installation

The work area was protected with tarpaulins to keep the wood dry. The wood was allowed to dry out to less than 20% moisture content before the new crowns were installed.

The holes (7/8" diameter) for the 1/2" reinforcing fiberglass rebars were drilled into the original logs. Corresponding holes were drilled into the crowns. An 8" piece of flexible tubing was stapled onto the nozzle of a caulking tube in order to reach to the back of the long drilled hole. The caulking gun was filled with a high-strength structural two-part epoxy in a paste-like consistency, which was then injected into the original log. The cavity was filled two-thirds. The paste-like consistency of the epoxy kept it from draining out of the drilled hole. The precut rebar was then inserted using a twisting motion (*see figure 6*). The replacement crown was also filled two-thirds with epoxy, then aligned, inserted and left to cure (*see figure 7*).

Working with epoxy is difficult. Setting times depend on the type of formula and the ambient temperature. Some epoxies set up in less than 15 minutes; others can be formulated to dry over a three-day period. The epoxy for this job set in less than 45 minutes, and for that reason, only small amounts were mixed at a time, and work was not undertaken in the direct sun, as this further reduced the effective working time. Curing took place in about 24 hours at temperatures between 60 to 80°F. The cribbing construction supporting the crown ends was kept in place until all the crowns were fully cured.

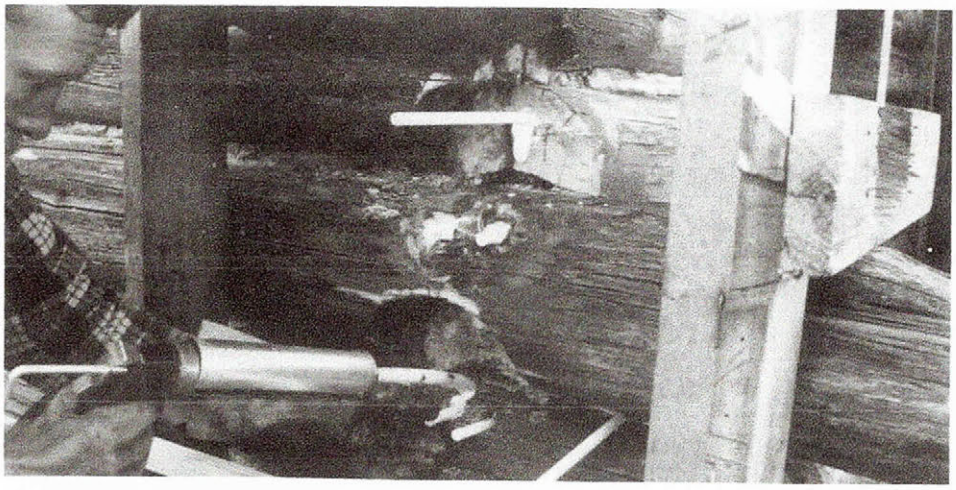


Figure 6. A flexible tube was stapled onto a caulking gun in order to fill the 12"-12 1/2" deep holes that had been drilled into the sound end of the historic log. The individual hole was filled two-thirds with epoxy adhesive and a 1/2" diameter fiberglass reinforcing rebar was then inserted. Photo: Harrison Goodall.



Figure 7. A 12 1/2" long hole was drilled into the new crowns. This hole was filled in the same manner as were the old logs. The crown was then immediately lifted into position and supported by the cribbing framework for several days until the epoxy cured. Photo: Harrison Goodall.



Figure 8. The joints between the historic logs and the new crowns are visible, but not disconcerting. The unsealed joint will help keep future decay isolated to the log crown. Photo: Rodd Wheaton.

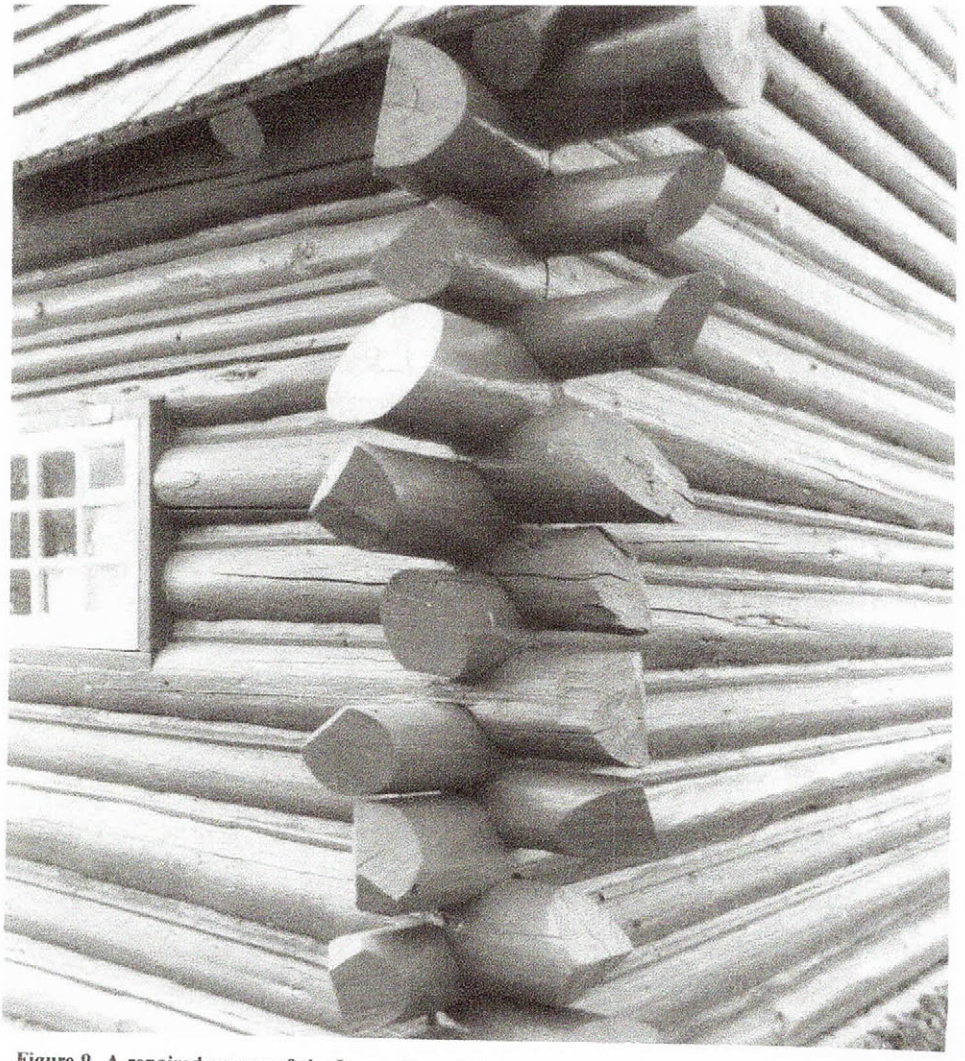


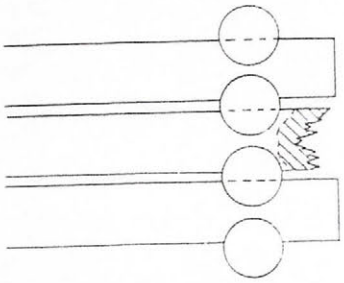
Figure 9. A repaired corner of the Lamar Barn. It is expected that the log crowns will need replacing in 10–30 years. Photo: Rodd Wheaton.

Finishing

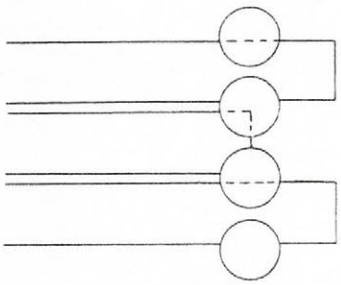
Once the epoxy cured and cribbing was removed, the log crowns were stained. A first coat of oil-based stain was used on the log crowns and eventually the entire building was stained. Had the new wood been treated with a salt-impregnated preservative solution, a full year of aging would have been required prior to staining. It is anticipated that every 3–6 years the building will need re-staining in addition to an annual coating of the new log crowns with a water repellant.

Evaluation

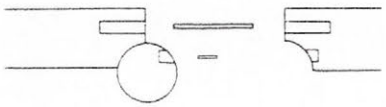
While there is a tendency to caulk the cracks in wood, it has been found that in many instances it is best to leave small checks open to let wood breathe naturally (*see figure 8*). For this reason the joints between the log crowns and the original log walls were also left open and not sealed. The new crown ends are expected to last between 10 and 30 years. The upper crowns directly under the roof runoff are likely to deteriorate first. These can be replaced as required. As with any completed preservation project, the better the routine maintenance the longer the work will last and the more cost-effective it will be in the long run (*see figure 9*).



Deteriorated log crown.

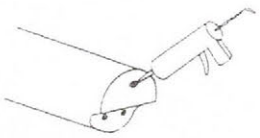


Remove deteriorated crown. Recess to the center line of the log wall. Remove all pockets of decay. Saturate the decay pockets with an epoxy consolidant.

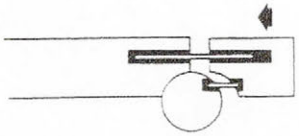


Cut and prefit log crown replacement. Typical log crown applications require one or two 1/2" diameter fiberglass rebars embedded 12" deep in the top of the existing wall log and replacement crowns. Shorter 4" long rebars placed at the bottom of the log will make the log crown rigid by creating a 3-point support. Drill holes 1/4" to 3/8" larger than rebar to accommodate the epoxy. Maintain 1" of good wood between the hole and the edge of the log.

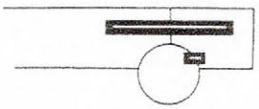




Fill holes with epoxy.



Assemble log crown replacement with fiberglass rebars. Support until epoxy has cured.



Completed log crown replacement.

PROJECT DATA:

Building:
Lamar Barn
Yellowstone National Park
Wyoming

Owner:
National Park Service
Yellowstone National Park
Wyoming

Project Date:
Summer 1986

Contractor:
Harrison Goodall
Conservation Services
Kinnelon, New Jersey

Epoxy Supplier:
ConServ Epoxies
Conservation Services
Kinnelon, New Jersey

Project Costs:
Total: $39,706

Epoxy cost = $375.00

Labor cost for log crown stabilization = 100 person days or approximately 2.5 days per log crown.

Project Included:
39 log crown replacements (wood supplied by the park)
38 rafters stabilized
69 lin.ft. sill log replacement
90 lin.ft. wall log facing
20 lin.ft. wall log epoxy stabilization
50 lin.ft. foundation repair
2 weeks log stabilization training

Approximately half of the contract involved log crown replacement

This PRESERVATION TECH NOTE was prepared by the National Park Service. Charles E. Fisher, Preservation Assistance Division, National Park Service, serves as Technical Coordinator for the PRESERVATION TECH NOTES. Special thanks go to the following National Park Service Staff: Lee Nelson, FAIA, Sharon Park, AIA, Michael Auer, Brenda Siler, and Rodd Wheaton for their assistance with this Tech Note.

PRESERVATION TECH NOTES are designed to provide practical information on innovative techniques and practices for successfully maintaining and preserving cultural resources. All techniques and practices described herein conform to established National Park Service policies, procedures and standards. This Tech Note was prepared pursuant to the National Historic Preservation Act Amendments of 1980, which direct the Secretary of the Interior to develop and make available to government agencies and individuals information concerning professional methods and techniques for the preservation of historic properties.

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PRESERVATION
Tech Notes
U.S. Department of the Interior
National Park Service
Cultural Resources
Preservation Assistance Division



EXTERIOR WOODWORK

NUMBER 4

Protecting Woodwork Against Decay Using Borate Preservatives

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Division of Conservation
Harpers Ferry Center
National Park Service

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Preservation Assistance Division
National Park Service

TOTEM POLES
Sitka National Historical Park
Sitka, Alaska

The totem pole collection at Sitka National Historical Park embodies the rich carving traditions — past and present — of Southeast Alaskan Natives. Started in the early 1900s, the collection was one of the significant factors for the park's designation as a National Monument in 1910. Deterioration of the poles' in-ground wood due to fungal decay necessitated making new base supports for seven poles. As part of the project, the carvings on the red cedar poles were treated with a borate wood preservative in order to protect them against fungal decay and insect damage. This treatment has broad potential applicability for the preservation of exterior woodwork on structures, site features and objects.

Problem

Famous as the capital of Russian-America and the home of the Tlingit Indians, Sitka is located along the southeast coast of Alaska. It has a relatively mild, yet very moist, climate with more than 95 inches of rainfall annually. The famous outdoor totem pole collection at the national

Proper preservation treatments and regular maintenance are essential for effective protection of exterior woodwork.

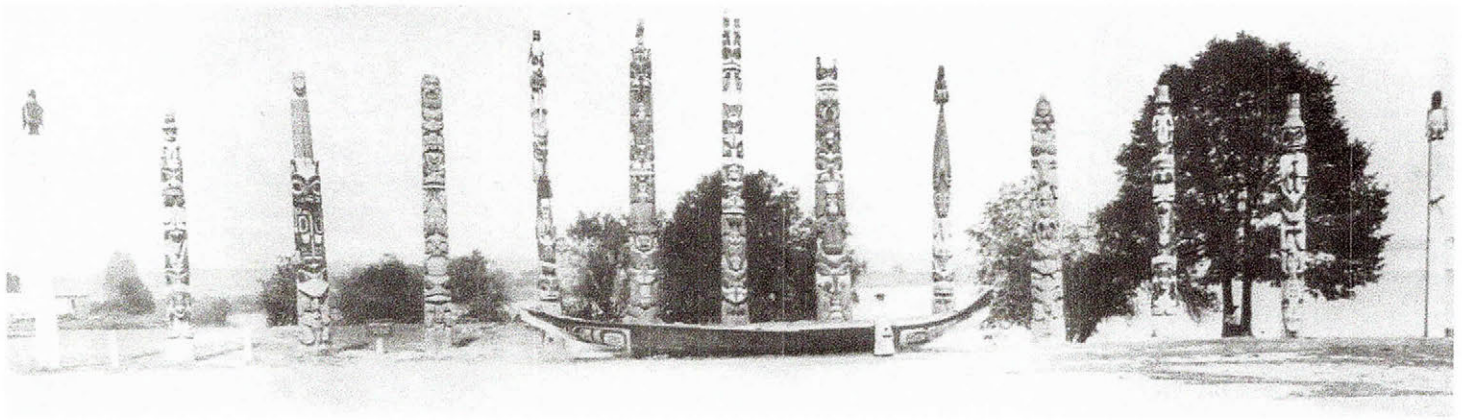


Figure 1. Some of the Sitka totem collection shown on display at the 1904 Louisiana Purchase Exposition. Totem poles (totems) generally serve one of four purposes: crest poles give the ancestry of a particular family; history poles record the history of a clan; legend poles illustrate folklore or real life experiences; and memorial poles commemorate a particular individual. The first recorded sightings were by European explorers and traders in the late 18th century. Detached exterior poles reached their zenith in the late 19th century, standing along the village fronts of the Haida and Tlingit Indians of northern British Columbia and extreme southeast Alaska.

park has suffered from the effects of moisture throughout much of the twentieth century. The most serious fungal decay recently encountered occurred at the base of the poles, although fungal growth and structural problems, including splits and cracks, were prevalent on the above-ground carvings as well.

Replicating poles at Sitka for outdoor display is a treatment practiced at the park as early as the 1930s. However, re-carving inevitably results in the loss of the original craftsmanship as well as the original artistic expression. Today, the National Park Service strives to extend the life of the totems for outdoor display as long as possible. Older original totems that have survived have been relocated indoors for exhibit or storage because of their significance and condition. The older replicas and the more recently carved new totems are being maintained and conserved for outdoor display.

Past Treatments

Of the seven standing poles that were identified as in most serious need of preservation work, it is now believed that one (Yaadaas Crest Pole) dates to the 19th century and was part of the original collection assembled by the District of Alaska territorial governor John Brady and displayed at the 1904 Louisiana Purchase Exposition in St. Louis *(see figure 1)*. This totem will be exhibited indoors. The other six poles are early replicas of ones in the park collection that were too deteriorated for outside display. Five of the replica poles had been carved during the 1930s by Alaskan Natives employed by the Civilian Conservation Corps. The remaining pole (Raven/Shark) is a 1978 reproduction of an original pole carved for the 1964 New York World's Fair, which was moved indoors in 1978 due to deterioration. All 7 poles were hollowed out on the back side at varying lengths above ground. Four poles (Waasgo Legend, Lakich'inei, Yaadaas Crest and Raven/Shark) were mounted with steel bolts onto separate supporting posts that were set into the ground *(see figure 2)*. The Mosquito Legend, Trader Legend and Frog Raven replicas, carved by the Civilian Conservation Corps, have concave backs (above ground only), with the full butt section of the carved poles extending into the ground — the original method for erecting totems.

A wide range of treatments was undertaken over the years to prolong the life of the poles. Some of the poles in the original collection may have had serious problems with base deterioration even in 1905 with "advanced decay" being reported by 1938. Rotted sections were cut out and recarved pieces attached in some areas during the 1930s. Exposed surfaces were treated with creosote in 1938. Between 1938 and 1940, some poles were repaired and others recarved completely. Yellow cedar logs, used as mounting posts, were treated with Avenarious Carbolineum® (highly refined penetrating creosote oil). Above-ground poles were treated with Permatox® (sodium pentachlorophenate) concentrate and coal tar, repainted and then treated with Perma Seal® varnish. By 1965, poles were being treated with pentachlorophenol. In 1972–73, the poles were taken down, most of the paint removed, then immersed in sodium fluoride and copper sulfate as a protective measure and the bases treated with "penta grease." Between 1976 and 1984, the poles were treated with a wax-mineral oil-varnish mixture (scheduled for reapplication every 3 years) and the poles were sprayed annually with 10% pentachlorophenol solution from 1976 to 1980. Since the wax-mineral oil-varnish mixture was not really effective, this treatment was discontinued by 1985.

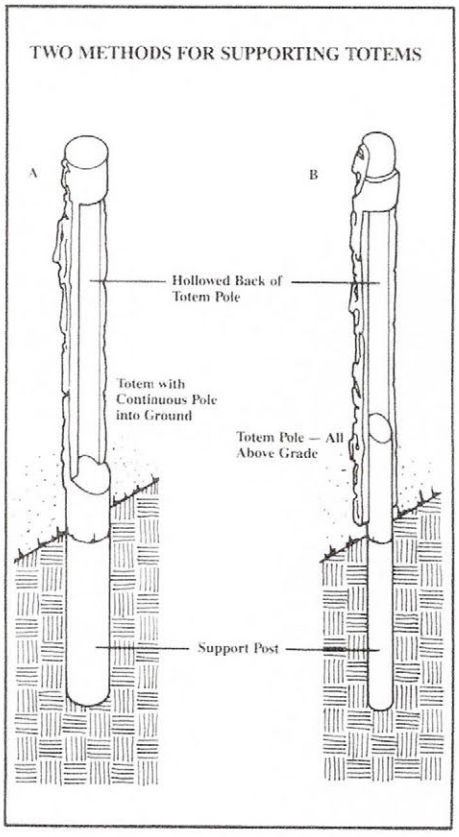


Figure 2. Two methods existed for securing the totems in place. Each of the 3 totems replicated by the Civilian Conservation Corps consisted of one continuous pole which extended into the ground (A). The other 4 totems did not extend into the ground but, rather, were attached to a separate supporting post (B). Due to the deteriorated wood below grade, all 7 totems are being re-erected using separate support posts (B). Drawing: Timothy Buehner.

Condition Survey

In 1991, a 3-day Totem Preservation Conference was held in Sitka to evaluate preservation approaches and a condition survey made of the collection. The survey included 30 carved poles and carved house poles at the park; some were on display and others were in storage *(see figure 3)*.

The 7 poles determined to be in the most advanced state of decay shared several characteristics. They were all displayed outside and, in consequence, their bases were decayed. In several cases, the moisture content of the wood to 6" above ground was an high as 47% and fungal decay on the surface was clearly evident. Damage to the bases had occurred directly above ground and below grade to a depth of 18".

Although less serious than the damage to the bases, fungal decay also had occurred at other locations. At the top of the poles, the open end grain and cracks in the wood created perfect conditions for water retention *(see figure 4)*. Some of the poles were flat at the top, permitting water ponding. Fungal decay also was evident on the horizontal surfaces of the carvings throughout the length of the poles, in crevices created by carvings, and in the cracks and splits in the wood where organic debris tended to accumulate and retain moisture. One pole had an 8 foot-long vertical split at the base. Finally, decay was evident in the concave backs of the poles that abutted supporting posts *(see figure 5)*.

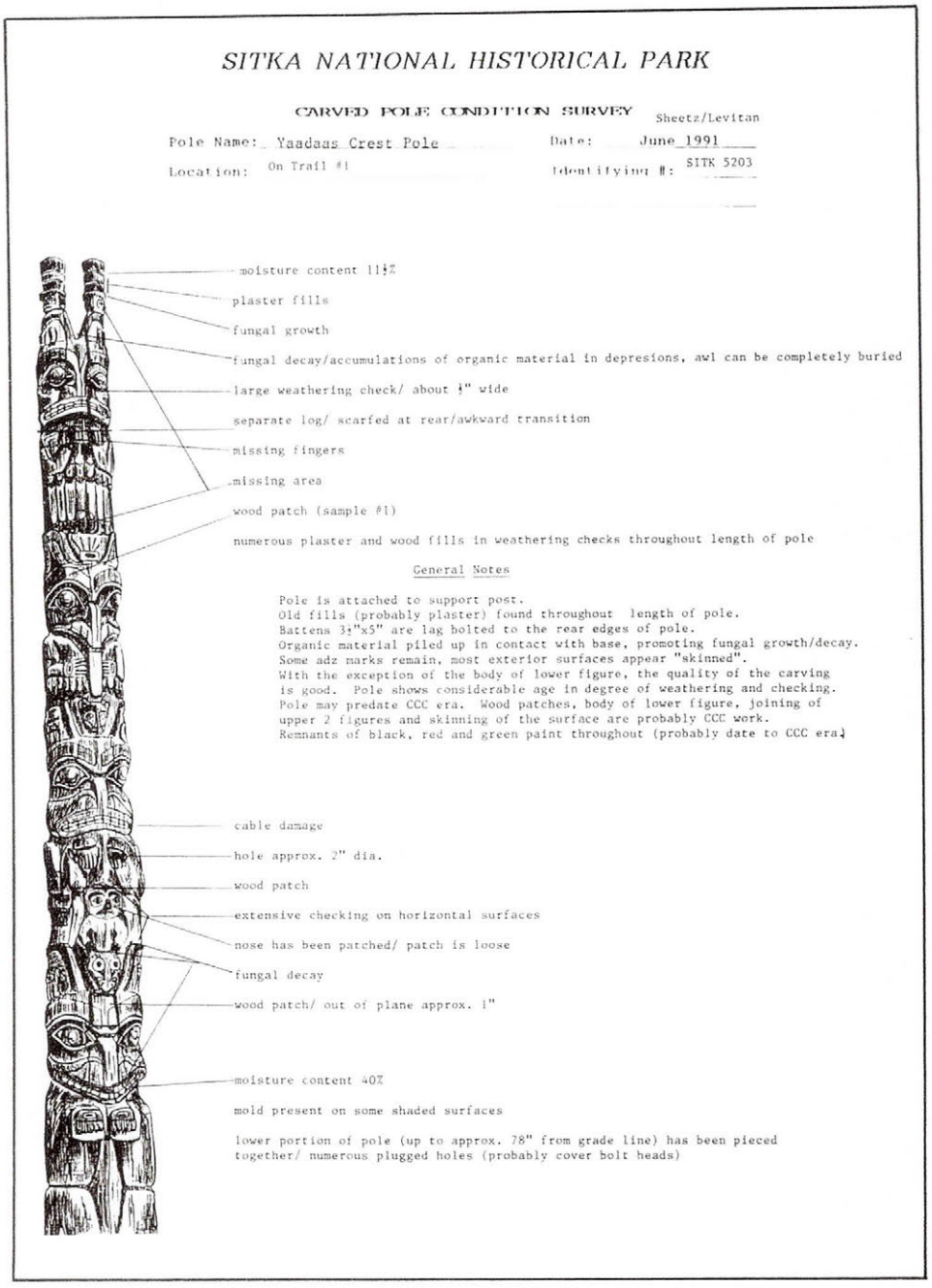


Figure 3. A condition survey of each of the 7 totem poles identified a variety of problems, including fungal decay, cracks and splits, and high moisture levels.

Solution

New support posts for the poles needed to be installed, including three that had been replaced in earlier work projects. Of greater concern, however, was choosing an appropriate method of treating the carvings along the pole to reduce water penetration and fungal decay. Three treatment goals were identified

- To provide effective protection for above-ground wood while minimizing hazards to both applicators and the environment.
- To utilize a treatment as "reversible" as possible in the event unforeseen problems or the availibility in the future of improved preservation treatments.
- To minimize changes in the appearance of the wood.

After investigation of various possible techniques, the decision was made to apply a borate preservative followed by a water repellent coating.

Borates

The prime advantage of using borate preservatives rather than other preservatives is that they are effective against brown rot and white rot fungi and most wood-destroying insects while being relatively safe for both users and the environment. Borate is a generic term for boron compounds containing the element oxygen. Boron is very toxic to most decay fungi and insects that commonly damage wood, including carpenter ants, most wood-destroying beetles and termites. While it penetrates wet wood better than dry wood and is used more commonly as a preservative for unseasoned wood, commercially available mixtures of borate and ethylene glycol provide protection even for seasoned wood. Aided by the ethylene glycol (a thick liquid alcohol), the borate solution diffuses into the wood, with greater penetration of the outer areas and also into moist areas.

The ethylene glycol used in commercial preparations will evaporate in a short time. Thus the mixture will wet and briefly darken freshly treated wood. However, this discoloration will usually diminish within a few days. After the glycol volatizes, the treatment will not affect subsequent painting, staining or the gluing of wood (appropriate glues must be used). In addition, borate compounds are not corrosive to most metal fasteners, although aluminum and galvanized metal may be affected. Borate penetration of wood can be

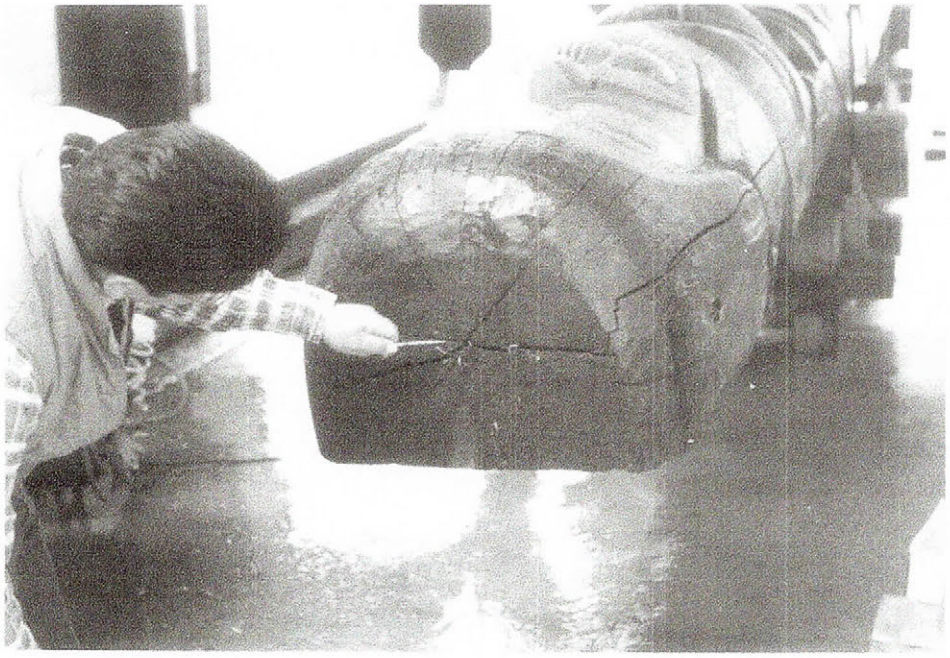


Figure 4. Organic debris had collected in the splits and cracks, contributing to moisture retention and fungal growth.

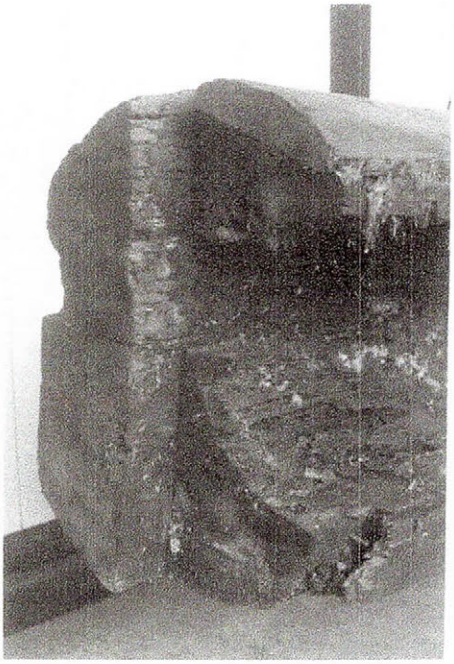


Figure 5. Deterioration occurred between the support post and the hollowed back of the totem. Coal tar had been applied in the past to the hollowed back of this totem to deter fungal decay.

readily detected by use of an applied color test for boron, but it does require slicing off a section of the wood. The work with the totem poles involved removing an underground butt section, treating it with borate and water repellent, and placing it outdoors to serve as a test.

There are some disadvantages. Borate compounds are not effective in controlling mildew fungi or soft-rot fungi. Borates are water soluble and may leach out of the surface when exposed to frequent wetting. Borates also are not as effective for applications on wood that will be used below grade, unless formulated with a co-biocide and protected from leaching. For above-grade, unpainted wood, subject to frequent wetting, a stain, paint or water repellent coating is desirable after treatment with borate preservatives. (The fact that borates are water soluble does provide for "reversibility" if there are unforeseen problems in the future.) During applications, care must be taken to protect nearby vegetation since borates are non-selective herbicides and are toxic to plants. Finally, the borate solution does not penetrate when applied to painted surfaces.

Water Repellent

It was decided that a water repellent with a mildewcide additive should be applied, after treating the totems with a borate wood preservative. A commercially available oil based water repellent was selected. According to the manufacturer, the paraffin oil penetrates the wood to form a water sealant while the soybean oil, reacts with oxygen and hardens to bond with surface fibers of the wood. The selected water repellent included in the mixture the mildewcide Busan 1009®, which is classified as a low-toxic chemical and has an odor that will dissipate in about a week's time. Application of a water repellent was considered necessary since frequent wetting of the poles would result in the borates leaching out of the unpainted wood. The mildewcide was used to reduce staining from mildew growth on the carvings. Like most water repellents, this one also caused some darkening of the wood. This was considered but some darkening was deemed acceptable, particularly since it will lighten over time. Since the effectiveness of most water repellents diminishes with age, reapplications to the totem poles will probably be needed approximately every 3 years. Samples to be taken from the test log in the future will help determine when reapplication of the borates may be needed.

Pole Preservation Procedures

The weather and work conditions necessitated that the project be done in two phases. Four poles were done in the first phase. Using a large crane and other equipment, the 1 to 2 ton totems were cut off at the decayed bases and removed to a covered area. The poles were then cleaned, using brushes to apply denatured alcohol in water in a 50/50 mixture. This was done to remove lichen, moss, and mold that was widespread at the top and at the base. Support posts were detached by removing the 1/2" all-thread steel rods that had connected the posts to the carved poles *(see figure 6)*. The totem poles then were cleaned with water using natural bristle brushes and a garden hose with a spray attachment. Since the red cedar poles had



Figure 6. Three of the 7 totems had support posts. The steel bolts connecting the support posts to the totem had rusted and often needed to be chiseled out of the support post. Note the hollowed back of the totem which extended nearly the entire length while the support post extended only about half way.

been exposed to rain, the use of water to clean them didn't present any problems.

Small pockets of decayed wood were removed from the totems. These usually occurred near the base and where the totem poles abutted the support posts at the back. Most of these pockets were small enough that patching with new wood was not warranted. All the totems had checks and splits, some as wide as one inch. Over the years, many had been filled with a variety of materials, including Plaster of Paris, wood shims, and wood filler compounds. Others were untreated but had collected organic matter. These filler materials had not moved with the old wood as it expanded and contracted. Thus, much of the filler material had separated from the wood, allowing retention of moisture that seeped in behind it. Each filled crack or split was first documented and, in most cases, the filler was removed, using compressed air, brushes, spatulas, and other small implements.

Small cracks and splits were similarly cleaned. Borates and water repellents would be used to retard water penetration and provide protection from insects and fungal decay. Large splits and cracks were handled differently because of a possible loss of structural integrity. They were filled with a flexible epoxy, fumed silica and micro-balloon mix, and then covered with an oil stain to blend with the adjacent old wood. The water repellent coating was then applied over the oil stain. In some instances where wood had been inlaid and recarved during earlier repairs, reattachment of these patches was done using an epoxy adhesive. (Future repairs with adhesives would require removal of the water repellent coating using a solvent since most adhesives do not bind to wood coated with a water repellent. Most exterior adhesives, however, will bind to wood treated with borates).

Following repairs, the poles were first treated with a commercially available borate preservative. It was purchased as a concentrate and diluted with warm water in a 1:1 mixture in accordance with label instructions. With the pole on its back, supported by cribbing and padding, the ends were treated with a brush application of the preservative as well as with any end grain exposed by carvings. The preservative was then sprayed onto the rest of the pole using a 2-gallon garden sprayer *(see figure 7)*. This was followed by a second coat, spraying slowly to ensure all cracks and crevices received ample coverage. The poles were sprayed until thoroughly wet and rotated with a chain hoist as needed. Near the surface, where wood was oversaturated with the preservatives, boron salts fluoresced on the surface after the glycol and water evaporated. The florescence was removed by wiping with a wet brush. After waiting several days for the surface to dry from the application of the wood preservative, the water repellent and mildewcide mix then was sprayed onto the pole, again using a garden sprayer to apply the mix and a brush to spread it.

Support Posts

Each of the totems needed to be fitted with a new support post. The support system selected consisted of a yellow cedar log, each engineered to size, that extended above and below grade. The yellow cedar log was shaped to fit against the concave back of the totem and bolted to it with fiberglass all-thread rods, thereby providing lateral support. Yellow cedar was chosen for the replacement bases. Yellow cedar was readily available in the required sizes and has a decay resistance similar to red cedar. Pressure-treated logs meeting project requirements were not commercially available in the Sitka area. Since the greatest deterioration would be at and below grade, a preservative treatment that could be applied in the field was necessary to facilitate future reapplications. Since major deterioration had occurred in the red cedar bases from the ground to 18" below grade, some additional protection was needed in the corresponding area of the new yellow cedar support posts.

After careful study, the decision was made to apply to the bases of the support posts a preservative in paste form that consisted of copper naphthenate and borax. This method had been developed to treat the groundline of utility poles. Copper naphthenate protects the outer layers of wood and is not readily leachable. The borate is not fixed and will move with the moisture in the wood, throughout the cross-section. A prepared bandage, consisting of the paste, applied to a polyethylene-backed wrap (bandage), was stapled to the support post so that it covered the post from of 3" above ground to 18" below the ground. It was anticipated that the copper naphthenate might migrate up the base about 6" above the bandage, giving a greenish color visible on the support base. This discoloration was not considered objectionable in the case of the support poles, since most of them at Sitka are already greenish in color at the base from



A B

Figure 7. Borates were applied to the totem using a garden sprayer and brushes. This was followed by an application of a water repellent with mildewcide. Photo A is during application and photo B shows totems while drying.

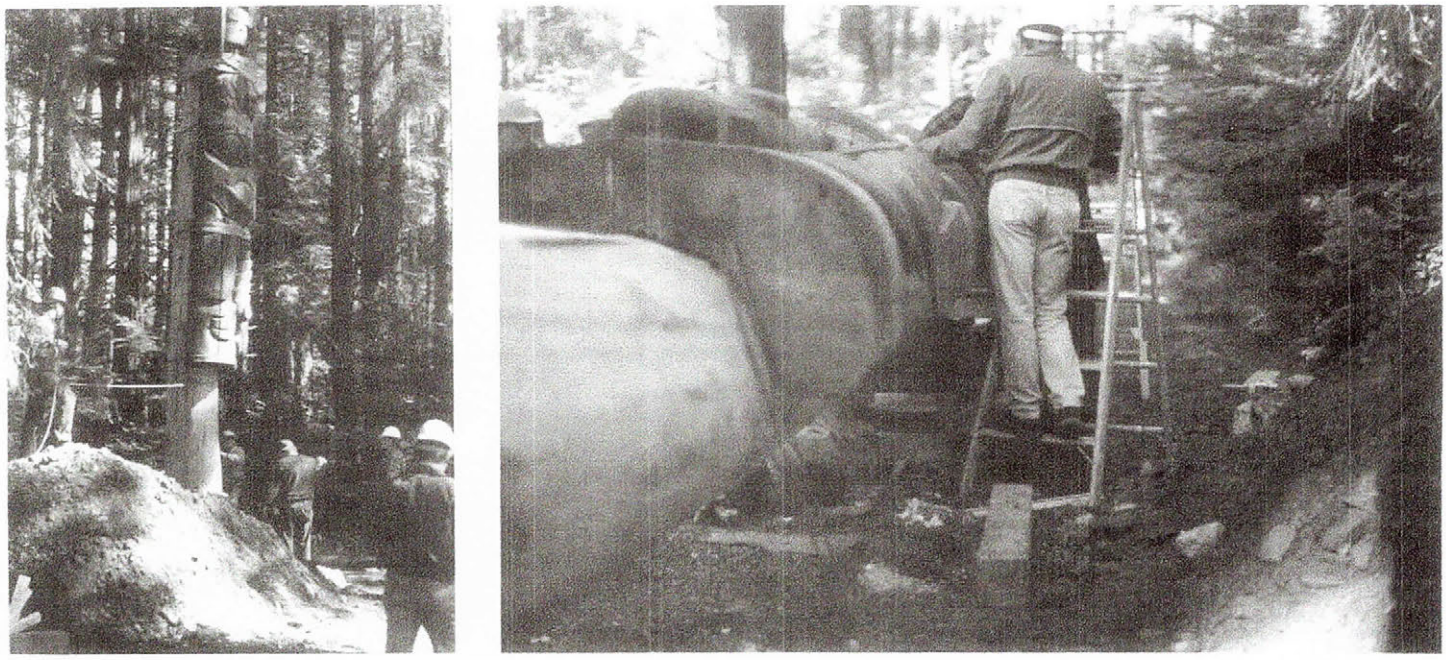


Figure 8. Due to the heavy weight of the totems, they were usually attached to their fitted support post and re-erected at the site.

mold and mildew. The utilization of a wrap or bandage was considered the most effective application method and, in addition, it would retard the borate from leaching out of the wood. It is anticipated that the wraps will be inspected in 10 years to assess their condition and possible replacement. (This would only require removal of the dirt around the bases to a depth of approximately 20" so that a new wrap could be applied, if needed.)

Upon securing the support post to the totem, the entire unit was re-erected *(see figure 8)*. The prepared bandage was fastened to the support post before the last 20" of fill dirt was added *(see figure 9)*.

Environmental and Health Considerations

The National Park Service favors an integrated pest management program (IPM) approach to pest management. This program maximizes the use of natural controls, when possible, while minimizing chemical treatments. Where chemicals are deemed necessary, it requires that chemicals may be used: (a) only after sufficient monitoring has shown that an injurious level of damage can be expected, if chemicals are not applied and, (b) when the least toxic chemicals are used. (Prior approval for use of chemical preservatives and pesticides may be necessary in organizations that have designated integrated pest management coordinators).

With the decision to keep the poles uncovered and displayed outdoors, experience had shown that effective chemical preservatives were needed in order to provide more long-term protection of the carvings.

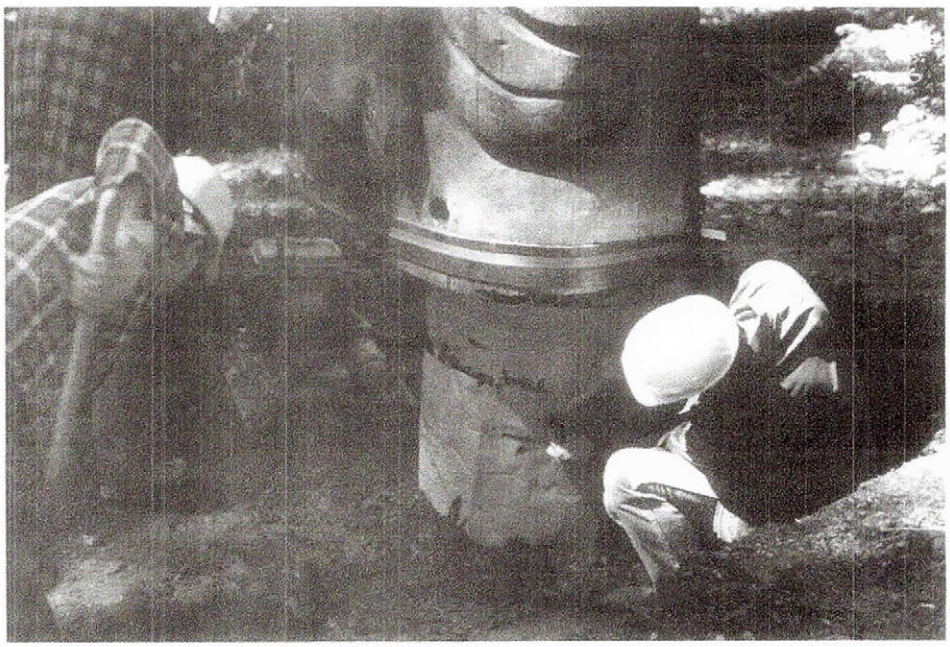


Figure 9. After securing the support post in the ground, a wood preservative in a "bandage" form was attached to the support post before dirt was filled to grade level.

Since exposed end-grains in the carvings and cracks and splits in the wood were commonplace, the unpainted poles could not be adequately protected by using water repellents alone. Clear repellents would need to be applied on a regular basis and the thoroughness of coverage would be difficult to establish over a long term, thus the need in the case of the totems of both a wood preservative and a water repellent.

Historically, the poles were painted only in selected areas and not in their entirety. No historic paint documentation existed and application of paint as a protective coating over the entire pole was not considered.

The borate application was selected as the most effective wood preservative for the totem pole, minimizing changes in appearance, as well as carrying the least safety risks.

In addition to the health precautions provided by manufacturer, nearby vegetation needs to be protected from contact during field re-application because borates are nonselective herbicides. This is accomplished by spreading a trap around the base of the totem to collect the run-off from both the borates and the water repellents with mildewcide.

Evaluation To Date

Research has indicated that borate preservatives can be effective in controlling most fungal decay and insect damage to above-ground wood. The type of wood involved, depth of penetration of the preservative, and site conditions may influence its effectiveness. It can be applied to seasoned unpainted wood in the field or under shop conditions using brushes, garden sprayers, or a dip trough.

Selected for use on various totem poles at Sitka because of its purported effectiveness and relative safety, borate treatment has potentially broad applications to wooden structures and outdoor artifacts. Log buildings, window sills, and above-ground outdoor wooden objects subject to decay or insect damage are just some of the potential applications. There are commercially available borate preservatives designed for topical applications to seasoned or partially seasoned wood such as that which was applied to the poles at Sitka. Careful monitoring of the carvings on the poles along with the test log will help document the long-term value of borate preservatives when applied to unpainted wood in this moist environment. Successful results will depend in part on regular maintenance of the poles, particularly in removing collected organic debris and in periodically reapplying a water repellent coating *(see figure 10)*.



Figure 10. Application of a water repellent to the totems will probably be needed approximately every 3 years. This can easily be done in place. The support post's "bandage" wrap located just below grade, will need to be inspected in about 10 years.

FOR FEATURE READING:

For an extensive technical and historical review of borates for wood protection, consult the proceedings of the First International Conference on Wood Protection with Diffusible Preservatives. (Available from the Forest Products Society (Telephone 608-231-1361).

Barnes, H.M.; Amburgey, T.L.; Williams, L. H.; Morrell, J.J. 1989. "Borates as Wood Preserving Compounds: The Status of Research in the United States." In: *Proceedings of the International Research Group on Wood Preservation — Working Group III: Preservatives and Methods of Treatment;* 1989 March 31; Stockholm, Sweden: IRG Secretariat: Document No: IRG/WP/3542.

Curtis, A. B., Jr.; Williams, Lonnie H. 1990. "Borates Offer Effective Protection with Less Hazard to the Environment." *Technology Update*, Southern Region, U.S. Department of Agriculture, Forest Service. Utilization Report R8-UR 6.

Quarles, William, "Borates Provide Least Toxic Wood Protection," *The IPM Practitioner.*

Williams, Lonnie H. 1990. "Diffusion Treatment of Domestic and Tropical Hardwood Lumber for Long-Term Protection from Decay Fungi and Insects." In: *Proceedings 47355. First International Conference on Wood Protection with Diffusible Preservatives.* 1990 November 27-30; Nashville, TN.

PROJECT DATA

Waasgo Legend Pole
Mosquito Legend Pole
Lekich' Inei Pole
Trader Legend Pole

Totem Poles (Phase II)-in progress:

Yaadaas Crest Pole
Frog Raven Pole
Raven/Shark Pole

Owner:

National Park Service
Sitka National Historical Park
Sitka, Alaska

Project Dates:

Summers of 1992 and 1993

Preservation Team:

Harpers Ferry Center
National Park Service
Harper Ferry, West Virginia

Williamsport Training Center
National Park Service
Williamsport, Maryland

Alaska Regional Office
National Park Service
Anchorage, Alaska

Sitka National Historical Park
National Park Service
Sitka, Alaska

Supplies:

Borate Preservative:
Bora-Care
Nisus Corporation
Knoxville, Tennessee

Water Repellent:
X-100 Natural Seal Clear
American Building Restoration Chemicals, Inc.
Franklin, Wisconsin

Base Bandage:
CuRap-20
CuRap with bandage maker
ISK Biotech Corporation
Memphis, Tennessee

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Preservation Tech Notes are designed to provide practical information on practices and innovative techniques for successfully maintaining and preserving cultural resources. All techniques and practices described herein conform to established National Park Service policies, procedures and standards. This Tech Note was prepared pursuant to the National Historic Preservation Act as amended, which directs the Secretary of the Interior to develop and make available to government agencies and individuals information concerning professional methods and techniques for the preservation of historic properties.

Comments on the usefulness of the information are welcomed and should be addressed to PRESERVATION TECH NOTES, Preservation Assistance Division-424, National Park Service, P.O. Box 37127, Washington, DC 20013-7127.

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26 PRESERVATION BRIEFS



The Preservation and Repair of Historic Log Buildings

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

The intent of this Brief is to present a concise history and description of the diversity of American log buildings and to provide basic guidance regarding their preservation and maintenance. A log building is defined as a building whose structural walls are composed of horizontally laid or vertically positioned logs. While this Brief will focus upon horizontally-laid, corner-notched log construction, and, in particular, houses as a building type, the basic approach to preservation presented here, as well as many of the physical treatments, can be applied to virtually any kind of log structure.

Log buildings, because of their distinct material, physical structure, and sometimes their architectural design, can develop their own unique deterioration problems. The information presented here is intended to convey the range of appropriate preservation techniques available. It does not, however, detail how to perform these treatments; this work should be left to professionals experienced in the preservation of historic log buildings.

Despite the publication since the 1930s of a number of books and articles on the history of log construction in America, some misconceptions persist about log buildings. Log cabins were not the first type of shelter built by all American colonists. The term "log cabin" today is often loosely applied to any type of log house, regardless of its form and the historic context of its set-



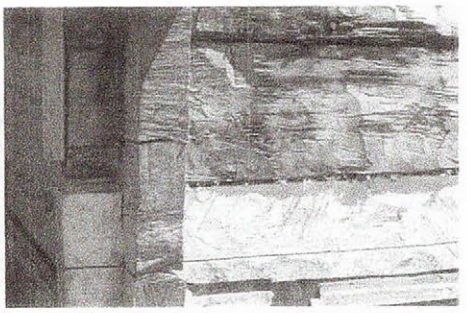
Fig. 1. Log construction was practical in the rough frontier and climate of Alaska, where it was used for a variety of structures such as the Sourdough Lodge (c. 1903) near Gakona. Built to serve the trail leading to the Klondike gold discoveries, this 1-story, L-shaped roadhouse is primarily of horizontal log construction with vertical logs in the front gable. Photo: National Park Service Files.



a



b



c

Fig. 2. Logs, both round and hewn, continued to be a basic construction material throughout much of the 19th century, here illustrated by (a) these c. 1831 industrial workers' houses for forgemen at the Mt. Etna Iron Furnace in Pennsylvania, and (b) the Larsson-Ostlund House built by Swedish immigrants in New Sweden, Maine, during the 1870s. (c) Corner detail of the Larsson-Ostlund House with the original clapboarding removed during restoration shows close-fitting log joints in the Scandinavian style that did not require chinking. Photos: (a) Jet Lowe, HAER Collection, (b-c) Maine Historic Preservation Commission.

ting. "Log cabin" or "log house" often conjures up associations with colonial American history and rough frontier life (Fig. 1). While unaltered colonial era buildings in general are rare, historic log buildings as a group are neither as old nor as rare as generally believed. One and two-story log houses were built in towns and settlements across the country until about the middle of the 19th century, and in many areas, particularly in the West, as well as the Midwest and southern mountain regions, log continued to be a basic building material despite the introduction of wooden balloon frame construction (Fig. 2). By the early 20th century, the popularity of "rustic" architecture had revived log construction throughout the country, and in many areas where it had not been used for decades.

A distinction should be drawn between the traditional meanings of "log cabin" and "log house." "Log cabin" generally denotes a simple one, or one-and-one-half story structure, somewhat impermanent, and less finished or less architecturally sophisticated. A "log cabin" was usually constructed with *round* rather than hewn, or hand-worked, logs, and it was the first generation homestead erected quickly for frontier shelter. "Log house" historically denotes a more permanent, *hewn*-log dwelling, either one or two stories, of more complex design, often built as a second generation replacement. Many of the earliest 18th and early 19th century log houses were traditionally clad, sooner or later, with wood siding or stucco.

Historical Background

No other architectural form has so captured the imagination of the American people than the log cabin. Political supporters of 1840 presidential candidate William Henry Harrison appropriated the log cabin as a campaign symbol. The log cabin was birthplace and home for young Abe Lincoln, as well as other national figures, and assumed by many 19th century historians to be the very first type of house constructed by English colonists. In 1893 Frederick Jackson Turner in his influential paper, *The Significance of the Frontier in American History* suggested that European colonists had adopted this means of shelter from the Indians.

More recent 20th century scholarship has demonstrated that horizontal log buildings were not the first form of shelter erected by all colonists in America. Nor was log construction technology invented here, but brought by Northern and Central European colonists. Finnish and Swedish settlers are credited with first introducing horizontal log building in the colony of New Sweden (now Pennsylvania) on the upper shores of Delaware Bay in 1638, who later passed on their tradition of log construction to the Welsh settlers in Pennsylvania.

During the 17th and 18th centuries, new waves of Eastern and Central Europeans, including Swiss and Germans, came to America bringing their knowledge of log construction. Even the Scotch-Irish, who did not possess a log building tradition of their own, adapted the form of the stone houses of their native country to log construction, and contributed to spreading it across the frontier. In the Mississippi Valley, Colonial French fur traders and settlers had introduced vertical log construction in the 17th century.

Through the late 18th and early 19th centuries, frontier settlers erected log cabins as they cleared land, winding their way south in and along the Appalachian valleys through the back country areas of Maryland, Virginia, the Carolinas and Georgia. They moved westward across the Appalachian Mountain barrier into the Ohio and Mississippi River valleys transporting their indispensable logcraft with them, into Kentucky and Tennessee, and as far to the southwest as eastern Texas. Log buildings are known to have been con-



Fig. 3. This mid-19th century double-pen corncrib on the Jamison Farm in Rowan County, North Carolina, is an example of a type of log building that did not require chinking. Photo: Denise Whitley.

structed as temporary shelters by soldiers during the Revolutionary War, and across the country, Americans used logs not only to build houses, but also commercial structures, schools, churches, gristmills, barns, corncribs and a variety of outbuildings (Fig. 3).

Around the mid-19th century, successive generations of fur traders, metal prospectors, and settlers that included farmers and ranchers began to construct log buildings in the Rocky Mountains, the Northwest, California, and Alaska (Fig. 4). In California and Alaska, Americans encountered log buildings that had been erected by Russian traders and colonists in the late 18th and early 19th centuries. Scandinavian and Finnish immigrants who settled in the Upper Midwest later in the 19th century also brought their own log building techniques with them. And, many log structures in the Southwest, particularly in New Mexico, show Hispanic influences of its early settlers.

While many parts of the country never stopped building with logs, wooden balloon frame construction had made it obsolete in some of the more populous parts of the country by about the mid-19th century. However, later in the century, log construction was employed in new ways. In the 1870s, wealthy Americans initiated the Great Camp Movement for rustic vacation retreats in the Adirondack Mountains of upstate New York. Developers such as William Durant, who used natural materials, including wood shingles, stone, and log—often with its bark retained to emphasize the Rustic style—designed comfortable summer houses and lodges that blended with the natural setting (Fig. 5). Durant and other creators of the Rustic style drew upon Swiss chalets, traditional Japanese design, and other sources for simple compositions harmonious with nature.

The Adirondack or Rustic style was balanced in the West with construction of the Old Faithful Inn at Yellowstone National Park in Wyoming, designed by Robert C. Reamer, and begun in 1903 (Fig. 6). This popular resort was tremendously influential in its use of locally-available natural materials, especially log, and gave impetus to Rustic as a true national style. From the turn of the century through the 1920s, Gustav

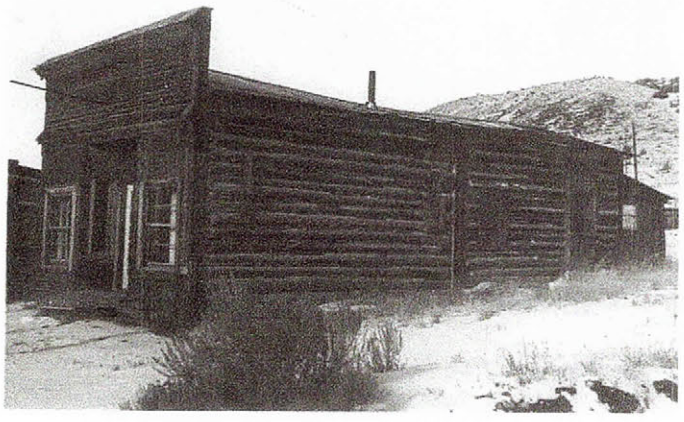
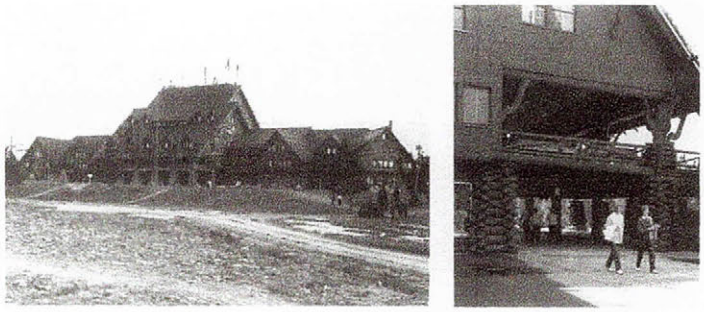


Fig. 4. Beginning around the mid-19th century, entire western boomtowns were hastily constructed of frame and log, such as the buildings in Bannack, Montana, the site of the State's first gold discovery. Photo: National Park Service Files.



Fig. 5. The main lodge of Echo Camp on Raquette Lake in New York State was built in 1883 by the governor of Connecticut. It typifies the Adirondack style in the use of exposed round logs with crowns, and porches and balconies constructed with bowed logs and round log columns. Photo: Courtesy The Adirondack Museum.



a *b*

Fig. 6. (a) Old Faithful Inn, Yellowstone National Park, Wyoming, shown here in 1912, brought the Rustic style to the West in 1903 in an original design, and a scale befitting its setting. (b) Although only the first story is of horizontal log construction, the use of logs is striking in the trestle work and cribbed piers around the entrance. Photo: (a) Courtesy National Park Service, (b) Laura Soulliere Harrison.

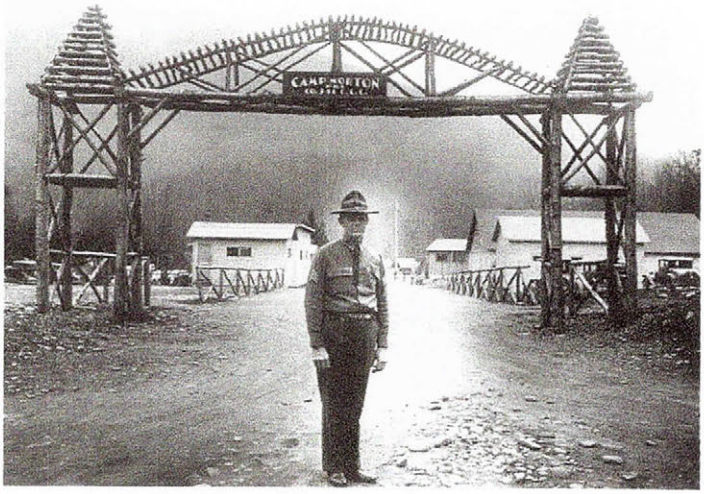


Fig. 7. The Civilian Conservation Corps built many recreational log structures across the country in the 1930s and 40s, including this rustic log gateway to Camp Morton, Lycoming County, Pennsylvania. Photo: Courtesy Lycoming County Historical Society and Museum.

Stickley and other leaders of the Craftsman Movement promoted exposed log construction. During the 1930s and 40s, the Civilian Conservation Corps (CCC) used log construction extensively in many of the country's Federal and State parks to build cabins, lean-tos, visitor centers, and maintenance and support buildings that are still in service (Fig. 7).

Traditional Log Construction

Plan and Form

When settlers took the craft of log construction with them onto the frontier, they successfully adapted it to regional materials, climates and terrains. One of the most notable characteristics of the earliest 18th and 19th century log houses is the plan and form. The plan can sometimes provide clues to the ethnic origin or route of migration of the original inhabitant or builder. *But in the absence of corroborating documentary evidence, it is important not to infer too much about the ethnic craft traditions of a particular log house.*

Historians have identified a number of traditional house plans and forms as prototypes (Fig. 8). They were often repeated with simple variations. The basic unit of each of these types is the one room enclosure formed by four log walls joined at their corners, called a single "pen" or "crib." The single pen was improved upon by installing interior partitions or by adding another log pen. Some variations of historic log house plans include: the typically mid-Atlantic "continental" plan, consisting of a single-pen of three rooms organized around a central hearth; the "saddlebag" or double-pen plan, composed of two contiguous log pens; and the "dogtrot" plan, formed by two pens separated by an open passage space (sometimes enclosed later), all covered by a continuous roof. The continental plan originated in central and eastern Europe and is attributed to 18th century German immigrants to Pennsylvania. Non-log interior partition walls form the multi-room plan within the exterior log walls. The saddlebag plan consists of two adjoining log pens that share a central chimney. A saddlebag is often the evolution of a single pen with an end chimney, expanded by adding a second pen onto the chimney endwall. The saddlebag was built in a number of different regions across the country. The dogtrot plan may be seen with variation in many parts of the country, although it is sometimes, perhaps erroneously, considered the most typically southern, because its covered passageway provided both air circulation and shelter from the heat. All these plan types were typically built in the form of one or one-and-one-half story settlement cabins.

A somewhat different form evolved in the West around the middle of the 19th century which became especially distinctive of the Rocky Mountain cabin. While the entrance doorway to most earlier log houses was generally placed beneath the eaves, as a means of adapting to the greater snowfall in the Rockies, here the entrance was placed in the gable end, and sometimes protected from roof slides by a porch supported by two corner posts created by an extension of the roof beyond the gable wall (Fig. 9).

From the late 18th through the mid-19th centuries, Americans also built many substantial two-story log

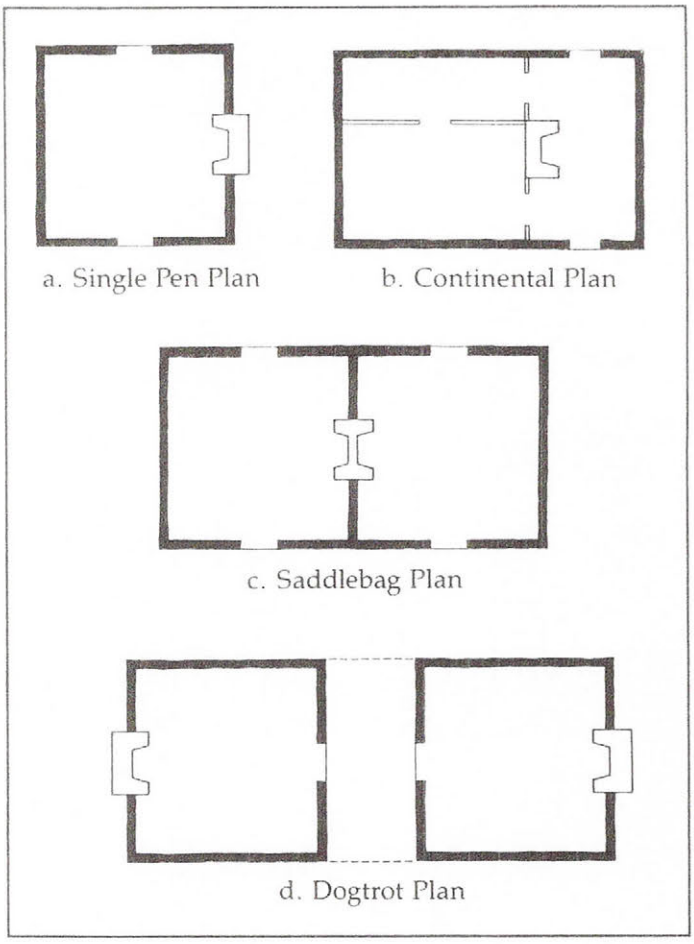


Fig. 8. These log house plans represent some of the basic housing forms constructed during the 18th and 19th centuries, and include: (a) single pen, (b) continental, (c) saddlebag, and (d) dogtrot. Drawing: James Caufield.

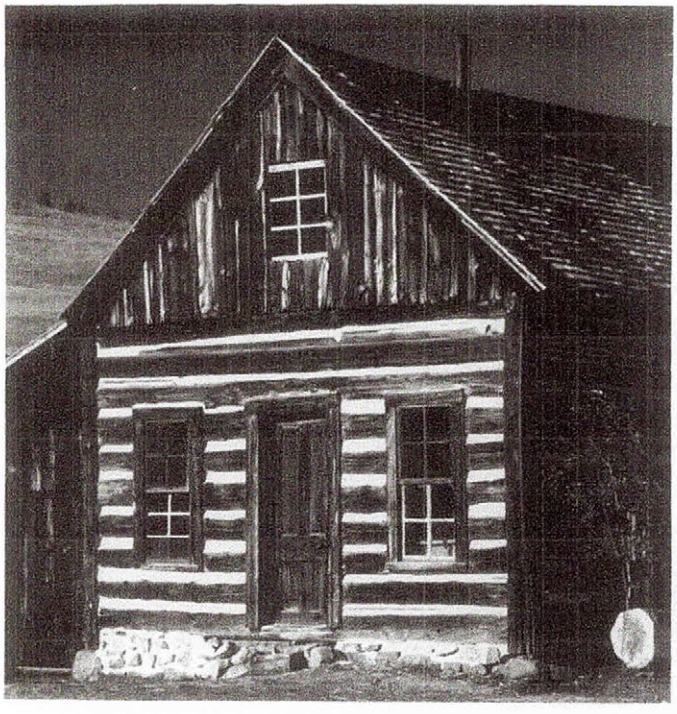


Fig. 9. This historic log building on the Walker Ranch in Boulder, Colorado is an example of the Rocky Mountain cabin form which is typified by the entrance door being located in the gable end. Photo: Bernard Weisgerber.

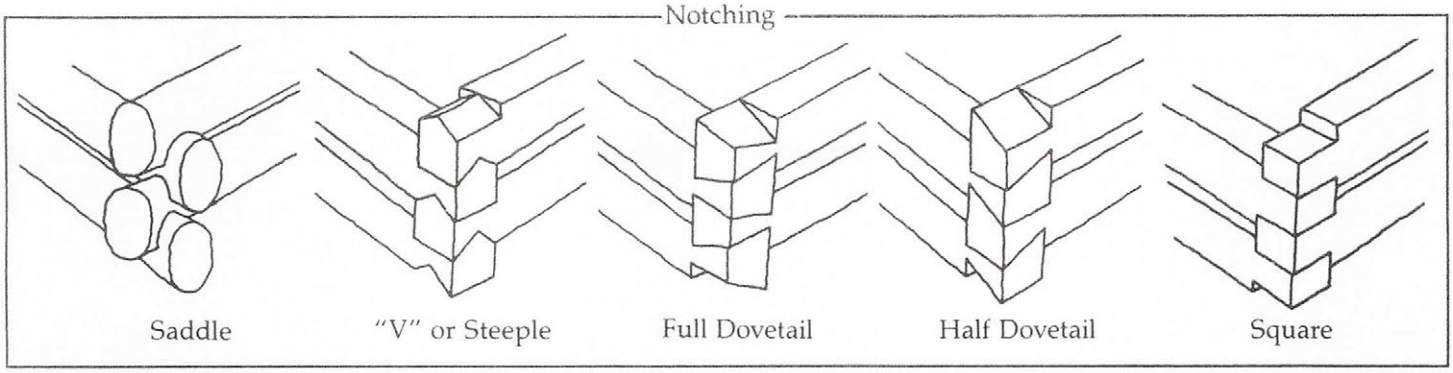


Fig. 10. Five examples of the more common historical methods of corner notching. Drawing: James Caufield.

houses in towns throughout the eastern half of the country. In rural areas two-story log houses were sometimes built to replace earlier, first-generation settlement cabins, but just as often the early hewn-log house was retained and enlarged. A second story was added by removing the roof and gables, constructing a second floor, laying additional courses of logs, and building a new roof, or reassembling the old one. Each generation of owners might expand an early log core building by adding on new log pens, or masonry or wood frame extensions. The addition of a rear ell, or infill construction to link a formerly free-standing outbuilding, such as a kitchen to the log main house was particularly common. Such a layering of alterations is part of the evolution of many log buildings.

Corner Notching and Other Fastening Techniques

Corner notching is another of the characteristic features of log construction. Most notching methods provide structural integrity, by locking the log ends in place, and give the pen rigidity and stability. Like the floor plan, the type of corner notching can sometimes be a clue to the ethnic craft origin of a log building, but it is important not to draw conclusions based only on notching details. Numerous corner notching techniques have been identified throughout the country (Fig. 10). They range from the simple "saddle" notching, which demands minimal time and hewing skill, to the very common "V" notching or "steeple" notching, to "full dovetail" notching, one of the tightest but most time-consuming to accomplish, "half-dovetail" notching which is probably one of the most common, and "square" notching secured with pegs or spikes.

The notching method on some of the earliest eastern cabins and most 19th century western cabins, particularly saddle notching, left an extended log end or "crown." Crowns are especially pronounced or exaggerated in Rustic style structures, and sometimes they are cut shorter as the wall rises, creating a buttress effect at the corners of the building.

Another method of securing log ends consists of fastening logs that are laid without notching ("false notching") with tenons into vertical corner posts, or using spikes or pegs to attach them to vertical corner planks. Vertically positioned logs were secured at their top and bottom ends, usually into roof and sill plate timbers.

Selecting Logs and Assembling the Building

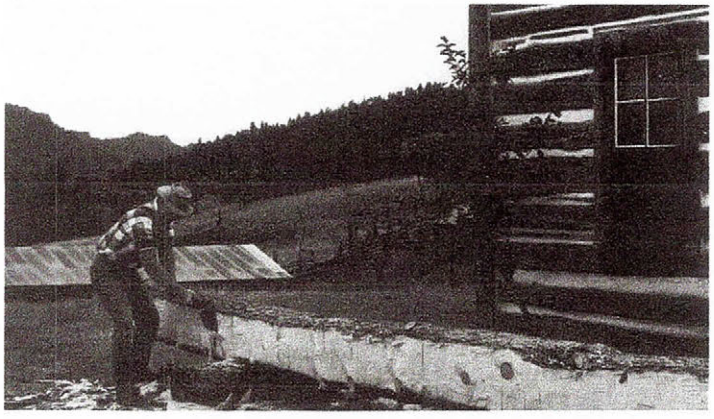
Although wood selection was most likely to be determined by availability, chestnut, white oak, cedar, and fir were preferred because these trees could provide



a



b



c

Fig. 11. Log-hewing tools and techniques: (a) scoring the log with a single-bladed felling axe, or "pole axe" in preparation for removing a uniform thickness of wood; (b) removal to depth of scoring; (c) finish hewing with a broad axe. Photos: Courtesy Bernard Weisgerber.

long, straight, rot-resistant logs. Pine, which also provided long straight logs, was also used in areas where it was plentiful. Woods were often mixed, utilizing harder, heavier rot-resistant wood such as white oak for the foundation "sill log", and lighter, more-easily hewn wood such as yellow poplar for the upper log courses.

One of the principal advantages of log construction was the economy of tools required to complete a structure (Fig. 11). A felling axe was the traditional tool for bringing down the tree and cutting the logs to length. For many frontier and western structures the round logs were debarked or used in their original form with the bark left on, or one or more sides of the logs were hewn flat with a broadaxe, or more finely finished with an adze as smooth thick planks. Notching was done with an axe, hatchet or saw; openings for doors and windows were usually cut after the logs were set into place, and door and window frames, particularly jambs, were put in place during construction to help hold the logs in place. Roof framing members and floor joists were either hewn from logs or of milled lumber. A log cabin could be raised and largely completed with as few as two to four different tools, including a felling axe, a broad axe, and a hand saw or crosscut saw.

The upper gable walls were completed with logs if the roof was constructed with purlins, which is more typical of Scandinavian or Finnish construction, and western and 20th century Rustic styles. However, vertical or horizontal weatherboard sheathing was commonly used throughout the country to cover wood-framed gables.

Chinking and Daubing

The horizontal spaces or joints between logs are usually filled with a combination of materials that together is known as "chinking" and "daubing." Chinking and daubing completed the exterior walls of the log pen by sealing them against driving wind and snow, helping them to shed rain, and blocking the entry of vermin. In addition, chinking and daubing could compensate for a minimal amount of hewing and save time if immediate shelter was needed. Not all types of log buildings were chinked. Corncribs, and sometimes portions of barns where ventilation was needed were not chinked. While more typical of Swedish or Finnish techniques, and not as common in American log construction, tight-fitting plank-hewn or scribed-fit round logs have little or no need for chinking and daubing.

A variety of materials were used for chinking and daubing, including whatever was most conveniently at hand. Generally though, it is a three-part system applied in several steps. The chinking consists of two parts: first, a dry, bulky, rigid blocking, such as wood slabs or stones is inserted into the joint, followed by a soft packing filler such as oakum, moss, clay, or dried animal dung (Fig. 12). Daubing, which completes the system, is the outer wet-troweled finish layer of varying composition, but often consisting of a mixture of clay and lime or other locally available materials. Instead of daubing, carefully fitted quarter poles or narrow wood strips were sometimes nailed lengthwise across the log joints.

Chinking, especially the daubing, is the least durable part of a log building. It is susceptible to cracking as a result of freeze-thaw action, structural settlement, drying of the logs, and a thermal expansion-contraction rate that differs from that of the logs. Seasonal deterioration of chinking necessitates continual inspection and regular patching or replacement.

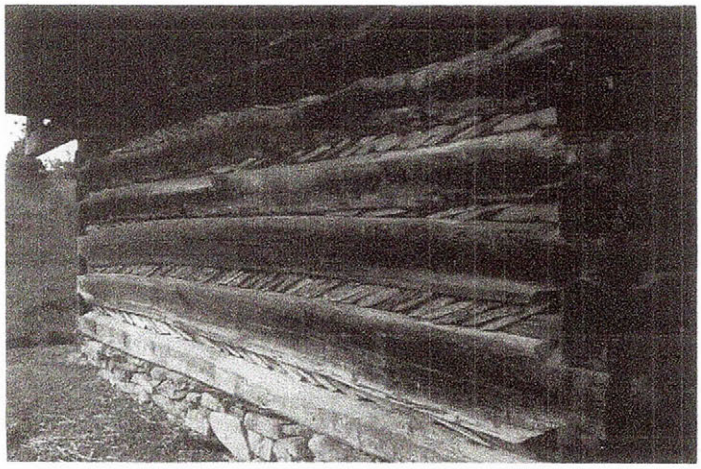


Fig. 12. The log joints have been cleaned out in preparation for new daubing exposing carefully laid stone chinking in this building in Virginia. Photo: Bernard Weisgerber.

Exterior Wall Treatments

Although the exterior logs of cabins in the West, and 20th century Rustic buildings are generally not covered, many 18th and 19th century log houses east of the Mississippi, with the exception of some of the simpler cabins and houses in remote or poorer areas, were covered with exterior cladding. The exterior of the log walls was covered for both aesthetic and practical reasons either as soon as the building was completed or sometime later.

In some instances, the exterior (and interior) of the logs was whitewashed. This served to discourage insects, and sealed hairline cracks in the daubing and fissures between the daubing and logs. Although the solubility of whitewash allows it to heal some of its own hairline cracks with the wash of rain, like daubing it has to be periodically reapplied. Usually, a more permanent covering such as wood siding or stucco was applied to the walls, which provided better insulation and protection, and reduced the maintenance of the log walls.

Sometimes log houses were sided or stuccoed later in an attempt to express a newly-achieved financial or social status. Many log houses were immediately sided and trimmed upon completion to disguise their simple construction beneath Georgian, Federal and later architectural styles. Frequently a log house was covered, or recovered, when a new addition was erected in order to harmonize the whole, especially if the original core and its addition were constructed of different materials such as log and wood frame (Fig. 13).

Vertical wood furring strips were generally nailed to the logs prior to applying weatherboarding or stucco (Fig. 14). This ensured that the walls would be plumb, and provided a base on which to attach the clapboards, or on which to nail the wood lath for stucco.

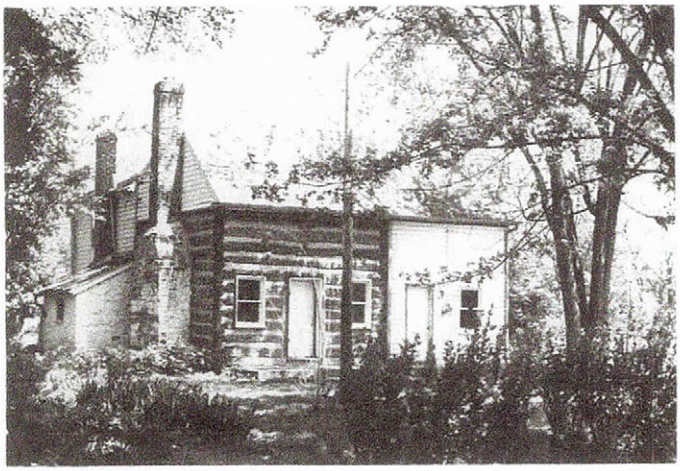


Fig. 13. Historic wood clapboard siding originally applied to conceal the fact that this house was built in two sections of different materials has been inappropriately removed from the 1793 log portion. Photo: National Park Service Files.



Fig. 14. Removal of the historic wood siding from the 1804 Zachariah Price DeWitt House in Butler County, Ohio, reveals that the clapboards were attached to vertical wood furring strips nailed to the logs. Photo: National Park Service Files.

Foundations

Log building foundations varied considerably in quality, material, and configuration. In many cases, the foundation consisted of a continuous course of flat stones (with or without mortar), several piers consisting of rubblestone, single stones, brick, short vertical log pilings, or horizontal log "sleepers" set on grade. The two "sill logs," were laid directly upon one of these types of foundations.

Climate and intended permanence of the structure were the primary factors affecting foundation construction. The earliest log cabins, and temporary log dwellings in general, were the most likely to be constructed on log pilings or log sleepers set directly on grade. Where a more permanent log dwelling was intended, or where a warm, humid climate accelerated wood decay, such as in the South, it was sometimes more common to use stone piers which allowed air to circulate beneath the sill logs. Full cellars were not generally included in the original construction of most of the earliest log houses, but root cellars were often dug later.

Roofs

Log buildings were roofed with a variety of different framing systems and covering materials. Like log house plans and corner notching styles, the types of roof framing systems used were often variations on particular ethnic and regional carpentry traditions. In most cases wood shingles were the first roof covering used on the earliest 18th and 19th century log houses. As wood shingle roofs deteriorated, many were replaced with standing seam metal roofs, many of which continue to provide good service today. Later pioneer log buildings west of the Mississippi were likely to be roofed with metal or roll roofing, or even with sod. Other log buildings have been re-roofed in the 20th century with asphalt shingles. For some rustic log buildings in the West and Great Camps in the Adirondacks, asphalt shingles are the original historic roofing material.

Chimneys

Ethnic tradition and regional adaptation also influenced chimney construction and placement. Chimneys in log houses were usually built of stone or brick, a combination of the two, or even clay-lined, notched logs or smaller sticks (Fig. 15). Later log buildings were frequently constructed with only metal stacks to accommodate wood stoves. The chimneys of log buildings erected in cold climates tended to be located entirely inside the house to maximize heat retention. In the South, where winters were less severe the chimney stack was more typically constructed outside the log walls. With the advent of more efficient heating systems, interior chimneys were frequently demolished or relocated and rebuilt to maximize interior space.

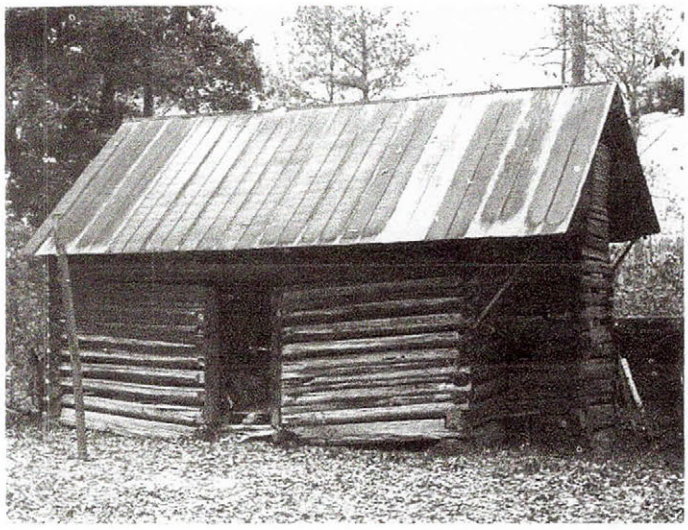


Fig. 15. The mid-19th century O'Quinn House, Moore County, North Carolina, provides a rare surviving example of a clay-lined log chimney. Although the logs of the house are saddle-notched, the chimney logs are "V" notched. The roof was extended out over the chimney to protect the daubing from the weather, and the chimney stack would have originally projected through a hole in the roof. Photo: Michael Southern.

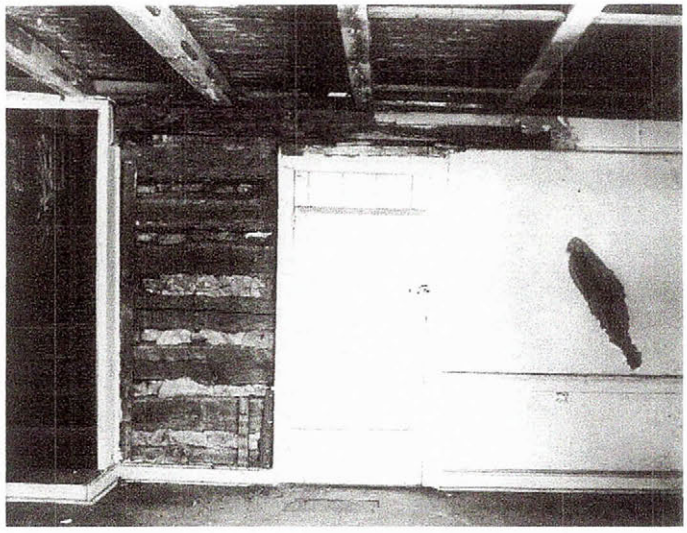


Fig. 16. This photograph of the interior of a 1793 log house in Maryland reveals much about historic log building construction and interior finish treatments. To the left of the plank door plaster has been removed exposing the stone chinking and daubing; remnants of vertical furring strips attached to the logs show evidence of traditional horizontal lath, while the hole broken through the plaster wall on the right shows the use of diagonal lath. The open door reveals a very steep, enclosed stairway typical of many early log houses. Although plaster has been removed from the ceiling, the wall to the right of the door shows the original plaster finish and fine woodwork including beaded chair rail, floor and door molding. Photo: National Park Service Files.

Interior Finishes

Logs on the interiors of many of the simpler cabins and Rustic style structures were often given a flattened surface or left exposed. But, in the more finished log houses of the 18th and 19th century, they were more commonly covered for most of the same reasons that the exterior of the logs was covered—improved insulation, ease of maintenance, aesthetics, and keeping out vermin. Covering the interior log walls with planks, lath and plaster, boards pasted with newspaper, fabric such as muslin, or wallpaper increased their resistance to air infiltration and their insulation value. Finished walls could be cleaned and painted more easily, and plastered walls and ceilings obscured the rough log construction and prepared interior surfaces for decorative wood trim in the current styles (Fig. 16).

Historical Evaluation and Damage Assessment

Before undertaking preservation work on a historic log building, its history and design should be investigated, and physical condition evaluated. It is always advisable to hire a historical architect or qualified professional experienced in preservation work to supervise the project. In addition, State Historic Preservation Offices, regional offices of the National Park Service, and local historical commissions may also provide technical and procedural advice.

The historical investigation should be carried out in conjunction with a visual inspection of the log building. Physical assessment needs to be systematic and thorough. It should include taking notes, photographs or video recording, and making drawings of existing conditions, including overall and detail views. This will serve as a record of the appearance and condition which can be referred to once work is under way. A physical assessment should also identify causes of deterioration, not just symptoms or manifestations and, in some instances, may need to include a structural investigation.

Foundation Inspection

The foundation of a log building should always be inspected before beginning work because, as in any building, foundation-related problems can transfer structural defects to other components of the building. Settling of the foundation is a typical condition of log buildings. If settlement is not severe and is no longer active, it is not necessarily a problem. If, however, settlement is active or uneven, if it is shifting structural weight to unintended bearing points away from the intended main bearing points of the corner notches and sill log, serious wall deflections may have resulted. Causes of settlement may include foundation or chimney stones or sill logs that have sunk into the ground, decay of log pilings, log sleepers, or of the sill logs themselves.

Log Inspection

Foundation problems usually result in damage to the sill logs and spandrels, which are often the most susceptible to deterioration. Sill logs, along with the corner notching, tend to bear most of the weight of the building, and are closest to vegetation and the ground, which harbors wood-destroying moisture and insects. If the sill log has come into contact with the ground, deterioration is probably underway or likely to begin (Fig. 17). It is also important to check the drainage around the building. The building assessment should note the condition of each log and attempt to identify the sources of problems that appear to exist.

Sill log inspection should not necessitate destruction of historic exterior cladding if it exists. Inspection can usually be made in areas where cladding is missing,



Fig. 17. Contact of this building's sill log with the ground has led to its decay, infestation by wood-destroying insects, and resulting building settlement. Photo: Anne Grimmer.

loose, or deteriorated. Sill log, as well as upper log, deterioration may also be revealed by loose or peeling areas of the cladding. If pieces of cladding must be removed for log inspection, they should be labeled and saved for reinstallation, or as samples for replacement work. Historic cladding generally need not be disturbed unless there are obvious signs of settling or other indications of deterioration.

Other areas of the log walls which are particularly susceptible to deterioration include window and door sills, corner notches, and crowns, and any other areas regularly saturated by rain run-off or backsplash. The characteristic design feature of Adirondack or Rustic style log buildings of leaving log ends or crowns to extend beyond the notched corners of the building positions the crowns beyond the drip-line of the roof edge. This makes them vulnerable to saturation from roof run-off, and a likely spot for deterioration. Saddle notching in which the cut was made out of the top surface of the log and which cups upward, and flat notching, may also be especially susceptible to collecting run-off moisture.

Detection of decay requires thorough inspection. Probing for rot should be done carefully since repair techniques can sometimes save even badly deteriorated logs. Soft areas should be probed with a small knife blade or icepick to determine the depth of decay. Logs should be gently tapped at regular intervals up and down their lengths with the tool handle to detect hollow-sounding areas of possible interior decay. Long cracks which run with the wood grain, called "checks," are not signs of rot, but are characteristic features of the seasoning of the logs. However, a check can admit moisture and fungal decay into a log, especially if it is located on the log's upper surface. Checks should also be probed with a tool blade to determine whether decay is underway inside the log.

Sill log ground contact and relative moisture content also provide ideal conditions for certain types of insect infestation. Wood building members, such as sill logs or weatherboarding, less than eight inches from the ground, should be noted as a potential problem for monitoring or correction. Sighting of insects, or their damage, or telltale signs of their activity, such as mud tunnels, exit holes, or "frass," a sawdust-like powder, should be recorded. Insect infestation is best treated by a professionally licensed exterminator, as the chemicals used to kill wood-destroying insects and deter re-infestation are generally toxic.

Roof Inspection

Along with the foundation, the roof is the other most vital component of any building. The roof system consists of, from top to bottom, the covering, usually some form of shingles or metal sheeting and flashing; board sheathing or roof lath strips; the framing structure, such as rafters or purlins; the top log, sometimes referred to as the "roof plate" or "rafter plate;" and, sometimes, but not always, gutters and downspouts.

The roof and gutters should be inspected and checked for leaks both from the exterior, as well as inside if possible. Inspection may reveal evidence of an earlier roof type, or covering, and sometimes remnants of more than one historic covering material. The roof may be the result of a later alteration, or raised when a second story was added, or repaired as the result of storm or fire damage. Often, roof framing may be composed of reused material recycled from earlier buildings. Inspection of the roof framing should note its configuration and condition. Typical problems to look for are framing members that have been dislodged from their sockets in the roof plate, or that are cracked, ridge damage, sagging rafters, broken ties and braces, and decay of exterior exposed rafter or purlin ends, especially common on Rustic style buildings (Fig. 18).



Fig. 18. Exposed roofing members of Rustic style buildings such as this structure at Yellowstone National Park are highly susceptible to deterioration. Photo: Laura Soulliere Harrison.

Other Features

The rest of the building should also be inspected as part of the overall assessment, including siding, window sash and frames, door frames and leafs, chimneys, porches, and interior walls, trim, and finishes. Any of these features may exhibit deterioration problems, inherent to the material or to a construction detail, or may show the effects of problems transmitted from elsewhere, such as a deformed or mis-shapen window frame resulting from a failed sill log. The inspection should note alterations and repairs made over time, and identify those modifications which have acquired significance and should be preserved. Nothing should be removed or altered before it has been examined and its historical significance noted.

Preservation Treatments

Since excessive moisture promotes and hastens both fungal and insect attack, it should be dealt with immediately. Not only must the roof and gutters be repaired —if none exist, gutters should probably be added—but the foundation grade should be sloped to ensure drainage away from the building. If the distance from the ground to the sill log or exterior sheathing is less than eight inches, the ground should be graded to achieve this minimum distance. Excess vegetation and debris such as firewood, dead leaves, or rubbish should be cleared from the foundation perimeter, and climbing vines whose leaves retain moisture and tendrils erode daubing, should be killed and removed. Moisture problems due to faulty interior plumbing should also be remedied. Solving or reducing moisture problems may in itself end or halt the progress of rot and wood-destroying insects.

Log Repair

Stabilizing and repairing a log that has been only partially damaged by decay or insects is always preferable to replacing it. Retaining the log, rather than substituting a new one, preserves more of the building's integrity, including historic tool marks and the wood species which may no longer be obtainable in original dimensions. Log repair can generally be done with the log in place at less cost, in less time, and with less damage to building fabric, than by removing, and installing a new hewn and notched replacement log. Log repair is accomplished by two basic methods: traditional methods of splicing-in new or old wood, or through the use of epoxies. These treatments are sometimes combined, and may also be used in conjunction with reinforcing members. *Historic log repair, whether it involves patching techniques or the use of epoxies, should always be performed only by an experienced craftsperson or architectural conservator.*

Wood Splicing

Wood splicing can involve several types of techniques. Also referred to as "piecing-in" or "Dutchman" repair, it involves treating a localized area of deterioration by cutting out the decayed area of the log, and carefully carving and installing a matching, seasoned wood replacement plug or splice. The wood species, if available, and the direction and pattern of the grain should match that of adjacent original wood. The location and depth of decay should determine the splicing technique to be used. In a case where decay runs deep within a log, a full-depth segment containing the affected area can be cut out, severing the log completely, and a new segment of log spliced in, using angled "scarf" joints or square-cut "half-lap" joints (Fig. 19). The splice is secured to the severed log by angling lag screws or bolts through the upper and lower surfaces that will be concealed by daubing.

Splicing can also be performed using epoxy as an adhesive. A log with shallow decay on its outer face can be cut back to sound depth, and a half-log face spliced on, adhered with epoxy, screws or bolts. A technique for the repair of badly deterioriated log crowns involves cutting them back to sound wood, and into the notching joint if necessary, and installing new crowns cut to match. Fiberglass or aluminum reinforcement rods are inserted into holes drilled into the new crowns, and into corresponding holes drilled in the ends of the original cut-off logs. Epoxy is used as an adhesive to attach and hold the new crowns in place. Long lag screws can be angled up through the underside of the crown into the log above to provide additional support for the repair.

Epoxy Consolidation and Repair

In some instances, epoxies may be used by themselves to consolidate and fill the voids left by deteriorated wood. Epoxies are versatile in performance, relatively easy to use by experts, and, after curing, may be shaped with wood-working tools. Their use requires that sufficient sound wood survives for the epoxy to adhere. But they can be used to stabilize rotted wood, return full or greater than original strength to decayed structure-bearing members, and to reconstitute the shape of decayed log ends. Epoxies resist decay and

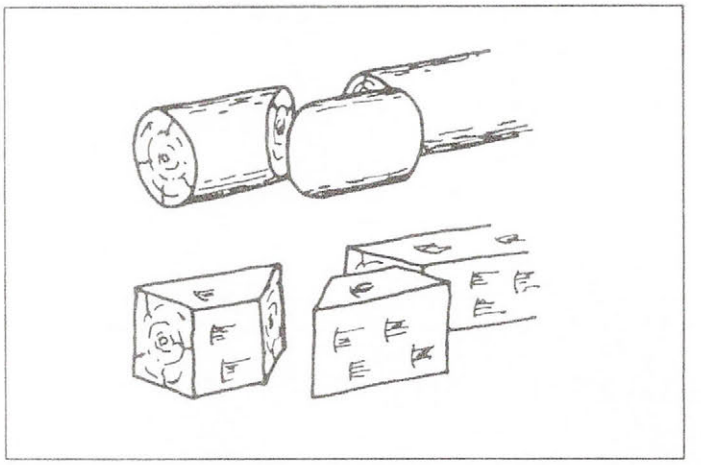
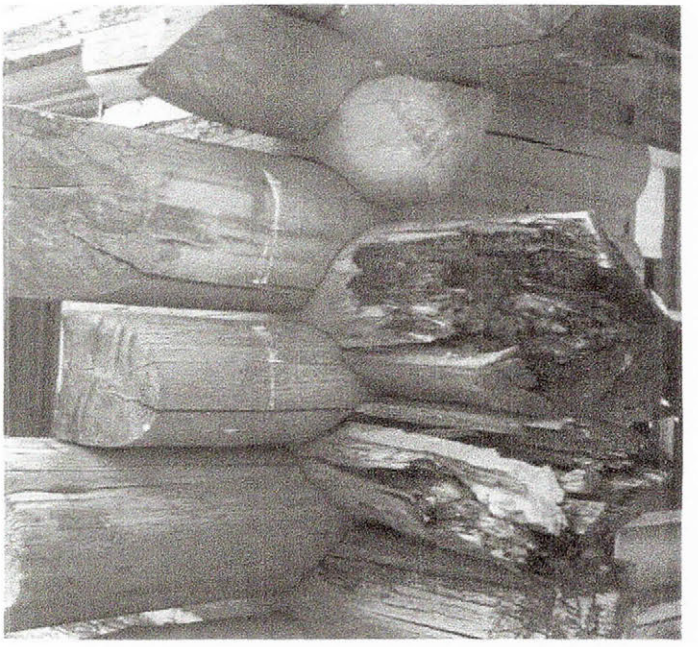
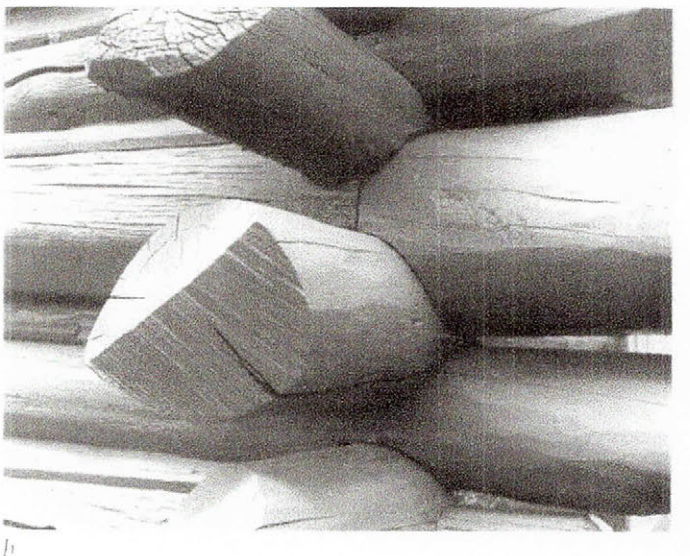


Fig. 19. Log splicing with scarf joints. Drawing: Harrison Goodall.



a



b

Fig. 20. (a) These deteriorated log crowns were (b) repaired with new crowns which were attached to the historic logs with reinforcing bars and epoxy. Epoxy repair of log crowns is most successful when the repaired crowns are protected from excess moisture by a roof overhang. Photos: Harrison Goodall.

insects, and while epoxy itself is resistant to moisture, epoxy tends to cause adjacent wood to retain moisture rather than dry out, and if not used in the right location, can actually further a continuing cycle of wood decay. Hence, epoxy repairs are most successful in areas where they are protected from moisture. Epoxies, of which there are a variety of commercially-available products on the market, are prepared in essentially two forms: a liquid consolidant and a flexible putty filler. Each consists of a resin and a hardener which must be mixed prior to use.

The technique of treating, for an example, a decayed log crown with epoxies is begun by removing loose decayed wood, and drying the area if necessary (Fig. 20). The rot-affected cavity and surface of the log end is then saturated with liquid epoxy by repeated brushing, or by soaking it in a plastic bag filled with epoxy that is attached to the log. The porous condition of the rot-damaged wood will draw up the epoxy like a lamp wick. Once the liquid epoxy has saturated the log end and cured, the log end has been consolidated, and is ready for the application of an epoxy putty filler. The filler resin and hardener must also be mixed; pigments must be mixed with the filler epoxy to color the patch, and more importantly to protect it from ultraviolet sunlight. The filler can be applied with a putty knife, pressing it into the irregularities of the cavity. The cured patch can be worked like wood and painted with an opaque stain or a dull finish paint to help it blend with surrounding wood, although epoxy repairs can be difficult to disguise on natural, unpainted wood.

Epoxies can be used to consolidate and repair other areas of a log, including rotted internal areas which have not yet progressed to damage the log's outer surface. Saturation of small internal areas can be accomplished by drilling several random holes into the log through an area that will be concealed by daubing, and then pouring in liquid epoxy. If a pure resin is used, it should be a casting resin to minimize shrinkage, and it is best to fill voids with a resin that contains aggregates such as sand, or micro-balloons. Epoxy is frequently used by architectural conservators to strengthen deteriorated structural members. The damaged log can be strengthened by removing the deteriorated wood, and filling the void by imbedding a reinforcing bar in epoxy filler, making sure the void is properly sealed to contain the epoxy before using it (Fig. 21). Sometimes larger decayed internal areas of a log can be more easily accessed and repaired from the interior of a structure. This may be a useful technique if it can be accomplished without causing undue damage to the interior finishes in the log building. However, despite its many advantages, epoxy may not be an appropriate treatment for all log repairs, and it should not be used in an attempt to conceal checking, or extensive log surface patching that is exposed to view, or logs that are substantially decayed or collapsed.

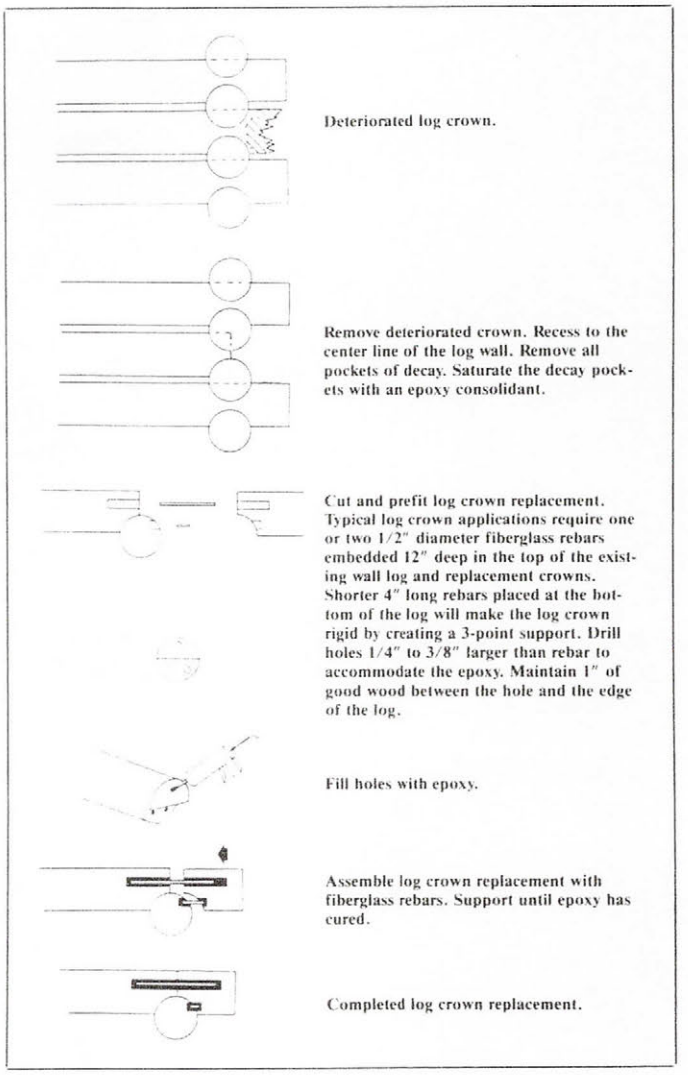


Fig. 21. Epoxy repair. Drawing: Harrison Goodall.

Log Replacement

Repairing or replacing only a segment of a log is not always possible. Replacement of an entire log may be the only solution if it has been substantially lost to decay and collapsed under the weight of logs above it. Log replacement, which should be carried out only by experienced craftspersons, is begun by temporarily supporting the logs above, and then jacking them up just enough to insert the new log. Potential danger to the structure may include creating inadequate temporary bearing points, and crushing chinking and interior finishes which may have settled slowly into non-original positions that cannot withstand jacking.

To begin the process of log replacement, the entire length of the log must be inspected from the exterior and the interior of the structure to determine whether it supports any structural members or features, and how their load can be taken up by bracing during jacking and removal. On the exterior, sheathing such as weatherboard, and adjacent chinking, must be removed along the length of the log to perform this inspection. Likewise, on the interior, abutting partition walls and plaster may also need to be removed around the log to determine what, if any, features are supported by or tied into the log to be removed.

A replacement log should be obtained to match the wood species of the original being removed. If it is a hewn log, then the replacement must be hewn to replicate the dimensions and tool marks of the original (Fig. 22). If the same wood species cannot be obtained in the original dimensions, a substitute species may have to be used, and may even be preferable in some instances

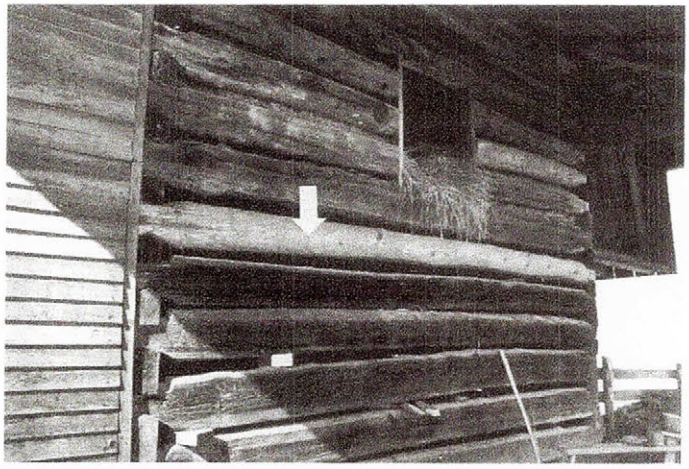


Fig. 22. The lighter-colored replacement log in this barn matches the dimensions and hewing marks of the original logs, and will darken in time to blend visually with the other logs. Photo: Bernard Weisgerber.

if a more durable wood can be found than the original wood species. It should, however, be chosen to match the visual characteristics of the original species as closely as possible.

Wood Preservatives

In most instances, the use of chemical wood preservatives is not generally recommended on historic log buildings. Preservatives tend to change the color or appearance of the logs. In addition, many are toxic, they tend to leach out of the wood over time, and like paint, must be periodically reapplied. Many of the late 19th and early 20th century Rustic structures were constructed of logs with the bark left on which may provide protection, while others have been painted. However, some log buildings, and especially log houses that have been inappropriately stripped of historic cladding in an earlier restoration, and now show signs of weathering, such as deep checking, may be exceptions to this guidance. A preservative treatment may be worth considering in these cases. Boiled linseed oil may sometimes be appropriate to use on selected exposures of a building that are particularly vulnerable to weathering, although linseed oil does tend to darken over time. Borate solutions, which do not alter the color or appearance of wood, may be another of the few effective, non-hazardous preservatives available. However, borate solutions do not penetrate dry wood well, and thus the wood must be green or wet. Because borate solutions are water-soluble, after treating, the wood must be coated with a water-repellent coating. In some instances, it may be appropriate to reapply varnish where it was used as the original finish treatment. Pressure-treating, while effective for new wood, is not applicable to in-place log treatment, and is generally not effective for large timbers and logs because it does not penetrate deeply enough.

Foundation Repair

The foundation should have good drainage, be stable, adequately support the building as well as any future floorloads, and keep the sill log sufficiently clear of the ground and moisture to deter decay and insect infestation. Log buildings with cellars are less likely to suffer problems than those built upon the ground or with crawl spaces, as long as the cellar is kept dry and ventilated. Because the foundations of many log buildings were neither dug nor laid below the frostline, they generally tend to be susceptible to freeze-thaw ground heaving and settlement. Also, as previously noted, some foundations consisted of wooden sleepers or pilings in direct contact with the ground. If a foundation problem is minor, such as the need for repointing or resetting a few stones, work should address only those areas. Loose stones should be reset in their original locations if possible. A clearly inadequate foundation that has virtually disappeared into the ground, or where large areas of masonry have buckled or sunk, resulting in excessively uneven or active settlement, will need to be rebuilt using modern construction methods but to match the historic appearance.

Chinking Repair

Repair of chinking, whether it is finished on the exterior with wooden strips or with daubing, should not be done until all log repair or replacement, structural jacking and shoring is completed, and all replacement logs have seasoned. Historically, patching and replacing daubing on a routine basis was a seasonal chore. This was because environmental factors—building settlement, seasonal expansion and contraction of logs, and moisture infiltration followed by freeze-thaw action—cracks and loosens daubing. If the exterior log walls are exposed, and the chinking or daubing requires repair, as much of the remaining inner blocking filler and daubing should be retained as possible. A daubing formula and tooled finish that matches the historic daubing, if known, should be used, or based on one of the mixes listed here. For the most part, modern commercially-available chinking products are not suitable for use on historic log buildings, although an exception might be on the interior of a log building where it will be covered by plaster or wood, and will not be visible. These products tend to have a sandy appearance that may be compatible with some historic daubing, but the color, and other visual and physical characteristics are generally incompatible with historic log surfaces.

Sections of wood chinking which are gone or cannot be made weathertight should be replaced with same-sized species saplings or quarter poles cut to fit. Generally, unless bark was used originally, it should be removed before nailing the new wood chinking replacements tightly into place.

Analysis of daubing can be done in much the same way as mortar analysis. If that is not feasible, by crushing a loose piece of daubing its constituent parts can be exposed, which may typically include lime, sand, clay, and, as binders, straw or animal hair. The color imparted by the sand or pigmented constituents should be noted, and any areas of original daubing should be recorded with color film for later reference. Daubing that is loose or is not adhered to the logs must first be cleaned out by hand. Blocking filler should be left intact, refitting only loose pieces. (Sometimes it may be difficult to obtain a good bond in which case it may be necessary to clean out the joint entirely.) If needed, soft filler should be added, such as jute or bits of fiberglass batt, pressed firmly into voids with a stick or blunt

tool. Concealed reinforcement may sometimes be used, depending upon the authenticity of the restoration. This can include galvanized nails partially inserted only on the upper side of the log to allow for the daubing to move with the upper log and keep the top joint sealed, or galvanized wire mesh secured with galvanized nails (Fig. 23). Like repointing masonry, daubing should not be done in full sun, excessive heat or when freezing temperatures are expected. The daubing materials should be dry-mixed, the chinking rechecked as being tight and secure, and the mix wetted and stirred to a stiff, paste-like consistency. The mix dries quickly, so no more daubing should be prepared at a time than can be applied in about 30 minutes. A test patch of new daubing, either on the building, or in a mock-up elsewhere, will help test the suitability of the formula's color and texture match.

Before applying the daubing, the chinking area, including filler and log surfaces to be covered, should be sprayed with water to prevent the dry filler from too rapidly drawing off the daubing moisture which will result in hairline cracking. A trowel, ground to the width of the daubing, is used to press the daubing into the chinking space, and to smooth the filled areas. Wide or deep chinking spaces or joints may have to be daubed in layers, to prevent sagging and separation from the logs, by applying one or two scratch coats before finishing the surface.

Daubing Mixes

	parts (volume)	material
Mix A.	1/4	cement
	1	lime
	4	sand
	1/8	dry color
		hog bristles or excelsior

(Donald A. Hutslar, "Log Cabin Restoration: Guidelines for the Historical Society," American Association for State and local History, Technical Leaflet No. 74, "History News," Vol. 29, No. 5 (May 1974.)

Mix B.	6	sand
	4	lime
	1	cement
Mix C.	1	portland cement
	4–8	lime
	7–10	sand

Mix B and C are reprinted from "Log Structures: Preservation and Problem-Solving," by Harrison Goodall and Renee Friedman, Nashville, TN: American Association for State and Local History, 1980.

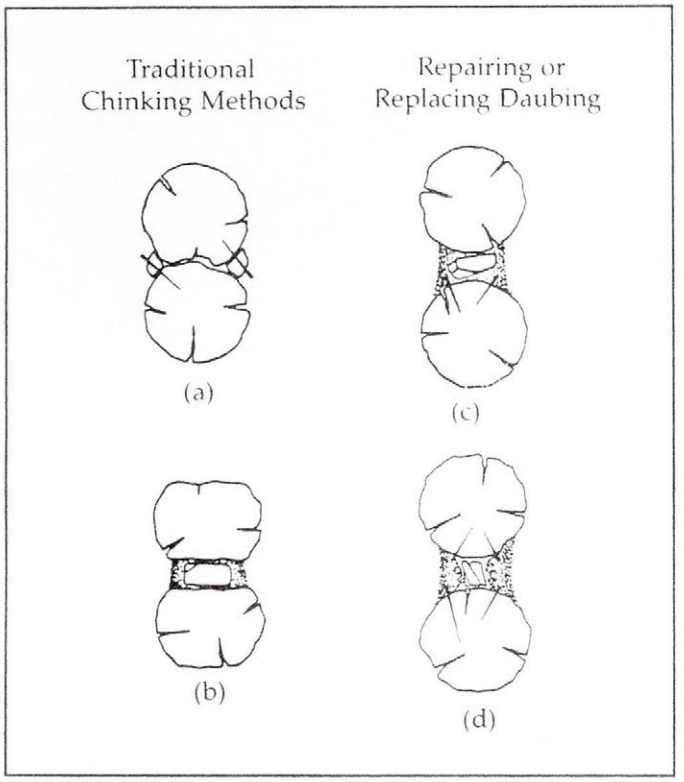


Fig. 23. Illustrated are various methods of chinking and daubing: (a) wood strips, or thin saplings nailed in place; and (b) 3-part system consisting of an inner blocking filler of stones or wood slabs, together with soft filler, such as clay, stuffed around the blocking, composes the chinking, and wet-applied daubing. Concealed aids that may improve the adherence of new daubing include (c) galvanized nails, or (d) galvanized mesh lath. Drawing: James Caufield.

Portland cement was a part of the original daubing used in many late 19th and early 20th century log buildings, and is therefore appropriate to include in repairing buildings of this period. Although a small amount of portland cement may be added to a lime, clay and sand mix for workability, there should not be more than 1 part portland cement to 2 parts of lime in daubing mixes intended for most historic log buildings. Portland cement tends to shrink and develop hairline cracks, and retain moisture, all of which can be potentially damaging to the logs.

Interior Treatments

There is no single appropriate way to finish or restore the interior of a historic log house. Each building and its history is unique. The temptation should be resisted to impart an unfinished frontier character by removing plaster to expose interior log walls or joists in the ceiling. Instead, interior treatments should be based on existing evidence, and guided by old photographs, written documentation, and interviews with previous owners. Interior features and finishes that might exist in some 18th and 19th century log houses include wood paneled walls, wood moldings, stairs, and fireplace mantels; where they have survived, these features should be retained. Many of the more rustic log buildings built later in the 19th or early 20th century intentionally featured exposed interior log walls, sometimes with the logs peeled and varnished. If interior plaster is severely damaged or has previously been removed, and evidence such as lath ghosting on the logs exists, walls should be replastered or recovered with gypsum board or dry wall to match the historic appearance.

Preserving Log Buildings in Their Historic Settings

Log buildings are too often viewed as portable resources. Like other historic buildings, moved or relocated log structures can suffer a loss of integrity of materials and of setting (Fig. 24). Historic buildings listed in the National Register of Historic Places may be subject to loss of that status if moved. Despite the popularity of dismantling and relocating log buildings, they should be moved only as a last resort, if that is the only way to save them from demolition. If they must be moved, it is preferable that they be moved intact—that is, in one piece rather than disassembled. Disassembling and moving a log building can result in considerable loss of the historic building materials. While the logs and roof framing members can be numbered for reassembly, dismantling a log building can result in loss of such features as foundation and chimney; chinking and daubing, exterior cladding, and interior finishes. Furthermore, log buildings can rarely be put back together as easily as they were taken apart.

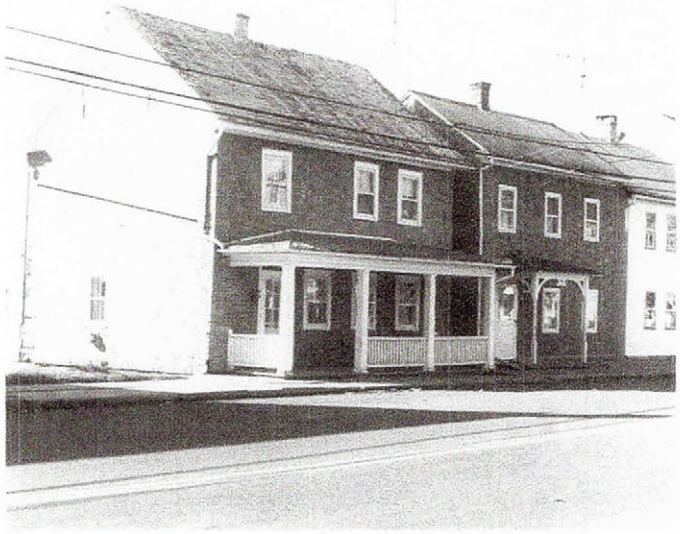








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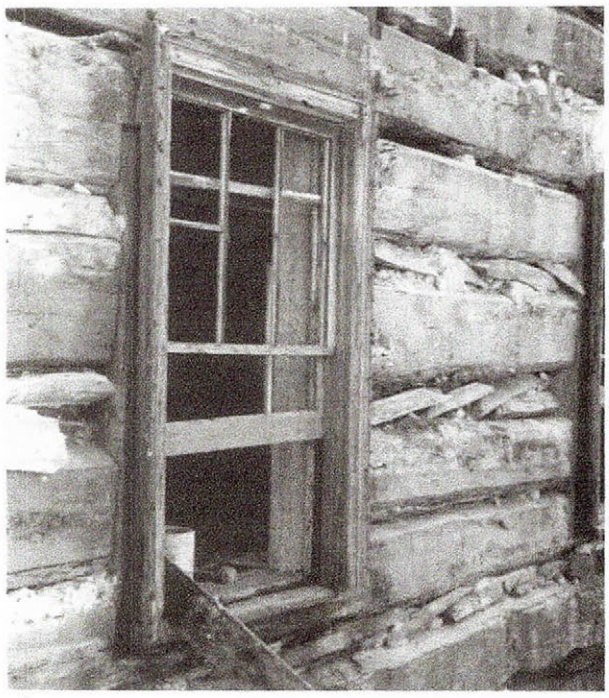
Fig. 24. Some towns still retain a high number of early log houses. (a) Middleway, West Virginia, is a small village dominated by 18th and 19th century log houses, and, with the exception of outbuildings, all are clad in original wood siding or stucco. Removal of one of the houses from this streetscape would not only result in a loss of integrity to the building, but also to the historic district. (b) The original wood clapboard of two of these c. 1830 log houses in Stouchsburg, Pennsylvania, has been covered with asphalt siding, and later porches added. Rehabilitation plans might appropriately include retention of the porches as having acquired significance over time, and removal of the asphalt siding. Uneven spacing between the two upper left windows of the house on the left, and the center chimney are indications that the house was built in two stages. Photos: (a) Anne Grimmer, (b) Pennsylvania Historical and Museum Commission.



a



b



c

Fig. 25. (a) Prior to rehabilitation, the exterior of this late 18th century log house was sided with wood clapboard, which had been covered over by a later artificial siding, while the upper gallery of the second floor porch was stuccoed. (b) During the rehabilitation both the historic wood siding and stucco were removed to expose the logs, the gables were sided with wood shingles, and what would have originally been milled wood columns supporting the porch were replaced with rough, unmilled log posts. Collectively, these treatments diminished the building's architectural integrity, and gave it an appearance it never had. (c) The depth that the window frames extend out beyond the log surface allowing space for siding is an indication that cladding was part of the building's original construction. Photos: National Park Service Files.

Summary

Historic log buildings regardless of whether they are of horizontal or vertical construction, or whether they are 18th century log houses or early 20th century Rustic style cabins, are unique. Their conservation essentially centers on the preservation and repair of the logs, and appropriate repairs to chinking and daubing, which like repointing of masonry, is necessary to ensure that most log buildings are weathertight. Log building preservation may be accomplished with a variety of techniques including splicing and piecing-in, the use of epoxy, or a combination of patching and epoxy, and often, selected replacement. But, like any historic building, a log structure is a system that functions through the maintenance of the totality of its parts.

The exterior of many of the earliest late 18th and 19th century log buildings, and particularly those east of the Mississippi, were commonly covered at the time of construction or later with some type of cladding, either horizontal or vertical wood siding, stucco, or sometimes a combination. If extant, this historic cladding, which may be hidden under a later, non-historic artificial siding such as aluminum, vinyl, or asbestos, should be preserved and repaired, or replaced if evidence indicates that it existed, as a significant character-defining feature of the building (Fig. 25).

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Termiticide, Insecticide and Fungicide Concentrate

For the Prevention and Control of:
• Subterranean Termites • Formosan Termites • Drywood Termites • Carpenter Ants • Listed Wood Destroying Beetles • Fungi (Rot) • Algae

For use in and around Residential, Institutional and Commercial Structures including Homes, Apartments, Garages, Museums, Public and Private Institutions, Schools, Hotels, Hospitals, Kennels, Stables, Farm Buildings, Trucks, Trailers, Warehouses and Non-Food Areas of Supermarkets, Restaurants and Food Processing Plants.

Active Ingredient:	
Disodium Octaborate Tetrahydrate (CAS No. 12280-03-4)..	40%
Other Ingredients.....	60%
Total.....	100%

EPA Reg. No. 64405-1
EPA Est. 64405-TN-1

U.S. Patent Nos. 5,645,828; 7,597,902

Keep Out of Reach of Children
CAUTION

PRECAUTIONARY STATEMENTS

Hazards to Humans & Domestic Animals

WEAR: Long-sleeved shirt & long pants, socks, shoes and chemical-resistant gloves (such as Barrier Laminate, Butyl Rubber, Nitrile Rubber, Neoprene Rubber, Polyvinyl Chloride (PVC), Viton or others listed in category C on an EPA -chemical-resistance category selection chart).

Environmental Hazards

(For product in containers less than 5 gallons)

This pesticide is toxic to fish and wildlife. Do not apply directly to water, to intertidal areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when cleaning equipment or disposing of equipment washwaters.

(For product in containers 5 gallons or greater)

This pesticide is toxic to fish and wildlife. Do not apply directly to water, to intertidal areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when cleaning equipment or disposing of equipment washwaters. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans or other waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance contact your state water board or regional office of the EPA.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

Notice

Read and understand the entire label before using. Use only according to label directions.

Before buying or using this product, read ***Warranty Disclaimer*** and ***Limitation of Remedies*** statements found elsewhere on this label. If terms are unacceptable, return unopened package to seller for full refund of purchase price. Otherwise, use by the buyer or any other user constitutes acceptance of the terms under ***Warranty Disclaimer*** and ***Limitation of Remedies.***

Use Restrictions

Do not use in edible product areas of food processing plants or on countertops and other surfaces where food is prepared. Do not use in serving areas where food is exposed. Do not contaminate feed, water or food. Do not enter or allow others to enter or occupy treated areas until spray has been absorbed into the wood. Treated areas must not be occupied during application.

Phytotoxicity

This product may be phytotoxic to plants. When treating around the exterior of structures, cover and protect shrubbery and plants that may be potentially exposed to this product, when applied in accordance with the label directions.

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Personal Protective Equipment (PPE)

Some materials that are chemical-resistant to this product are barrier laminate; butyl, nitrile, neoprene and natural rubbers ≥ 14 mils; polyethylene; polyvinyl chloride; and viton ≥ 14 mils. If you want more options, follow the instructions for category C on an EPA chemical-resistance category selection chart.

Applicators, mixers and other handlers must wear long-sleeved shirt, long pants, socks, shoes, chemical-resistant gloves and protective eyewear. When applying Bora-Care solutions in confined spaces, provide ventilation or an exhaust system or use of a NIOSH-approved dust/mist filtering respirator (MSHA/NIOSH approval number prefix TC-21C) with a prefilter approved for pesticides (MSHA/NIOSH approval prefix TC-23C), or a canister approved for pesticides (MSHA/NIOSH approval prefix TC-14G) or a NIOSH-approved respirator with any N, R, P or HE prefilter is recommended.

User Safety Requirements

Follow manufacturer's instructions for cleaning/ maintaining PPE. If no such instructions for washables exist, use detergent and hot water. Keep and wash PPE separately from other laundry.

User Safety Recommendations

Users should:

- Wash hands before eating, drinking, chewing gum, using tobacco or using the toilet;
- Remove clothing immediately if pesticide gets inside, then wash thoroughly and put on clean clothing;
- Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

I. Mixing Instructions

Bora-Care is a concentrate that **must** be diluted with clean water before use. The use of warm or hot water, if available, and an impeller-type mixer that can be used with an electric drill aids the dilution process.

A. Hand Sprayers: Mix in a clean container and stir the solution until completely uniform. Always mix in a separate container then add the solution to a spray tank. Mixing Bora-Care directly in a spray tank can block hoses and nozzles.

B. Hand Volume Pumping Systems: Add all of the dilution water to tank, start recirculator and slowly add Bora-Care concentrate. Mix until uniform.

Use 1:1, 2:1 and 3:1 Bora-Care solutions within 24 hours after mixing; 5:1 solutions will remain stable for up to 30 days. Do not leave unused solution under pressure or in tank overnight. Clean and/or flush equipment and lines with water after use.

Bora-Care solutions can be mixed with pyrethrins at 0.3% for carpenter ants and other listed insects, or with Mold-Care® Moldicide Concentrate (EPA Reg. No. 6836-212-64405) for mold, in accordance with the most restrictive of label limitations and precautions. Do not exceed label dosage rates. This product cannot be mixed with any product containing a label prohibition against such mixing.

For tracking purposes (to make it easier to see where Bora-Care solutions have been applied) an appropriate marker dye or pigment may be added as part of the diluent to the Bora-Care solution. Refer to the dye or pigment product label for the recommended amount to add to the Bora-Care solution. Bora-Care concentrate may also be diluted with approved water-based water repellants or coatings at dilution ratios listed on the repellant/coating label provided the ratios are greater than 1 part water to 1 part Bora-Care.

Use soap and water to clean up tools.

SPECIMEN

II. Dilution Rations by Volume

Table A

Target Pests	Mixing Ratios Water plus Bora-Care	Application Notes
Subterranean and Formosan Termites	1:1 or 2:1	For remedial and preventative treatments apply a 1:1 dilution ratio for all treatments by spray, injection, brush or roller. The 2:1 dilution ratio may be used for foaming or, for application into inaccessible wall voids, may be used in a misting machine.
Drywood Termites	1:1, 2:1 or 5:1	For remedial treatment apply the 1:1 or 2:1 by foam or by misting using a misting machine. Use the 5:1 dilution ratio for prevention.
Anobiid and Lyctid Powderpost Beetles	1:1, 2:1 or 5:1	For all remedial treatments use a 1:1 dilution ratio. Logs > 4" require a 1:1 dilution ratio for prevention. Use a 2:1 dilution ratio for treating hardwood floors. Use the 5:1 dilution ratio for prevention.
Old House Borers, Longhorn Beetles and Ambrosia Beetles	1:1 or 5:1	Use the 1:1 dilution ratio for remedial and preventative treatment in wood > 4" thick. Use the 5:1 dilution ratio for prevention in wood less than 4" thick.
Carpenter Ants	1:1, 2:1 or 5:1	Use the 1:1 dilution ratio for all remedial treatments. Use the 2:1 dilution ratio for remedial treatments applied by foam or with a misting machine (or applicator). Use the 5:1 dilution ratio for prevention.
Fungi (Rot) and Algae	1:1, 3:1 or 5:1	For remedial control use a 1:1 dilution ratio on wood members 4" thick or greater. Use a 3:1 dilution ratio for wood less than 4" in thickness. For prevention use a 5:1 dilution ratio.

Table B

Materials to Be Treated	Mixing Ratios Water plus Bora-Care	Application Notes
Logs, Large Beams, Timber and Dimensional Lumber > 4"	See target pests in Table A	All spray applications for insects and fungi (rot).
Decking, Fences and Plywood	See target pests in Table A	Use on wood members 2" or less in thickness.
Logs, Large Beams and Dimensional Lumber	See target pests in Table A	Use the 5:1 dilution ratio only for dip treatment for insect prevention. May be used in conjunction with other fungicides for fungi (rot) control.
Cellulosic Drywall and Insulation	1:1, 3:1 or 5:1	Use the 3:1 dilution ratio for active remedial treatment of dry rot. Use the 5:1 dilution ratio for prevention of dry rot. May be used in conjunction with other fungicides.

Table C

Parts Water		Part Bora-Care	% Disodium Octaborate Tetrahydrate
1	to	1	23%
2	to	1	16%
3	to	1	13%
5	to	1	9%

III. General Information

Bora-Care is not intended for application to soil; it is not a soil termiticide. **Do not use to directly treat soil. When active infestations exist, get a professional inspection. Prior to using this product, consult with your state regulatory agency to see if additional qualifications are required to apply this product.**

Bora-Care contains an inorganic borate salt, soluble in water, with insecticidal and fungicidal properties effective against wood destroying organisms, including the target pests listed below. This product may be used as a remedial treatment of infested wood and as a long-term protective or preventive treatment (before signs of infestations are observed) of wood in existing or new construction. Bora-Care solution is recommended for protection of all interior and exterior wood (including wood-foam composite structural components). Treatment is long lasting provided the treated material is not exposed to rain,

SPECIMEN LABEL

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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 H. Ward Jandl, Chief, Technical Preservation Services Branch, Preservation Assistance Division, National Park Service, P.O. Box 37127, Washington, D.C. 20013–7127. 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.

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Cover Photograph (logo): The log cabin was used on this 1840 campaign medal to symbolize frontier life and democratic egalitarianism, a platform that successfully elected William Henry Harrison to the presidency. Photo: The State Museum of Pennsylvania, Pennsylvania Historical and Museum Commission.

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BORA-CARE®

Opportunity knocks on wood.

GREEN SOLUTION TO WOOD DESTROYING ORGANISMS.



Bora-Care is sprayed directly onto raw wood, concrete and foundation penetrations by pest management professionals. Its patented formula penetrates into the wood, providing long-term residual protection against subterranean, Formosa and drywood termites; wood destroying beetles, carpenter ants and decay fungi.

12/25 BORASHIELD™

12/25 YEAR LIMITED WARRANTY

Bora-Care is used for new construction primary termite pretreatments, whole house treatments and remedial treatments.

- Kills and prevents termites and other wood destroying organisms.
- Eliminates wood as a food source and creates a barrier termites cannot build shelter tubes across.
- Prevents termites from tubing across concrete.
- Delivers long-term residual benefit that protects wood for years.
- Has low mammalian toxicity – its active ingredient is a borate mineral salt.
- Emits no VOCs (volatile organic compounds).
- Has minimal risk of chemical run-off.
- Won the Overall Grand Prize, Best of Show award from Green Builder® magazine at the 2006 National Green Building Show.
- Qualifies builders for LEED® for Homes points as well as points in many other green building programs.
- Has more than 12 years of proven product-specific efficacy testing and more than 25 years of successful field use.
- Is the only borate-based termiticide that is EPA-registered as a primary perimeter termite pretreatment for new construction with its own product-specific field efficacy studies.
- Is HUD-allowed, listed for use by the 2006 International Residential Code and meets the end-cut requirements of building codes and the American Wood Protection Association (AWPA).

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Active Ingredient:	
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Other Ingredients.....	60%
Total.....	100%

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CAUTION

PRECAUTIONARY STATEMENTS

Hazards to Humans & Domestic Animals

WEAR: Long-sleeved shirt & long pants, socks, shoes and chemical-resistant gloves (such as Barrier Laminate, Butyl Rubber, Nitrile Rubber, Neoprene Rubber, Polyvinyl Chloride (PVC), Viton or others listed in category C on an EPA -chemical-resistance category selection chart).

Environmental Hazards

(For product in containers less than 5 gallons)

This pesticide is toxic to fish and wildlife. Do not apply directly to water, to intertidal areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when cleaning equipment or disposing of equipment washwaters.

(For product in containers 5 gallons or greater)

This pesticide is toxic to fish and wildlife. Do not apply directly to water, to intertidal areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when cleaning equipment or disposing of equipment washwaters. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans or other waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance contact your state water board or regional office of the EPA.

DIRECTIONS FOR USE

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Notice

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Use Restrictions

Do not use in edible product areas of food processing plants or on countertops and other surfaces where food is prepared. Do not use in serving areas where food is exposed. Do not contaminate feed, water or food. Do not enter or allow others to enter or occupy treated areas until spray has been absorbed into the wood. Treated areas must not be occupied during application.

Phytotoxicity

This product may be phytotoxic to plants. When treating around the exterior of structures, cover and protect shrubbery and plants that may be potentially exposed to this product, when applied in accordance with the label directions.

Personal Protective Equipment (PPE)

Some materials that are chemical-resistant to this product are barrier laminate; butyl, nitrile, neoprene and natural rubbers ≥ 14 mils; polyethylene; polyvinyl chloride; and viton ≥ 14 mils. If you want more options, follow the instructions for category C on an EPA chemical-resistance category selection chart.

Applicators, mixers and other handlers must wear long-sleeved shirt, long pants, socks, shoes, chemical-resistant gloves and protective eyewear. When applying Bora-Care solutions in confined spaces, provide ventilation or an exhaust system or use of a NIOSH-approved dust/mist filtering respirator (MSHA/NIOSH approval number prefix TC-21C) with a prefilter approved for pesticides (MSHA/NIOSH approval prefix TC-23C), or a canister approved for pesticides (MSHA/NIOSH approval prefix TC-14G) or a NIOSH-approved respirator with any N, R, P or HE prefilter is recommended.

User Safety Requirements

Follow manufacturer's instructions for cleaning/ maintaining PPE. If no such instructions for washables exist, use detergent and hot water. Keep and wash PPE separately from other laundry.

User Safety Recommendations

Users should:

- Wash hands before eating, drinking, chewing gum, using tobacco or using the toilet;
- Remove clothing immediately if pesticide gets inside, then wash thoroughly and put on clean clothing;
- Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

I. Mixing Instructions

Bora-Care is a concentrate that **must** be diluted with clean water before use. The use of warm or hot water, if available, and an impeller-type mixer that can be used with an electric drill aids the dilution process.

A. Hand Sprayers: Mix in a clean container and stir the solution until completely uniform. Always mix in a separate container then add the solution to a spray tank. Mixing Bora-Care directly in a spray tank can block hoses and nozzles.

B. Hand Volume Pumping Systems: Add all of the dilution water to tank, start recirculator and slowly add Bora-Care concentrate. Mix until uniform.

Use 1:1, 2:1 and 3:1 Bora-Care solutions within 24 hours after mixing; 5:1 solutions will remain stable for up to 30 days. Do not leave unused solution under pressure or in tank overnight. Clean and/or flush equipment and lines with water after use.

Bora-Care solutions can be mixed with pyrethrins at 0.3% for carpenter ants and other listed insects, or with Mold-Care® Moldicide Concentrate (EPA Reg. No. 6836-212-64405) for mold, in accordance with the most restrictive of label limitations and precautions. Do not exceed label dosage rates. This product cannot be mixed with any product containing a label prohibition against such mixing.

For tracking purposes (to make it easier to see where Bora-Care solutions have been applied) an appropriate marker dye or pigment may be added as part of the diluent to the Bora-Care solution. Refer to the dye or pigment product label for the recommended amount to add to the Bora-Care solution. Bora-Care concentrate may also be diluted with approved water-based water repellants or coatings at dilution ratios listed on the repellant/coating label provided the ratios are greater than 1 part water to 1 part Bora-Care.

Use soap and water to clean up tools.

SPECIMEN LABEL

II. Dilution Rations by Volume

Table A

Target Pests	Mixing Ratios Water plus Bora-Care	Application Notes
Subterranean and Formosan Termites	1:1 or 2:1	For remedial and preventative treatments apply a 1:1 dilution ratio for all treatments by spray, injection, brush or roller. The 2:1 dilution ratio may be used for foaming or, for application into inaccessible wall voids, may be used in a misting machine.
Drywood Termites	1:1, 2:1 or 5:1	For remedial treatment apply the 1:1 or 2:1 by foam or by misting using a misting machine. Use the 5:1 dilution ratio for prevention.
Anobiid and Lyctid Powderpost Beetles	1:1, 2:1 or 5:1	For all remedial treatments use a 1:1 dilution ratio. Logs > 4" require a 1:1 dilution ratio for prevention. Use a 2:1 dilution ratio for treating hardwood floors. Use the 5:1 dilution ratio for prevention.
Old House Borers, Longhorn Beetles and Ambrosia Beetles	1:1 or 5:1	Use the 1:1 dilution ratio for remedial and preventative treatment in wood > 4" thick. Use the 5:1 dilution ratio for prevention in wood less than 4" thick.
Carpenter Ants	1:1, 2:1 or 5:1	Use the 1:1 dilution ratio for all remedial treatments. Use the 2:1 dilution ratio for remedial treatments applied by foam or with a misting machine (or applicator). Use the 5:1 dilution ratio for prevention.
Fungi (Rot) and Algae	1:1, 3:1 or 5:1	For remedial control use a 1:1 dilution ratio on wood members 4" thick or greater. Use a 3:1 dilution ratio for wood less than 4" in thickness. For prevention use a 5:1 dilution ratio.

Table B

Materials to Be Treated	Mixing Ratios Water plus Bora-Care	Application Notes
Logs, Large Beams, Timber and Dimensional Lumber > 4"	See target pests in Table A	All spray applications for insects and fungi (rot).
Decking, Fences and Plywood	See target pests in Table A	Use on wood members 2" or less in thickness.
Logs, Large Beams and Dimensional Lumber	See target pests in Table A	Use the 5:1 dilution ratio only for dip treatment for insect prevention. May be used in conjunction with other fungicides for fungi (rot) control.
Cellulosic Drywall and Insulation	1:1, 3:1 or 5:1	Use the 3:1 dilution ratio for active remedial treatment of dry rot. Use the 5:1 dilution ratio for prevention of dry rot. May be used in conjunction with other fungicides.

Table C

Parts Water		Part Bora-Care	% Disodium Octaborate Tetrahydrate
1	to	1	23%
2	to	1	16%
3	to	1	13%
5	to	1	9%

III. General Information

Bora-Care is not intended for application to soil; it is not a soil termiticide. **Do not use to directly treat soil. When active infestations exist, get a professional inspection. Prior to using this product, consult with your state regulatory agency to see if additional qualifications are required to apply this product.**

Bora-Care contains an inorganic borate salt, soluble in water, with insecticidal and fungicidal properties effective against wood destroying organisms, including the target pests listed below. This product may be used as a remedial treatment of infested wood and as a long-term protective or preventive treatment (before signs of infestations are observed) of wood in existing or new construction. Bora-Care solution is recommended for protection of all interior and exterior wood (including wood-foam composite structural components). Treatment is long lasting provided the treated material is not exposed to rain,

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continuous water or in direct contact with the ground. The active ingredient in Bora-Care is an inorganic salt and once in place will not decompose or volatilize out of the wood.

Subterranean Termites: *Reticulitermes, Heterotermes*
Formosan Termites: *Coptotermes*
Drywood Termites: *Kalotermes, Incisitermes*
Dampwood Termites: *Zootermopsis, Neotermes*
Powderpost Beetles: *Lyctidae, Bostrichidae*
Anobiid Beetles: *Anobiidae*
Old House Borers, Longhorn Beetles: *Cerambycidae, Hylotrupes*
Ambrosia Beetles: *Platypodidae, Scolytidae*
Carpenter Ants: *Camponotus*
Brown Rot (including dry rot), White Rot, Wood Decay

Bora-Care solutions may be used on all non-food contact surface cellulosic materials including wood, plywood, particleboard, paper, oriented strand board (OSB), cardboard (non-food packaging material), wood composite structural components, concrete, block, brick, metals, PVC plumbing pipes and other non-cellulosic materials found in structures. Apply Bora-Care solutions only to bare wood, plywood, particleboard and other cellulosic materials where an intact water-repellent barrier, such as paint, stain or sealer, is not present.

When spraying overhead interior areas of homes, apartment buildings, etc., cover or protect all surfaces below the areas being sprayed with plastic sheeting or other material and dispose if contamination from dripping occurs. Do not apply in food serving areas while food is exposed. Cover all food contact and preparation surfaces prior to treatment. After treatment, thoroughly clean all food contact surfaces with a water/detergent solution followed with a potable water rinse. Remove all pets; turn off fish aquarium pumps and cover.

In new construction applications for the prevention of subterranean termites, structural wood is defined as: only wood needed for the basic building structure as found in the "dried-in" stage of construction, including wood in direct contact with foundations, interior and exterior wall sill plates, wood studs, wood or cellulosic sheathing, floor joists and sub-flooring.

In structures where a soil treatment/barrier termiticide has been applied and/or termite bait system installed, apply Bora-Care solution as an additional treatment to protect wood from subterranean termites that may have penetrated the chemical gaps occurring within the termiticide-treated soil or have bypassed the bait/monitor systems.

As a remedial treatment, Bora-Care solution will both eliminate and prevent infestations of Formosan, native subterranean termites, wood boring beetles, carpenter ants and decay fungi. It may also be used as a supplement or alternative to fumigation to provide long-term residual control.

Older wood boring beetle larvae and especially pupae (particularly Old House Borers) already present in the wood at the time of treatment may occasionally emerge sometime after treatment. This is because they are no longer feeding on the wood. This will not occur frequently enough to cause structural damage to any wooden member and reinfestation is prevented.

IV. Remedial Wooden Structure Treatment for the Control of Subterranean, Formosan, Drywood and Dampwood Termites, Carpenter Ants, Old House Borers, Powderpost and Listed Wood Boring Beetles and Fungi (Rot)

A. Infested wood: Spray and/or inject Bora-Care solution into beetle holes, termite and carpenter ant galleries and decay pockets. Apply 1 coat of Bora-Care solution to the point of surface saturation to all infested and -susceptible wood, paying particular attention to infested areas. Apply 2 coats of Bora-Care solution to those wood members with only 1 or 2 exposed sides. For quicker control, apply an additional coat to heavily infested areas. Allow first application to dry by waiting at least 20 minutes between applications. For specific pests to be controlled refer to **Table A** for applicable mixing instructions.

In cases where the infestation is not accessible from the surface, drill small holes into the wood to gain access to the infested area. Inject enough solution to completely flood galleries or voids. Adjacent intact wood may be treated by pressure injecting Bora-Care solution into holes drilled into the wood at 8- to 10-inch intervals. Inject at 40 psi for 4 to 6 seconds per hole.

For treating infested wall voids, refer to Sections IV.E. and F.

B. Basements and crawl spaces: Apply 1 coat of diluted Bora-Care solution to the point of surface saturation to all accessible surfaces including sill plates, piers, girders, subfloors, floor joists and any wood exposed to vertical access above ground. On wood where access is limited to 1 or 2 sides of wood members, such as sills and plates on foundation walls, apply 2 coats of Bora-Care solution. Allow first application to dry by waiting at least 20 minutes between applications. One gallon of solution will treat 200 square feet of floor area (subfloor, floor joists, header and sill plates) or 50 linear feet of 8 foot high walls.

C. Buildings on concrete slabs: Apply Bora-Care solution into wall voids by foaming or Apply Bora-Care solution into wall voids by foaming (See Section IV.F.) or misting. Locate each stud and drill a small hole through the wall covering to gain access to the infested area. Drill holes every 18-24 inches adjacent to the side of each stud and inject at least 1/3 fluid ounce of Bora-Care solution per hole. Drill at least one hole per stud bay near the floor to treat the base plate in each void. Treat entire wall area as opposed to single stud bays to completely include the infested area within the treatment zone. Cover at least 6 inches of concrete slab surface area out from the penetration site.

D. Wood flooring: Treat by spray, brush or roller application. Prior to application, remove any existing finish by complete coarse sanding or stripping. Apply a 2:1 Bora-Care solution at a rate of approximately 1 gallon of

solution per 500 square feet of floor surface. For treating infestations of subterranean or Formosan termites, 2 coats may be required, waiting at least 1 hour between applications. Allow floor to completely dry (typically 48 to 72 hours). Moisture content must be 16% or less before applying final finish. Bora-Care solution applications may raise the grain of the wood and an additional **light** sanding may be necessary before applying a new finish. The Bora-Care solution is compatible with most floor coatings; always test a small section of treated floor with the new finish and check for appropriate adhesion prior to coating the entire floor.

Note: If surface is tacky or residue is evident after 72 hours of drying time, wash affected area with clean water and a mop, cloth or sponge, rinsing frequently. Allow surface to dry prior to final **light** sanding and application of finish coat.

E. Inaccessible wall voids, wall studs and wood members: Apply by foaming (See Section IV.F.) or misting into voids and channels of damaged or suspected infested wood and/or through small holes drilled into walls and baseboard areas. Space holes no more than 24" apart along each member to be treated and at least 1 hole must be drilled between each wall stud when treating base plates. Use sufficient amount of solution to cover all areas to the point of surface saturation.

Note: Existing insulation may interfere with distribution of the Bora-Care solution. If necessary, move or displace insulation during or prior to treatment.

F. Foam application: Apply Bora-Care solution to bare wood surfaces and void areas as a foam by mixing 2 parts water with 1 part Bora-Care (2:1) and adding 3 to 8 ounces of foaming agent per gallon of mixed solution. Foam will take approximately 1 hour to return to liquid state and soak into bare wood. Apply foamed Bora-Care solution to void spaces at a 1:20 to 1:30 foam ratio (1 gallon of mixed solution expanded with foaming agent to produce 20 to 30 gallons of foam). Apply enough foam to fill void and contact all wood surfaces in the void space.

G. Foam insulation: Apply by injecting a 1:1 Bora-Care solution into the infested area and/or by low pressure surface spraying at a rate of 1 gallon per 300 to 400 square feet. Bora-Care solution may also be mixed with approved topically-applied insulation products. To protect insulation from infestation, pre-mix the appropriate amount of Bora-Care solution with foaming materials during or prior to installation that will achieve a 0.5-1.5% by weight retention.

Note: Some types of foam insulation, such as polyisocyanurate and extruded polystyrene, have closed cell structures that do not allow significant penetration from surface application. Inject and surface spray these types of insulation.

H. For remedial treatments: Apply a supplemental treatment of Bora-Care solution to concrete, block or brick on the interior of crawlspace and basement foundations to prevent shelter tubing by subterranean termites. Apply a 1:1 Bora-Care solution at the rate of 1 gallon to 400 square feet of surface area. In crawlspaces, apply solution 2 feet (24 inches) up from the ground on interior wall surfaces. In unfinished basements with bare concrete slabs, apply the 1:1 Bora-Care solution 2 feet up from the concrete slab on interior foundation walls. In -addition to the wall treatment, extend application up to 6 inches away from foundation walls onto the horizontal surface of the bare concrete slab. Treat bath trap areas in concrete slab construction, after obtaining access to the area, by evenly applying 8 ounces of the 1:1 Bora-Care solution into the traps out at least 1 foot (12 inches) in all directions from the edge of the trap area. Treat other termite access areas (such as plumbing penetrations, expansion joints and abutting slabs) by applying the 1:1 Bora-Care solution into the penetration, out at least 1 foot in all directions from the edge of the penetration area. Also treat protruding utilities and adjacent wood to a height of 2 feet.

V. Preventative Treatment of Wooden Structures for Formosan, Drywood and Dampwood Termites, Carpenter Ants, Old House Borers, Powderpost and other Wood Boring Beetles, and Fungi (Rot)

Note: Bora-Care is not intended for application to soil.

Bora-Care solution provides only limited and temporary protection of wood in contact with the ground (see specific instructions) and is not a substitute for products registered for protection of wood in contact with the ground. Bora-Care solution may be applied as a treatment to protect wood from Formosan, drywood and dampwood termites, carpenter ants, old house borers, powderpost and listed wood boring beetles and wood decay fungi.

Apply when access to wooden structural components is optimized such as at the "dried-in" stage when sheathing and roofing are in place, yet before installation of insulation, wiring, plumbing and other mechanical components.

For framed wood surfaces above ground, apply to the point of surface saturation 1 coat of a 1:1 Bora-Care solution for subterranean termites and Formosan termites as described in Section VI. For treatment of new log structures see Section IX. Treat remainder of structural wood with a 5:1 Bora-Care solution. Concentrate application in areas susceptible to attack, to include all sills, plates, floor joists, piers, girders and subfloors. Treat structural wood in all plumbing, electrical and ductwork areas where they penetrate walls and/or floors. Treat all structural wood base plates and studs on interior and exterior walls, especially those surrounding any high moisture areas such as bathrooms, kitchens and laundry rooms. For buildings built on concrete slabs, treat all structural wood in contact with the concrete slab, all interior and exterior wall studs and wall sheathing material. In attics, treat all structural wood including ceiling joists, trusses, top plates, rafters and roof decking. Treat all structural wood sill plates and structural wood contacting garages and porches.

In areas where access is limited to 1 or 2 sides of a wood member, including exterior wall base plates and any

married studs, apply 2 coats of Bora-Care solution to the exposed surfaces. Allow first application to dry by waiting at least 20 minutes between applications.

Treat all exterior wood including siding, facias, soffits, eaves, roofing, porches, decks and railings.

VI. Preventative Treatments and Pretreatments for Subterranean Termites (Crawl Space, Basement and Slab)

Note: This treatment serves as a primary treatment for the control of subterranean termites. This product must be applied with a 1:1 Bora-Care solution.

In new construction applications for the prevention of subterranean termites, structural wood is defined as only wood needed for the basic building structure as found in the "dried-in" stage of construction, including wood in direct contact with foundations, interior and exterior wall sill plates, wood studs, wood or cellulosic sheathing, floor joists and sub-flooring.

Apply when access to wooden structural components is optimized and when no further framing modifications will be made, such as after final framing inspection. If treatment is carried out prior to framing inspection, a second visit is required to ensure full treatment is still intact.

In areas where access is limited to 1 or 2 sides of a wood member, including exterior wall base plates and any married studs, apply 2 coats of Bora-Care solution to the exposed surfaces. Allow first application to dry by waiting at least 20 minutes between applications. s

A. Buildings on Crawl Spaces and Basements: Apply 1 coat of a 1:1 Bora-Care solution in a 2-foot-wide uninterrupted band to the point of surface saturation to all structural wood surfaces in crawl spaces and basements, to include all sills, plates, floor joists, piers, girders and subfloors as well as structural wood exposed to direct vertical access from the soil. To prevent termite shelter tubes on crawlspace walls, apply a 1:1 Bora-Care solution to crawlspace concrete or block walls in a 2-foot band up from the ground on interior wall surfaces. Apply at the rate of 1 gallon to 400 square feet of surface area. Treat a 2-foot band around construction materials and structural wood adjacent to plumbing, electrical conduit and ducts where they penetrate subfloors, if they provide a direct vertical access from the soil. Treat all structural wood, including wall studs and sills, in finished-out basements where structural wood framing is immediately adjacent to the exterior foundation walls. Spray the concrete slab surface a minimum of 2 up to a maximum of 8 inches. To prevent termite shelter tubes on basement walls, spray all interior concrete or block foundation walls with a 2-foot band up from the concrete slab area. Apply the 1:1 Bora-Care solution at the rate of 1 gallon per 400 square feet of concrete foundation wall area.

On structural wood where access is limited to 1 or 2 sides of wood members such as sills plates and headers on foundation walls, married studs or wrapped sheathing, apply 2 coats of Bora-Care solution. Allow first application to dry by waiting at least 20 minutes between applications. If accessible, treat the exterior of structural wood sill areas around the entire perimeter of the structure with a 2-foot-wide band of a 1:1 Bora-Care solution beginning with the sill area and extending upwards onto the sheathing material. On multiple story structures, treat only the first story above the masonry foundation level. Coated or painted structural wood may be treated by pressure injecting Bora-Care solution into holes drilled into the wood at 8- to 10-inch intervals. Inject at 40 psi for 4 to 6 seconds per hole.

B. Buildings on concrete slabs: Apply 1 coat of a 1:1 Bora-Care solution to all wood, metal and/or non-cellulosic base plates and the bottom 2 feet of all wood, metal and/or non-cellulosic studs on all exterior and interior walls in contact with the concrete slab. Treat at the rate of 1 gallon of solution to 200 linear feet of stud walls. Treat all wood in plumbing walls, bath traps and any wood adjacent to plumbing, electrical conduit and duct penetrations to provide a minimum 2-foot-wide barrier of treatment between the bottom of the penetration site and the balance of the structure. **In areas where access is limited to 1 or 2 sides of a structural wood member, such as sills and plates on foundation walls, married studs or wrapped sheathing, apply 2 coats of Bora-Care solution to the exposed surfaces.** Allow first application to dry by waiting at least 20 minutes between applications. When spraying base plates, also treat the concrete slab a minimum of 2 inches to a maximum of 8 inches out from plates. Treat the concrete slab where any visible cracks may be occurring, extending treatment 8 to 12 inches out on each side of the concrete slab crack. Treat all penetrations (such as plumbing, expansion joints and abutting concrete slabs) by spraying the 1:1 Bora-Care solution 2 feet high and extending application to cover at least 6 inches of concrete slab out from penetration site. Concrete, cinder block or non-cellulosic exterior walls must be treated with a 1:1 Bora-Care solution 2 feet on the interior side of wall surface up from the concrete slab. This treatment must be applied as a continuous 2-foot barrier to all interior surfaces of all exterior walls. Treat at the rate of 1 gallon of a 1:1 Bora-Care solution to 400 square feet of surface area. Do not use for new construction treatments if the total linear footage of the cellulosic base plates is less than 60% of the total linear footage of all base plates in the structure to include exterior and interior walls. In new construction with 60% or more lineal footage of base plates, but without continuous wood on every exterior wall, the Bora-Care treatment must be installed to all other exterior structural construction materials, including brick or block, to a height of 2 feet and extended out onto the slab a minimum of 2 to a maximum of 8 inches.

C. Foam insulation: Treat with low-pressure surface spraying or injecting a 1:1 Bora-Care solution to the infested area at the rate of one 1 gallon per 300 to 400 square feet.

Note: Some types of foam insulation, such as polyisocyanurate and extruded polystyrene, have closed cell structures that do not allow significant penetration from

surface application. Inject and surface spray these types of insulation.

VII. Preventative Treatment for Drywood Termites and Powderpost Beetles

Apply 1 coat of a 5:1 Bora-Care solution to the point of surface saturation to all structural wood surfaces using a brush, spray or mist. Apply 2 coats of Bora-Care solution to those surfaces where access is limited to 1 or 2 sides of structural wood members. Allow first application to dry by waiting at least 20 minutes between applications.

VIII. Treatment of Exterior Wood Surfaces Less Than Two Inches Thick such as Decks, Sheds and Fences

Apply only to bare wood or to wood surfaces where an intact water repellent or finish is not present. Remove paint or finish prior to application. Apply 1 coat of Bora-Care solution to the point of surface saturation to all wood surfaces. Apply 2 coats of Bora-Care solution to heavily infested areas and to those surfaces where access is limited to 1 or 2 sides of wood members. Allow first application to dry by waiting at least 20 minutes between applications. Do not apply in rain or snow. Do not expose treated exterior wood surfaces to rain or snow for at least 48 hours after treatment. If inclement weather is expected, protect exterior treated surfaces with a plastic tarp.

For wood in contact with the ground or soil, see Section XI.

A. Finishing and Maintaining Treated Surfaces: For longer performance, exterior wood surfaces that have been treated with Bora-Care solution will require a topcoating with a water-resistant finish such as paint or exterior stain. Apply the finish or topcoat within 6 weeks of treatment. It is important to allow Bora-Care-treated wood to completely dry (at least 48 hours) before applying any protective topcoat. Coat a small section of treated wood with the finish to be used and check for compatibility prior to complete application.

IX. Treatment of Log Structures, Timbers, Beams, Pilings and Exterior Wood Members Two or More Inches Thick

Apply only to bare wood or to wood surfaces where an intact water repellent or other finish is not present. Remove paint or finish prior to application. Prior to treatment clean interior, unfinished surfaces that have accumulated dirt or cooking oils with a strong detergent. Apply a 1:1 Bora-Care solution to the point of surface saturation to all interior and exterior wood surfaces. Apply 2 coats of Bora-Care solution to log ends, notches, corners and sill logs. Wait at least 1 hour before reapplication.

Actual number of coats necessary to meet minimum requirements will depend upon actual wood size, surface porosity and number of sides accessible for treatment. Refer to application chart for the minimum amount of Bora-Care solution needed to treat various sized logs or beams. Typically, 2 coats of solution are required to treat round logs 10" or greater in diameter and rectangular logs larger than 6" x 12". Wait at least 1 hour before re-application. Do not apply in rain or snow. Do not expose treated exterior wood surfaces to rain or snow for at least 48 hours after treatment. If inclement weather is expected, protect exterior treated surfaces with a plastic tarp.

A. Finishing and Maintaining Treated Surfaces: For long-term protection, exterior wood surfaces that have been treated with Bora-Care solution will require a topcoating with a water-resistant finish, paint or exterior stain. Apply the finish or topcoat within 6 weeks of treatment. It is important to allow Bora-Care-treated wood to completely dry (at least 48 hours) before applying any protective topcoat. Coat a small section of treated wood with the finish to be used and check for compatibility prior to complete application.

X. Dip Treating Logs and Lumber

Prepare a 5:1 Bora-Care dip treating solution. This will result in a stable solution containing 9% active ingredient. Sticker bundled wood to ensure the solution covers all wood surfaces. Submerge logs and/or lumber in the solution for at least 1 minute or until all entrapped air has escaped. Protect treated wood from rain or snow for at least 24 hours after treatment.

XI. Treatment of Wood In Contact With the Ground

A Bora-Care solution treatment to wood in contact with the ground or soil has a limited lifespan and will require periodic reapplication. Protection may be extended with the use of a 40% disodium octaborate tetrahydrate (or borate) gel product.

XII. Prevention and Remedial Control of Algae for Cellulosic Building Components

Apply Bora-Care solution for the prevention and remedial control of algae to cellulosic building components (drywall, insulation) in new construction and existing structures and where an intact water repellant barrier such as paint, stain or sealer is not present. Apply Bora-Care solution at the rate of 1 gallon of solution per 400 square feet of surface area. Apply only to the back paper side of drywall and to cellulose insulation. In areas where drywall has been installed and insulation is enclosed, apply Bora-Care solution using a misting machine (or applicator) applying sufficient solution to cover surfaces at the rate of 1 gallon per 400 square feet. Refer to **Tables A and B** for mixing ratios for preventative and remedial algae treatments.

The Bora-Care solution can also be applied to exterior stone and concrete walkways and walls for the prevention and control of algae growth. Apply a 5:1 Bora-Care solution at the rate of 1 gallon of solution per 400 square feet of walkway or wall surface area. Do not spray abutting grass or plantings.

XIII. General Pest Control Applications

The application of Bora-Care solution to the surface of wood in new construction or to wood surfaces inside wall void areas in existing structures helps to prevent the establishment of cockroach, ant (except Fire, Harvester and Pharaoh ants), silverfish, earwig, boxelder bug, millipede and cricket infestations that come in direct contact with these treated areas. Apply 1 gallon of

Bora-Care solution per 400 square feet of surface area or refer to **Tables A and B** when applying as a surface application.

XIV. Bora-Care Total Wood Preservative

Bora-Care is a wood preservative for protection and treatment of wood against brown rot, white rot, fungi (rot) and wood destroying insects including beetles, termites and carpenter ants. Treatment is permanent provided the treated material is not exposed to rain, moisture or ground contact.

A. General Information: Bora-Care is a concentrated mixture of sodium borate with additives that facilitate rapid penetration of wood, regardless of moisture content. It is designed for preventative and/or remedial treatment of wood in both new and existing structures against fungi (rot) and wood boring insects including:

Subterranean Termites (*Reticulitermes, Heterotermes, Coptotermes*)
Dampwood Termites (*Zootermopsis*)
Drywood Termites (*Kalotermes, Incisitermes*)
Powderpost Beetles (*Lyctidae, Bostrichidae*)
Anobiid Beetles (*Anobiidae*)
Old House Borers, Longhorn Beetles (*Cerambycidae*)
Carpenter Ants (*Camponotus*)

B. Surface Preparation: Apply only to bare wood or to wood surfaces where an intact water repellent or other finish is not present. Remove any previous finishes or water repellents before application the Bora-Care solution. Surfaces must be free of dirt and other contaminates. Prior to treatment, clean with a strong detergent all interior, unfinished surfaces that are to be treated and that have accumulated dirt or cooking oils. If finished appearance is a concern, prior to application of Bora-Care solution, remove any mold or mildew with an appropriate wood cleaner followed by thorough surface rinsing.

C. Application Instructions: Do not apply in rain or snow. Do not expose exterior wood surfaces to rain or snow for at least 48 hours after treatment. If inclement weather is expected, protect exterior treated surfaces with a plastic tarp.

1. Treatment of Dimensional Lumber, Plywood and Exterior Wood Surfaces (Decks, Sheds, Siding, etc.): To all wood surfaces apply to the point of surface saturation 1 coat of: a 1:1 Bora-Care solution for remedial control of wood-infesting insects; a 2:1 Bora-Care solution foam or mist; a 3:1 Bora-Care solution for remedial control of fungi (rot); or a 5:1 Bora-Care solution for insect and fungi (rot) prevention. Apply 2 coats of Bora-Care solution to heavily infested areas and to those surfaces where access is limited to 1 or 2 sides of wood members. Allow first application to dry by waiting at least 20 minutes between applications.

2. Treatment of Logs, Timbers and Large Beams: Apply to the point of runoff by spray or brush a 1:1 Bora-Care solution to all interior and exterior wood surfaces. Refer to application chart for minimum amount of Bora-Care solution to treat various sized logs or beams. Typically, 2 coats of solution will be required to treat round logs 10" or greater in diameter and rectangular logs larger than 6" x 12". Wait at least 1 hour between applications. Also apply 2 coats of Bora-Care solution to log ends, notches, corners and sill logs. Actual number of coats necessary to meet the minimum requirements will depend upon actual wood size, surface porosity and number of sides accessible for treatment.

3. Dip Treating Logs and Lumber: Prepare a 5:1 Bora-Care dip treating solution. This will result in a stable solution containing 9% active ingredient. Sticker bundled wood to ensure the solution covers all wood surfaces. Submerge logs and/or lumber in the solution for at least 1 minute or until all entrapped air has escaped.

D. Finishing and Maintaining Exterior-Treated Surfaces: For long-term protection, exterior wood surfaces that have been treated with Bora-Care solution require a topcoating with a water-resistant finish such as paint or exterior stain. Apply the finish or topcoat within 6 weeks of treatment. It is important to allow Bora-Care-treated wood to completely dry (at least 48 hours) before applying any protective topcoat. Coat a small section of treated wood with the finish to be used and check for compatibility prior to complete application. Interior surfaces do not require topcoating except in situations involving repeated moisture contact or high humidity (shower stalls, bath houses, saunas, etc.).

E. Retention Rates: One gallon of Bora-Care concentrate (2 gallons of Bora-Care solution as applied) will treat 800 board feet of wood to a minimum retention level of 0.084 pounds per cubic foot boric acid equivalent (BAE). Since the active ingredient penetrates throughout the wood being treated, calculate the amount of Bora-Care solution needed on the volume of wood being treated, not just the surface area. Use the following formulas to calculate the required amount of Bora-Care solution:

For Dimensional Lumber
(2 x 4, 2 x 6, 2 x 12, etc.)

Material thickness (inches) x material width (inches)
x material length (feet) divided by 12 = Board Feet

For Log Homes

Log height (inches) x log thickness (inches)
x perimeter (feet)
x number of courses divided by 12 = Board Feet
(For round logs use the average diameter for both height and thickness measurements)

For Siding and Paneling

One gallon of Bora-Care concentrate (2 gallons of solution) will treat 800 sq. ft. of 1" thick wood by spraying only one side. If siding or paneling is 1/2" thick, 1 gallon of Bora-Care concentrate (2 gallons solution) treats 1,600 sq. ft.

XV. Application Rates

Table A – Dimensional Lumber

Lumber Size (Inches)	1 Gallon of Diluted Bora-Care Will Treat Up To	Minimum Amount of Diluted Bora-Care To Treat 1000 Lineal Feet
1 x 4	1,200 Lineal Feet	0.8 Gal.
1 x 12	400	2.6
2 x 4	600	1.6
2 x 6	400	2.6
2 x 8	308	3.2
2 x 10	240	4.2
2 x 12	200	5.0
4 x 4	300	3.4
4 x 6	200	5.0
4 x 8	150	6.8
4 x 12	100	10.0
6 x 6	133	7.6
6 x 8	100	10.0
6 x 10	80	12.6
6 x 12	68	15.0

Table B – Panels, Siding and Plywood
(1:1 or 2:1 mixing ratio)

Thickness (Inches)	1 Gallon of Diluted Bora-Care Will Treat Up To	Minimum Amount of Diluted Bora-Care To Treat 1000 Square Feet
1/4	1,600 sq. ft.	0.6 Gal.
3/8	1,067	1.0
1/2	800	1.2
3/4	533	1.8
1	400	2.6

Table C – Round Logs
(only the 1:1 mixing ratio)

Diameter (Inches)	1 Gallon of Diluted Bora-Care Will Treat Up To	Minimum Amount of Diluted Bora-Care To Treat 1000 Lineal Feet
6	167 Lineal Feet	6.0 Gal.
8	96	10.4
10	61	16.4
12	43	23.4

Note: The numbers listed above are based on an application rate of one gallon of Bora-Care solution to 400 board feet of wood.

XVI. Bora-Care Solution to Control Annosus Root Disease (*Heterobasidion annonsum* (Fr.) Bref.) to Treat the Top of Freshly Cut Stumps

Dilute Bora-Care to a 5% solution by thoroughly mixing 1 gallon of Bora-Care with 9 gallons of water. Using a mechanical harvester, backpack sprayer or hand-held sprayer, apply solution to the point of wetness to the surfaces of freshly cut stumps immediately after or within 3 days of felling. One gallon of solution will treat 200 square feet of stump surface area (approximately 200 to 1,000 stumps, depending on stump size). Marker dye may be added to the solution as a visual aid.

Storage and Disposal

(For product packaged in rigid, nonrefillable containers less than or equal to 5 gallons)

Do not contaminate water, food or feed by storage or disposal.

Pesticide Storage: Store in original container in a preferably locked storage area inaccessible to children and pets. Do not freeze. **Pesticide Disposal:** Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility. **Container Management:** Nonrefillable container; do not reuse or refill this container. Triple rinse (or equivalent) container promptly after emptying. Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank and drain for 10 seconds after the flow begins to drip. Fill the container ¼ full with water and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Drain for 10 seconds after the flow begins to drip. Repeat this procedure two more times, then offer for recycling, if available; or reconditioning, if appropriate; or puncture and dispose of in a sanitary landfill; or by incineration.

Storage and Disposal

(For product packaged in rigid, nonrefillable containers greater than 5 gallons)

Do not contaminate water, food or feed by storage or disposal.

Pesticide Storage: Store in a cool, dry (preferably locked) storage area inaccessible to children and pets. Do not freeze. **Pesticide Disposal:** Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility. **Container Management:** Nonrefillable container; do not reuse or refill this container. Triple rinse (or equivalent) container promptly after emptying. Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank. Fill the container ¼ full with water. Replace and tighten closures. Tip container on its side and roll it back and forth, ensuring at least one complete revolution, for 30 seconds. Stand container on its end and tip it back and forth several times. Turn the container over onto its other end and tip it back and forth several times. Empty the rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Repeat this procedure two more times, then offer for recycling, if available; or reconditioning, if appropriate; or puncture and dispose of in a sanitary landfill; or by incineration.

SPECIMEN

Storage and Disposal

(For product packaged in rigid, refillable containers)
Do not contaminate water, food or feed by storage or disposal.

Pesticide Storage: Store in original container in a preferably locked storage area inaccessible to children and pets. Do not freeze. **Pesticide Disposal:** Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility. **Container Management:** Refillable container; refill this container only with Bora-Care. Do not reuse this container for any other purpose. Cleaning the container before refilling is the responsibility of the refiller; cleaning before final disposal is the responsibility of the person disposing of the container. To clean the container before final disposal, empty the remaining contents from this container into application equipment or mix tank. Fill the container about 10% full with water, then vigorously agitate or recirculate water with the pump for 2 minutes. Pour or pump rinsate into application equipment or rinsate collection system. Repeat this rinsing procedure 2 more times, then offer for recycling, if available; or reconditioning, if appropriate; or puncture and dispose of in a sanitary landfill; or by incineration..

XVII. Warranty Disclaimer

Manufacturer warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes stated on the label when used in strict accordance with the directions, subject to the inherent risks set forth below. To the extent not prohibited by applicable law, **MANUFACTURER MAKES NO OTHER EXPRESS OR IMPLIED WARRANTY OF MERCHANT-ABILITY, FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY.**

Inherent Risks of Use

The directions for use of this product are believed to be adequate and must be carefully followed. It is impossible to eliminate all risks associated with use of this product. Lack of performance or other unintended consequences may result because of such factors as use of the product contrary to label instructions, abnormal conditions, the presence of other materials, climatic conditions or the manner of use/application, all of which are beyond the control of the Manufacturer. The buyer/user assumes all such risks.

Limitation of Remedies

To the extent not prohibited by applicable law, the exclusive remedy for losses or damages resulting from this product (including claims based on contract, negligence, strict liability or other legal theories) shall be limited to, at Manufacturer's election, one of the following:

1. Refund of purchase price paid by buyer or user for product bought, or
2. Replacement of amount of product used.

To the extent not prohibited by applicable law: a) Manufacturer shall not be liable for losses or damages resulting from handling or use of this product unless Manufacturer is promptly notified of such loss or damage in writing; and b) **IN NO CASE SHALL MANUFACTURER BE LIABLE FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES OR LOSSES, INCLUDING WITHOUT LIMIT, HEALTH RELATED DAMAGES OR INJURIES.**

The terms of this **Warranty Disclaimer** and **Limitation of Remedies** cannot be varied by any written or verbal statements or agreements. No employee or sales agent of Manufacturer or the seller is authorized to vary or exceed the terms of this **Warranty Disclaimer** or **Limitation of Remedies** in any manner.

It is not intended that this product be used to practice any applicable patent, whether mentioned or not, without procurement of a license, if necessary, from the owner, following investigation by the user.

Nisus Corporation
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(800) 264-0870

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Issued Date: 8/24/1989
Revised Date: 05-01-11

MATERIAL SAFETY DATA SHEET

BORA-CARE®

Health Emergencies: CHEMTREC® (800) 424-9300

SECTION 1 - PRODUCT AND COMPANY INFORMATION

Manufacturer: Nisus Corporation
100 Nisus Drive
Rockford, TN 37853
(800) 266-0870

Product Trade Name: **BORA-CARE®**
EPA Registration No. 64405-1
Chemical Family: Glycol borate solution
Formula: Proprietary Mixture CAS No.: N/A

SECTION 2 – INGREDIENTS INFORMATION

40% Disodium Octaborate Tetrahydrate

60% mixed glycols (monoethylene and polyethylene glycols are used in the manufacturing process)

SECTION 3 – HEALTH HAZARD INFORMATION

Hazard Rating: NFPA			
	Health	1	Slight hazard
	Flammability	0	
	Reactivity	0	

Material or Component: Manufactured using Ethylene Glycol CAS No. 107-21-1
TLV 50.00 ppm ACGIH Type CEIL
(Note this is a raw material and there is no free ethylene glycol present.)

EYE CONTACT: Causes moderate eye irritation. Direct contact may cause burning, tearing and redness in sensitive individuals.
SKIN CONTACT: This material is essentially non-irritating. Prolonged or repeated exposure to this material may cause softening of the skin. Persons with preexisting skin disorders may be more susceptible to the effects of this material. Harmful if absorbed through skin.
INGESTION: Ingestion of large amounts may cause nausea, mental sluggishness followed by difficulty in breathing and heart failure, kidney and brain damage, possibly death.
INHALATION: Harmful if inhaled. Breathing high concentrations of vapors may cause nausea, dizziness or drowsiness, and irritation of the nose and throat. Preexisting lung disorders may be aggravated by exposure to this material.

SECTION 4 - EMERGENCY AND FIRST AID PROCEDURES

INHALATION: Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth, if possible.
SKIN CONTACT: Take off contaminated clothing. Immediately rinse skin with plenty of water for 15-20 minutes.
EYE CONTACT: Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for further treatment advice. Have the product container or label with you when calling a poison control center or doctor, or going for treatment.
INGESTION: SEEK EMERGENCY MEDICAL ATTENTION If the victim is drowsy or unconscious, place on the left side with the head down. Do not give anything by mouth. If victim is conscious and alert, vomiting should be induced for ingestion of more than 1 – 2 tablespoons for an adult, preferably with syrup of ipecac under direction from a physician or poison center. If syrup of ipecac is not available, vomiting can be induced by gently placing two fingers in back of throat. If large amounts are ingested, treat for glycol and borate toxicity. If possible, do not leave victim unattended.

NOTE TO PHYSICIAN: Treat for exposure to glycols. Contains borates. Monitor electrolytes.

SECTION 5 - FIRE AND EXPLOSION DATA

FLASH POINT Above 220°F (Tag Closed Cup)
FLAMMABLE LIMITS: Not known.
EXTINGUISHING MEDIA: CO_2, dry powder or universal type foam.
FIRE AND EXPLOSION HAZARDS: This material will not readily ignite.
FIRE FIGHTING PROCEDURES: Avoid inhaling smoke. The use of a SCBA is recommended for fire fighters. Water spray may be useful in minimizing vapors and cooling containers exposed to heat and flame.

SECTION 6 - ACCIDENTAL RELEASE MEASURES

PRECAUTIONS IN CASE OF RELEASE OR SPILL: Absorb with organic liquid absorbent. Do not let material or washwaters enter sewers or waterways. Where large release has occurred see ecological section.

SECTION 7 - HANDLING AND STORAGE

HANDLING AND STORAGE PRECAUTIONS: Store between 40°F and 90°F. Do not store in direct sunlight. Keep containers tightly closed.
Store in areas not accessible to children and pets.
Do not store with strong oxidizers.
Locked storage is required for EPA registered materials.

SECTION 8 – EXPOSURE CONTROLS AND PERSONAL PROTECTION

RESPIRATORY PROTECTION: Good ventilation. When applying Bora-Care in confined spaces, provide ventilation or an exhaust system or use of a NIOSH-approved dust/mist filtering respirator (MSHA/NIOSH approval number prefix TC-21C) with a prefilter approved for pesticides (MSHA/NIOSH approval prefix TC-23C), or a canister approved for pesticides (MSHA/NIOSH approval prefix TC-14G) or a NIOSH-approved respirator with any N, R, P or HE prefilter is recommended.
VENTILATION: Exhaust to ventilate.

Bora-Care is easily washed form eyes and skin.

US EPA requires the following personal protective equipment when applying registered materials:

PROTECTIVE GLOVES: Some materials that are chemical-resistant to this product are barrier laminate; butyl, nitrile, neoprene and natural rubbers ≥ 14 mils; polyethylene; polyvinyl chloride; and viton ≥ 14 mils. If you want more options, follow the instructions for category C on an EPA chemical-resistance category selection chart.

EYE PROTECTION: Use safety glasses, goggles or face shield.
OTHER PROTECTIVE EQUIPMENT: Applicators, mixers and other handlers must wear long-sleeved shirt, long pants, socks, shoes, chemical-resistant gloves and protective eyewear. It is recommended that a source of clean water be available in the work area for flushing eyes and washing skin.

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Appearance: Clear viscous gel
Specific Gravity: 1.38 g/ml
% Volatile: 36% by weight by TGA (as water)
Vapor Pressure: Negligible (<0.1)
Boiling Point: Above 212° F
Odor: None
% Solubility in Water: 100%
pH: 50% aqueous solution 6.9 - 7. 1

SECTION 10 - STABILITY AND REACTIVITY

STABILITY: Stable
CONDITIONS TO AVOID: Exposure to strong oxidizing agents. INCOMPATIBILITY (MATERIALS TO AVOID). This material is incompatible with strong oxidizing agents. This product may corrode aluminum.
HAZARDOUS POLYMERIZATION: Will not occur
HAZARDOUS DECOMPOSITION PRODUCTS: Ethylene oxide, carbon monoxide, carbon dioxide.

SECTION 11 - TOXICOLOGY

Bora-Care is of very low acute mammalian toxicity.

Acute oral LD_{50} - greater than 5000 mg/kg body weight (Sprague-Dawley male and female rats).
Acute dermal LD_{50} - greater than 2000 mg/kg body weight (New Zealand Albino male and female rabbits).
Acute inhalation LC_{50} – 5.06 mg/L for 4 hours (Sprague-Dawley male and female rats).
Intentional misuse by deliberately concentrating and inhaling this material may be harmful or fatal.
None of the major constituents of this material have been identified as carcinogens or probable carcinogens by IARC or OSHA.
The RfD for ethylene glycol is 2.0 mg/kg/day based on kidney toxicity in rats. US EPA has a high confidence in the study on which the RfD was based. The RfD is protective of animal demonstrated chronic and reproductive effects. Preexisting kidney disorders may be aggravated by exposure to this material.
Borates have been shown to have some chronic toxicity in animals fed high doses, similar to that of alcohol, but this has not been found in humans.

SECTION 12 – ECOLOGICAL INFORMATION

General: Boron (B) is the element in disodium octaborate tetrahydrate (the active ingredient in Bora-Care) which is used by convention to report borate product ecological effects. To convert disodium octaborate tetrahydrate into the equivalent boron (B) content, multiply by 0.2096. Bora-Care contains 8.4% B by weight.
Phytotoxicity: Boron is an essential micronutrient for healthy growth of plants; however, it can be harmful to boron sensitive plants (e.g. grass and ornamentals) in high quantities.
Algal Toxicity: Green algae, *Scenedesmus subspicatus*
96-hr EC_{10} = 24 mg B/L
Invertebrate Toxicity: Daphnids, *Daphnia magna straus*
24-hr EC_{50}=242 mg B/L
Test substance: sodium tetraborate
Fish Toxicity:
Seawater:
Dab, *Limanda limanda*
96-hr LC_{50} 74 MG B/LL
Freshwater:
Rainbow trout, *S. gairdneri* (embryo-larval stage)
24-day LC_{50} = 88 mg B/L
32-day LC_{50}) = 54 mg B/L
Goldfish, *Carassius auratus* (embryo-larval stage)
7-day LC_{50} = 65 mg B/L
3-day LC_{50} = 71 mg B/L

The LC_{50} of ethylene glycol = 9500 to 51,000 mg/l depending on organism, so is of no relevance. See above boron ecological information.

In the event of accidental environmental release, dilute with water.

Bora-Care is rapidly diluted to natural background micronutrient levels of boron, and the organic glycol components are biodegraded by microorganisms with a half-life of between 1 and 10 days (90% in one day using OECD 302B Test).

SECTION 13 – DISPOSAL CONSIDERATION

Make up only the amount of solution to be used that day. Excess solution can be used in treatment or further diluted with water and this diluted solution used to dilute product in future applications.

WASTE DISPOSAL METHOD: Unopened containers may be returned to Nisus corporation for reprocessing. Contact your State Pesticide, Environmental Control Agency or local authorities for proper disposal guidelines. Most sewage facilities will allow discharge to sewage of small volumes. Very large volume can retard sewage processing.

SECTION 14 – TRANSPORTATION INFORMATION

DOT Hazard Classification: Not Regulated

SECTION 15 – REGULATORY INFORMATION

EPA Registration No. 64405-1
Chemical Family: Glycol borate solution

Hazard Rating: NFPA	Health	1	Slight hazard
	Flammability	0	
	Reactivity	0	

SECTION 16 – OTHER INFORMATION

The information and recommendations contained herein are based upon data believed to be correct. However, no guarantee or warranty of any kind expressed or implied is made with respect to the information contained herein. This information and product are furnished on the condition that the persons receiving them shall make their own determination as to the suitability of the product for their particular purpose and on the condition that they assume the risk of their use thereof.

Nisus® CORPORATION

100 Nisus Drive • Rockford, TN 37853 USA • (800) 264-0870

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JECTA®

Diffusible Boracide.

WORKS WELL IN TIGHT SPACES.



Jecta is a ready-to-use injectable borate gel used by PMPs to reach places where other products can't be applied effectively. It protects sealed, moisture-laden or inaccessible wood from termites and other wood destroying organisms. Jecta's patented carrier system facilitates rapid penetration throughout wood of any moisture content.



Jecta is a "green" borate-based termiticide, insecticide and fungicide packaged in a 14-oz. caulking tube that fits conveniently into an easy-to-use applicator.

- Controls and prevents drywood termites, subterranean termites, Formosan termites, wood destroying beetles, carpenter ants and decay fungi.
- Highly concentrated 40% active disodium octaborate tetrahydrate with a controlled diffusion rate, providing a long-lasting reservoir of active borate ingredient.
- No known resistance.
- Specifically designed for treating sealed or unsealed wood in contact with ground or soil in high risk, moist and hard-to-reach places.

Visit www.nisuscorp.com for the complete line of green products.

100 Nisus Drive ▪ Rockford, TN 37853 ▪ (800) 264-0870 ▪ www.nisuscorp.com

Nisus® CORPORATION

Green Pest Control Solutions

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Jecta®

DIFFUSIBLE BORACIDE

Kills Infestations, Prevents and Eliminates Termites, Drywood Termites, Carpenter Ants, Wood-Destroying Beetles, and Fungi (Decay [white rot, brown rot and dry rot])
Long Lasting Protection for Wood in Contact with the Ground

ACTIVE INGREDIENT:
Disodium Octaborate Tetrahydrate (CAS No. 12280-03-4)..... 40%
OTHER INGREDIENTS: 60%
TOTAL: 100%

EPA Reg. No. 64405-4
EPA Est. 66405-TN
U.S. Patent No. 5,645,828

KEEP OUT OF REACH OF CHILDREN
CAUTION

PRECAUTIONARY STATEMENTS

Hazards to Humans and Domestic Animals

CAUTION: Harmful if inhaled or absorbed through skin. Avoid breathing vapors. Causes moderate eye irritation. Avoid contact with skin, eyes or clothing. Thoroughly was with soap and water after handling and before eating, drinking or using tobacco. Remove contaminated clothing and wash clothing before reuse. Avoid contamination of food or feed.

FIRST AID Borate Pesticide	
If Inhaled	• Move person to fresh air. • If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible.
If on Skin or Clothing	• Take off contaminated clothing. • Immediately rinse skin with plenty of water for 15-20 minutes.
If in Eyes	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye.
Call a poison control center or doctor for further treatment advice. Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-424-9300 for emergency medical treatment information.	

ENVIRONMENTAL HAZARDS

This pesticide is toxic to fish and wildlife. Do not apply directly to water, to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate walls or cisterns. Do not contaminate water when cleaning equipment or disposing of equipment washwaters or rinsates.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

NOTICE

Read and understand the entire label before using. Use only according to label directions.

Before buying or using this product, read ***Warranty Disclaimer*** and ***Limitation of Remedies*** statements found elsewhere on this label. If terms are unacceptable, return unopened package to seller for full refund of purchase price. Otherwise, use by the buyer or any other user constitutes acceptance of the terms under ***Warranty Disclaimer*** and ***Limitation of Remedies***.

SAFE HANDLING PROCEDURES

The use of chemical-splash goggles and solvent-resistant gloves is advised. Spills may be cleansed with a damp cloth or absorbed with appropriate materials. When applying Jecta in confined spaces, it is recommended that ventilation or an exhaust system be provided. If this is impractical the use of a NIOSH-approved respirator designed for protection from organic vapors is recommended.

PRODUCT INFORMATION

Jecta is highly concentrated to provide a long-lasting reservoir of active borate ingredient to wood, particularly in high-risk or moist areas. Because of its high concentration and controlled diffusion rate, Jecta is recommended for treating wood in contact with the ground or soil. Jecta controls and prevents wood-decaying fungi, wood-destroying beetles and termites. Jecta has no known resistance.

Jecta eliminates existing wood-destroying insects and fungal infestations and provides residual protection against:

- Subterranean Termites: *Reticulitermes, Heterotermes*
- Formosan Termites: *Coptotermes*
- Drywood Termites: *Kalotermes, Incisitermes*
- Dampwood Termites: *Zootermopsis, Neotermes*
- Powderpost Beetles: *Lyctidae, Bostrichidae*
- Anobiid Beetles: *Anobiidae*
- Carpenter Ants: *Camponotus*
- Old Houses Borers, Longhorn Beetles: *Cerambycidae, Hylotrupes*
- Ambrosia Beetles*: Platypodidae, Scolytidae*
- Fungi (Decay [white rot, brown rot and dry rot])

Jecta contains 40% by weight disodium octaborate tetrahydrate formulated in a patented carrier system that facilitates rapid penetration throughout wood of any moisture content. Jecta is particularly suited for treatment of wood that is coated with a water-repellent finish or is in ground contact, such as fence posts and utility poles. It is not necessary to remove any wood finish prior to injection of Jecta.

Use of this product does not substitute for mechanical alteration, soil treatment or foundation treatment, but is merely a supplement to a termiticide monitoring control program.

In new construction, Jecta is to be used as a supplemental treatment in conjunction with termiticide treatments. For existing structures, use Jecta as a remedial treatment. The 40% active borate gel diffuses deep into wood and allows access to painted, stained or sealed wood. Use Jecta for hard-to-reach areas including: Flooring and foundation systems; window and door framing and headers; exterior steps, porches and decks; roof trim and soffits; infested or susceptible support beams; porches and garages; fence posts; pilings and piers; log construction; utility poles; railroad ties (sleepers).

NOTE: If any wood member's structural integrity has been reduced to the extent that repair or replacement is necessary, make such repairs and/or replacement prior to treating with Jecta. Jecta does not add structural integrity to previously damaged wood.

I. APPLICATION METHODS

Jecta is designed for application to wood by injection into voids, checks, cracks, pre-drilled holes or injection sleeves designed for this purpose. To facilitate reapplication in high-risk areas, use a plug of material such as cork rubber, wood or caulk to seal the injection site.

Inject Jecta through any wood surface coating. Place injection sites in either a staggered, linear or angled pattern. Inject Jecta throughout the infested area and for at least 6 inches on either side of wood showing any signs of infestation.

Space injection holes at even intervals throughout the infested area to provide the best distribution of Jecta. Drill holes at a downward angle to help retain liquid in place while sealing hole. If a long section of a beam or member is being treated, do not exceed a 24-inch spacing between holes.

II. APPLICATION STEPS

1. Measure the dimensions and length of the zone of wood to be treated. If the zone has an active infestation, calculate amount to include an additional six (6) to twelve (12) inches in either side of the infested area. Refer to Table 1 for the amount of Jecta required to treat various size wood members.
2. Refer to Table 2 and select the appropriate size and number of holes to accommodate the required amount of Jecta. If possible, drill holes to extend to the center of the wood member being treated. Do not drill holes that significantly decrease the structural strength of any wood member.
3. Inject the proper amount of Jecta into holes.
4. Seal holes with a cork, plastic or wooden plug, exterior wood putty or rubber stopper.
5. Remove any excess Jecta from the surface with a damp cloth or sponge.

TABLE 1

Note: If possible, angle holes downward to prevent liquid from escaping hole after injection. Never space holes more than 24" apart along the length of any wood member being treated.

DIMENSIONAL LUMBER	
Actual Size (inches)	**Amount Required per Lineal Foot (cc)**
2 X 2	2
2 X 4	4
2 X 6	5
2 X 8	7
2 X 10	8
2 X 12	10
4 X 4	7

ROUND LOGS, POLES AND TIMBERS	
Diameter (inches)	**Amount Required per Lineal Foot (cc)**
4	5
6	12
8	21
10	33
12	48
14	63

SQUARE AND RECTANGULAR LOGS AND BEAMS	
Actual Size (inches)	**Amount Required per Lineal Foot (cc)**
4 X 4	7
4 X 6	10
4 X 8	13
4 X 10	17
4 X 12	20
6 X 6	15
6 X 10	25
6 X 12	30
8 X 8	27
8 X 10	33
8 X 12	39
10 X 10	42
12 X 12	60

TABLE 2
Liquid Capacity for Various Sized Holes in Cubic Centimeters

Depth (inches)	Hole Diameter (inches)			
	(3/8)	(1/2)	(5/8)	(3/4)
1	1.8	3.2	5.0	7.1
2	3.6	6.4	10.1	14.6
3	5.4	9.7	15.1	21.8
4	7.2	12.9	20.2	29.1
5	9.0	16.1	25.2	36.4
6	10.8	19.3	30.2	43.7
7	12.6	22.5	35.3	51.0
8	14.4	25.7	40.3	58.2
9	16.2	28.9	45.4	65.5
10	18.0	32.2	50.4	72.8

III. APPLICATION SITES

Use Jecta in areas where wood decay or insects are present or in high-risk areas vulnerable to infestation, such as wood that remains moist or is subject to frequent wetting, or wood that is in contact with the ground or soil. Examples include:

Flooring and Foundation Systems – especially around kitchens and bathrooms where leaky plumbing, bath traps or deteriorated caulking and inadequate moisture barriers may be present.

Window and Door Framing and Headers – where weathered paint or caulk provides inadequate protection against moisture. The corners, in particular, often exhibit signs of decay.

Exterior Steps, Porches and Decks – where damage may be found in columns, railings, floors and support members.

Roof Trim and Soffits – especially fascia boards supporting gutter systems and soffits; where wood is in contact with skylights, vents, flashing or chimneys and wherever excessive moisture is found.

Attics and Roofing – where leaks may cause decay damage to support members and rafters.

Porches and Garages – where wood contacts concrete slabs or brick walls are adjacent to dirt filled porches. The base of garage door frames, for example, is particularly susceptible to infestation by decay, termites and carpenter ants.

Fence Posts, Pilings and Piers – apply within six inches of the ground line as well as on top of the post and into existing cracks and checks.

Log Construction – in any decayed or susceptible areas or where a water-repellant finish is present such as corners, joints, ends and lower courses; and especially into upward facing cracks and checks that allow water entry. Apply directly into beetle emergence holes and carpenter ant galleries.

Utility Poles – in susceptible areas such as the groundline and where cross-arms are attached. Use wherever an active infestation is present or where preventative maintenance is desired.

Railroad Ties (Sleepers) – adjacent to rail plates, in cracks and checks where water accumulates, and in any infested or susceptible area.

Note: SPILLED JECTA MAY STAIN SOME WOOD FINISHES. IF NECESSARY, PROTECT SURFACE DURING APPLICATION AND WIPE UP EXCESS WITH A DAMP CLOTH.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

Storage: Store in a cool, dry (preferably locked) storage area inaccessible to children and pets. Do not freeze. **Pesticide Disposal**: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility. **Container Disposal**: Non-refillable container; do not reuse or refill this container. Clean container promptly after emptying, then offer for recycling, if available, or reconditioning, if appropriate; or puncture and dispose of container in a sanitary landfill; or, if allowed by state and local authorities, by incineration.

WARRANTY DISCLAIMER

Manufacturer warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes stated on the label when used in strict accordance with the directions, subject to the inherent risks set forth below. **MANUFACTURER MAKES NO OTHER EXPRESS OR IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY**.

INHERENT RISKS OF USE

The ***Directions for Use*** of this product are believed to be adequate and must be carefully followed. It is impossible to eliminate all risks associated with the use of this product. Lack of performance or other unintended consequences may result because of such factors as use of the product contrary to label instructions, abnormal conditions, the presence of other materials or the manner of use/application, all of which are beyond the control of the seller. All such risks shall be assumed by the buyer.

LIMITATION OF REMEDIES

To the extent not prohibited by applicable law, the exclusive remedy for losses or damages resulting from this product (including claims based on contract, negligence, strict liability or other legal theories) shall be limited to, at Manufacturer's election, one of the following:

1. Refund of purchase price paid by buyer or user for product bought, or
2. Replacement of amount of product used.

To the extent not prohibited by applicable law: a) Manufacturer shall not be liable for losses or damages resulting from handling or use of this product unless Manufacturer is promptly notified of such loss or damage in writing; and b) **IN NO CASE SHALL MANUFACTURER BE LIABLE FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES OR LOSSES, INCLUDING WITHOUT LIMIT, HEALTH-RELATED DAMAGES OR INJURIES**.

The terms of this **Warranty Disclaimer** and **Limitation of Remedies** cannot be varied by any written or verbal statements or agreements. No employee or sales agent of Manufacturer or the seller is authorized to vary or exceed the terms of this **Warranty Disclaimer** or **Limitation of Remedies** in any manner.

Nisus Corporation
100 Nisus Drive • Rockford, TN 37853 • 800-264-0870

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SPECIMEN

Issued Date: 8/24/1989
Revised Date: 5/1/2012

MATERIAL SAFETY DATA SHEET

Jecta®

Health Emergencies: CHEMTREC® (800) 424-9300

SECTION 1 - PRODUCT & COMPANY INFORMATION

Manufacturer: Nisus Corporation
100 Nisus Drive
Rockford, TN 37853
(800) 266-0870

Product Trade Name: **JECTA®**
EPA Registration No. 64405-4
Chemical Family: Glycol borate solution
Formula: Proprietary Mixture CAS Nos.: 12280-03-04; 25322-68-3; 107-21-1

SECTION 2 – INGREDIENTS INFORMATION

40% Disodium Octaborate Tetrahydrate

60% mixed glycols (monoethylene and polyethylene glycols are used in the manufacturing process)

SECTION 3 - HEALTH HAZARD INFORMATION

Hazard Rating: NFPA			
	Health	1	Slight hazard
	Flammability	0	
	Reactivity	0	

Material or Component: Manufactured using Ethylene Glycol CAS No. 107-21-1
TLV 50.00 ppm ACGIH Type CEIL
(Note this is a raw material and there is no free ethylene glycol present.)

EYE CONTACT: Causes moderate eye irritation. Direct contact may cause burning, tearing and redness in sensitive individuals.

SKIN CONTACT: This material is essentially non-irritating. Prolonged or repeated exposure to this material may cause softening of the skin. Persons with preexisting skin disorders may be more susceptible to the effects of this material. Harmful if absorbed through skin.

INGESTION: Ingestion of large amounts may cause nausea, mental sluggishness followed by difficulty in breathing and heart failure, kidney and brain damage, possibly death.

INHALATION: Harmful if inhaled. Breathing high concentrations of vapors may cause nausea, dizziness or drowsiness, and irritation of the nose and throat. Preexisting lung disorders may be aggravated by exposure to this material.

SECTION 4 - EMERGENCY AND FIRST AID PROCEDURES

INHALATION: Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth, if possible.

SKIN CONTACT: Take off contaminated clothing. Immediately rinse skin with plenty of water for 15-20 minutes.

EYE CONTACT: Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for further treatment advice. Have the product container or label with you when calling a poison control center or doctor, or going for treatment.

INGESTION: SEEK EMERGENCY MEDICAL ATTENTION If the victim is drowsy or unconscious, place on the left side with the head down. Do not give anything by mouth. If victim is conscious and alert, vomiting should be induced for ingestion of more than 1 – 2 tablespoons for an adult, preferably with syrup of ipecac under direction from a physician or poison center. If syrup of ipecac is not available, vomiting can be induced by gently placing two fingers in back of throat. If large amounts are ingested, treat for glycol and borate toxicity. If possible, do not leave victim unattended.

NOTE TO PHYSICIAN: Treat for exposure to glycols. Contains borates. Monitor electrolytes.

SECTION 5 - FIRE & EXPLOSION DATA

FLASH POINT Above 220°F (Tag Closed Cup)
FLAMMABLE LIMITS: Not known.
EXTINGUISHING MEDIA: CO_2, dry powder or universal type foam.
FIRE AND EXPLOSION HAZARDS: This material will not readily ignite.
FIRE FIGHTING PROCEDURES: Avoid inhaling smoke. The use of a SCBA is recommended for fire fighters. Water spray may be useful in minimizing vapors and cooling containers exposed to heat and flame.

SECTION 6 - ACCIDENTAL RELEASE MEASURES

PRECAUTIONS IN CASE OF RELEASE OR SPILL: Absorb with organic liquid absorbent. Do not let material or washwaters enter sewers or waterways. Where large release has occurred see ecological section.

SECTION 7 - HANDLING AND STORAGE

HANDLING AND STORAGE PRECAUTIONS: Store between 40°F and 90°F. Do not store in direct sunlight. Keep containers tightly closed.
Store in areas not accessible to children and pets.
Do not store with strong oxidizers.
Locked storage is required for EPA registered materials.

SECTION 8 - EXPOSURE CONTROLS AND PERSONAL PROTECTION

RESPIRATORY PROTECTION: Good ventilation. When applying JECTA in confined spaces, provide ventilation or an exhaust system or use of a NIOSH-approved dust/mist filtering respirator (MSHA/NIOSH approval number prefix TC-21C) with a prefilter approved for pesticides (MSHA/NIOSH approval prefix TC-23C), or a canister approved for pesticides (MSHA/NIOSH approval prefix TC-14G) or a NIOSH-approved respirator with any N, R, P or HE prefilter is recommended.

VENTILATION: Exhaust to ventilate.

JECTA is easily washed from eyes and skin.

US EPA requires the following personal protective equipment when applying registered materials:

PROTECTIVE GLOVES: Some materials that are chemical-resistant to this product are barrier laminate; butyl, nitrile, neoprene and natural rubbers ≥ 14 mils; polyethylene; polyvinyl chloride; and viton ≥ 14 mils. If you want more options, follow the instructions for category C on an EPA chemical-resistance category selection chart.
EYE PROTECTION: Use safety glasses, goggles or face shield.
OTHER PROTECTIVE EQUIPMENT: Applicators, mixers and other handlers must wear long-sleeved shirt, long pants, socks, shoes, chemical-resistant gloves and protective eyewear. It is recommended that a source of clean water be available in the work area for flushing eyes and washing skin.

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Appearance: Clear viscous gel
% Volatile: 36% by weight by TGA (as water)
Vapor Pressure: Negligible (<0.1)
Odor: None
pH: 50% aqueous solution 6.9 - 7. 1

Specific Gravity: 1.38 g/ml
Boiling Point: Above 212° F
% Solubility in Water: 100%

SECTION 10 - STABILITY AND REACTIVITY

STABILITY: Stable
CONDITIONS TO AVOID: Exposure to strong oxidizing agents. INCOMPATIBILITY (MATERIALS TO AVOID). This material is incompatible with strong oxidizing agents. This product may corrode aluminum.
HAZARDOUS POLYMERIZATION: Will not occur
HAZARDOUS DECOMPOSITION PRODUCTS: Ethylene oxide, carbon monoxide, carbon dioxide.

SECTION 11 - TOXICOLOGY

JECTA is of very low acute mammalian toxicity.

Acute oral LD_{50} - greater than 5000 mg/kg body weight (Sprague-Dawley male and female rats).
Acute dermal LD_{50} - greater than 2000 mg/kg body weight (New Zealand Albino male and female rabbits).
Acute inhalation LC_{50} – 5.06 mg/L for 4 hours (Sprague-Dawley male and female rats).
Intentional misuse by deliberately concentrating and inhaling this material may be harmful or fatal.
None of the major constituents of this material have been identified as carcinogens or probable carcinogens by IARC or OSHA.
The RfD for ethylene glycol is 2.0 mg/kg/day based on kidney toxicity in rats. US EPA has a high confidence in the study on which the RfD was based. The RfD is protective of animal demonstrated chronic and reproductive effects. Preexisting kidney disorders may be aggravated by exposure to this material.
Borates have been shown to have some chronic toxicity in animals fed high doses, similar to that of alcohol, but this has not been found in humans.

SECTION 12 – ECOLOGICAL INFORMATION

General: Boron (B) is the element in disodium octaborate tetrahydrate (the active ingredient in JECTA) which is used by convention to report borate product ecological effects. To convert disodium octaborate tetrahydrate into the equivalent boron (B) content, multiply by 0.2096. JECTA contains 8.4% B by weight.
Phytotoxicity: Boron is an essential micronutrient for healthy growth of plants; however, it can he harmful to boron sensitive plants (e.g. grass and ornamentals) in high quantities.
Algal Toxicity: Green algae, *Scenedesmus subspicatus*
96-hr EC_{10} = 24 mg B/L
Invertebrate Toxicity: Daphnids, *Daphnia magna straus*
24-hr EC_{50}=242 mg B/L
Test substance: sodium tetraborate
Fish Toxicity:
Seawater:
Dab, *Limanda limanda*
96-hr LC_{50} 74 MG B/LL
Freshwater:
Rainbow trout, *S. gairdneri* (embryo-larval stage)
24-day LC_{50} = 88 mg B/L
32-day LC_{50}) = 54 mg B/L
Goldfish, *Carassius auratus* (embryo-larval stage)
7-day LC_{50} = 65 mg B/L
3-day LC_{50} = 71 mg B/L

The LC_{50} of ethylene glycol = 9500 to 51,000 mg/l depending on organism, so is of no relevance. See above boron ecological information.

In the event of accidental environmental release, dilute with water.

JECTA is rapidly diluted to natural background micronutrient levels of boron, and the organic glycol components are biodegraded by microorganisms with a half-life of between 1 and 10 days (90% in one day using OECD 302B Test).

SECTION 13 – DISPOSAL CONSIDERATION

Product is supplied in a re-sealable container and can be re-sealed and stored for future use if not all used up. Empty container can go to plastic re-cycling.

WASTE DISPOSAL METHOD: Unopened containers may be returned to Nisus corporation for reprocessing. Contact your State Pesticide, Environmental Control Agency or local authorities for proper disposal guidelines. Most sewage facilities will allow discharge to sewage of small volumes. Very large volume can retard sewage processing.

SECTION 14 – TRANSPORTATION INFORMATION

DOT Hazard Classification: Not Regulated

SECTION 15 – REGULATORY INFORMATION

EPA Registration No. 64405-4
Chemical Family: Glycol borate solution

Hazard Rating: NFPA	Health	1	Slight hazard
	Flammability	0	
	Reactivity	0	

SECTION 16 – OTHER INFORMATION

The information and recommendations contained herein are based upon data believed to be correct. However, no guarantee or warranty of any kind expressed or implied is made with respect to the information contained herein. This information and product are furnished on the condition that the persons receiving them shall make their own determination as to the suitability of the product for their particular purpose and on the condition that they assume the risk of their use thereof.

100 Nisus Drive • Rockford, TN 37853 USA • (800) 264-0870

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Frequently Asked Question

How do I use Cobra Rods?

Answer

Cobra Rods Instructions

Cobra Rods are effective against some kinds of termites. Cobra Rods are used internally in wood with a permanent or periodical moisture content above the fiber saturation point (30%) for poles, etc. The rate of application for Cobra Rods is dependent upon the volume of wood to be treated. The recommended load is up to 6 oz. Boric Acid per cubic foot of wood depending upon requirements for treatment. The loading should not be less than 2.0 oz. of Boric Acid per cubic foot of wood. Cobra Rods contain 1.45 times equivalent Boric Acid (BAE).

Inspections can be carried out every 5-8 years for Industrial wood and every 8-10 years for commercial wood. If reusable plastic plugs are used new rods may be inserted into existing holes during the re-inspection process and the same plugs tapped back into place. The angle at which the rods are installed should be at 45Â° for wood placed vertically into the ground. If the wood is decayed sufficiently to be condemned and no reinforcement is mandated, DO NOT install Cobra Rods. Be careful during installation to not cause unacceptable structural damage to the wood during installation of rods.

Cobra Rods are placed into holes drilled in wood at specific high risk locations (such as at the ground line or near joints and exposed end-grain) and are dependant upon moisture in the wood to work. The rods are positioned so that they are dissolved by the moisture in the wood and the desired loadings are distributed throughout the target area. For remedial treatments of existing decay, 6 oz. of Boric Acid Equivalent (BAE) per cubic foot of wood is recommended. For preventive treatments, 2 oz. BAE per cubic foot is sufficient. When treating exposed ends or joints, Cobra Rods should be installed within six inches of the exposed end or joint.

DIRECTIONS FOR USE

Genics Cobra Rods are for treatment of pole structures, dimensional lumber (round stock, square stock) or any non-food contact wood. Cobra Rods are recommended for protection against fungal decay and insects. Cobra Rods can be used for all wood species.

To install Cobra Rods, the three step process is as follows:

1. Drill a hole at ground level (for posts and poles) using a 1/2" spade bit. Start the hole with the drill positioned horizontally. Once the bit is established, raise the drill to aim downward into the post at a 45Â° angle. Leave enough headroom to accommodate a 1/16" oversize plug.
2. Place the Cobra Rod into the hole. Never hammer the Cobra Rod during installation.
3. Insert the plug and push firmly to seat in hole. Hammer in plug until flush with surface.

Store out of reach of CHILDREN

Do not contaminate water, food or feed by storage or disposal.

Storage: Store in a dry location at all times, out of the reach of children and out of contact with food and feed.

Disposal: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

Package Disposal: Dispose of empty packaging in a sanitary landfill through ordinary trash collection, or if allowed by state and local authorities by burning. If burned, stay out of smoke.

EPA Reg. No. 71653-2

CSE since 1980
ConServ Epoxy LLC

"From hands-on professionals...For hands-on preservationists"
P.O. Box 454 Northford, CT 06472 phone (203) 484-4123 fax (203) 484-2398 www.conservepoxy.com

INSTRUCTIONS

FLEXIBLE EPOXY CONSOLIDANT 100 & W100

ConServ 100 FLEXIBLE EPOXY CONSOLIDANT is a non-structural, slow curing, low viscosity liquid epoxy system designed for saturating and encapsulating wood decay, or priming damaged areas. The W100 is a faster curing formula created for cold weather applications down to 35°F. The properties of both formulas are ideally suited for consolidating and stabilizing pockets of wood decay, checks, fissures and other surface imperfections due to weather exposure, insect infestation or minor charring from fire damage. Applications include porous end grain, window and door sills, sash, jambs, trim, siding, porch elements, stair parts, framing, log and timber elements etc. Use as a stabilizing primer for **ConServ 200** Flexible Epoxy Patch.

NOTICE: Labels & literature are ***color coded*** for proper identification. ***Please*** take time to acquaint yourself with ***all*** labels, instructions & precautions ***before*** mixing. View instructional videos at www.conservepoxy.com. Due to the variety of uses, application methods and conditions that customers might use these epoxy products for, no warranty is written or implied.

WOOD PREPARATION normally involves removing most of the loose and soft decay close to good wood prior to the application of the epoxy consolidant. If serious decay exists and if practical, drill 1/8" to 1/4" holes close together in the ***decay zone*** to provide for better penetration. Wood to be consolidated should be ***clean*** and ***dry*** with moisture content **below 20%.** For vulnerable moisture prone areas that have sustained decay, consider treating with liquid borate preservative 700-BC or 700-BD.

MIXING EPOXY: ***In hot weather put the can of* A *resin on ice*** & keep it in the shade to slow the curing process and increase pot life. ***This can be done with the 100, but is especially important for faster curing large batches of the* W100 *or* 100**.** The ***preferred*** mixing method is to pour the entire contents of bottle **B** (curing agent) into can **A** (epoxy resin). Blend ***thoroughly*** for three minutes by hand with a firm flat stick or use a power mixer. If you intend to use less than a full matched set, the ***easiest basic method*** is to break down components A & B into as many sets as you choose of equal volume, using clear wide mouth plastic bottles, then return **A** into metal cans and keep **B** in the bottles. (CSE offers various sizes of bottles and cans). A simple break down video of this method is on our website. Or, see the Technical Data sheet for more advanced options using vol. or wt.

CAUTION: The A Resin may ***crystallize*** in prolonged cool storage and become cloudy or form crystals on the bottom of the can. This condition can easily be corrected and ***does not*** in any way alter or inhibit the effectiveness of the epoxy. ***Dissolve*** by gradually warming in direct sun, use a hair dryer, heat gun or carefully place the A can in hot water or a double boiler and stir gently until the material is almost clear. **Do not over heat.** Allow epoxy to regain normal room temperature before using.

APPLY CONSOLIDANT ideally in a temperature range of 50°F-90°F to achieve a reasonably quick cure. Use W100 when the temperature is below 50°F and as low as 35°F. Provide covers to protect the epoxy from wet weather and hold in heat. Covers also increase the TEMP. of the substrate and shorten the epoxy cure time which is esp. helpful in cold weather. The original 100 formula is our slowest curing epoxy and *can* be used in warm temperatures; but if possible, avoid applying epoxy in direct sunlight during hot weather, or in rain. Apply **100** by funneling epoxy into a narrow mouth squirt bottle used to ***saturate*** areas like checks and fissures or brush on directly from the can or a wide mouth bottle. Spraying should only be done by experienced professionals. When practical, apply consolidant repeatedly until the wood glosses over and accepts no more epoxy. The objective is fiber saturation to encapsulate and stabilize any remaining decay. Protect the work area with polyethylene or another type of covering to keep the repair zone warm and dry until epoxy has cured. Protect unaffected areas from overspray or spills. Before applying **ConServ 200 Patch**, **consolidant *need not*** be fully cured. Apply **200** on wet **100** (preferred) or at a later time.

CURING of ConServ 100 Consolidant is 3-5 days at 72°F or room TEMP. W100 cure is 1½-2½ days at 72°F. The **100** cures slowly in hot weather to maximize penetration, W100 will cure slowly at 50°F and very slow at 35°F. Heat causes epoxy to cure faster and cold causes epoxy to cure slower. Expect to double the cure time for approx. every 20°F drop in temperature.

CLEAN-UP: Reusable tools may be wiped clean with dry paper towels ASAP after the epoxy has been applied. Discard paper towels, non-reusable containers, brushes etc. according to local regulations. White vinegar will soften cured epoxy on tools or equipment if allowed to soak for an extended period of time. Acetone, Methylene chloride and MEK softens cured epoxy for easy removal, but should be avoided due to their toxicity.

EPOXY SAFETY is a function of common sense and good housekeeping. ***Wear chemical resistant disposable gloves, eye protection, and work clothes.*** Don't get epoxy on your skin or clothing. Work with good ventilation.

STORAGE: ConServ 100 series epoxy consolidant has a one year shelf life if stored at moderate temperatures and kept dry in tightly sealed containers. Epoxy stored at 50°F to 75°F is a guideline for an ideal long term storage temperature.

(See reverse side for TECHNICAL DATA)

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TECHNICAL DATA

FLEXIBLE EPOXY CONSOLIDANT 100 & W100

ConServ 100 FLEXIBLE EPOXY CONSOLIDANT is a non-structural, slow curing, low viscosity liquid epoxy system designed for saturating and encapsulating wood decay, or priming damaged areas. The **W100** is a faster curing formula created for cold weather applications down to 35°F. The properties of both formulas are ideally suited for consolidating and stabilizing pockets of wood decay, checks, fissures and other surface imperfections due to weather exposure, insect infestation or minor charring from fire damage. Applications include porous end grain, window and door sills, sash, jambs, trim, siding, porch elements, stair parts, framing, log and timber elements etc. Use as a stabilizing primer for **ConServ 200** Flexible Epoxy Patch.

MEASURING EPOXY: Website Breakdown Video shows one method, or by volume and weight as follows:

	By Volume	By Weight
100	ratio of 4 A : 1 B	ratio of 4.5 A : 1 B
W100	ratio of 3.25 A : 1 B	ratio of 3.5 A : 1 B

CURE SCHEDULE

Pot Life **100**	4 fl oz - approx. 4-6 hrs. @ 72°F
Gel Time	4 fl oz - approx. 4-6 hrs. @ 72°F
Cure Time	3-5 days @ 72°F (approx. 75% cured, tack free)
Pot Life **W100**	4 fl oz - approx. 1-2 hrs. @ 72°F
Gel Time	4 fl oz - approx. 1-2 hrs. @ 72°F
Cure Time	1½-2½ days @ 72°F (approx. 75% cured, tack free)

Cold temperature extends cure time, but **W100** can be used down to 35°F with wind protection.
Hot temperature speeds cure time, but **100** can be used up to 100°F in shade and small qty.
In hot weather avoid exposure to intense sunlight until final cure is complete.
Large volumes speed up cure time due to heat generating exothermic reaction of the epoxy.

PROPERTIES

Color	Clear
Viscosity	Consistency of vegetable oil @ 72°F
Operating Range	-30°F to 160°F for cured epoxy
Mixing Range	50°F to 90°F is ideal, but in colder temperature pre-warm epoxy or mix for 3-5min. to start reaction
Shelf life	1 year in unopened original containers

PACKAGING & YIELD

ConServ 100 & **W100** are supplied in ½ gallon, 1 quart, 1 pint, ½ pint, ¼ pint and 2 fl oz quantities and 1 gallon, 2 gallon and 4 gallon quantities on request. ***Coverage is variable*** depending on the extent of the decay and subsequent degree of saturation. Sufficient saturation to stabilize the damaged material is imperative for proper protection and preparation for the **ConServ 200** patch.

(See reverse side for INSTRUCTIONS)

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INSTRUCTIONS

FLEXIBLE EPOXY PATCH 200, S200 & W200

ConServ 200 FLEXIBLE EPOXY PATCH is a non-structural epoxy system for filling cavities, voids and surface imperfections in wood. S200 is an extra slow curing version designed for hot weather. W200 is fast curing for cold weather down to 35°F, or for when a faster cure time is needed. The **ConServ 200 system** is flexible to withstand some of the ongoing expansion and contraction of wood, yet firm enough to replace damaged portions of wood. It is easily tooled, carved, planed, drilled or sanded. It will accept nails & screws, and can be painted or stained solid. Applications include windows, doors, trim, siding, porch elements (columns, balustrades, flooring), stair parts, framing, logs, timbers, and ornamental components etc.

NOTICE: Labels and literature are ***color coded*** for proper identification. ***Please*** take time to acquaint yourself with ***all*** labels, instructions and precautions ***before*** mixing. View instructional videos at www.conservepoxy.com. Due to the variety of uses, application methods and conditions that customers might use these epoxy products for, no warranty is written or implied.

WOOD PREPARATION normally involves removing most of the loose and soft decay close to good wood prior to applying epoxy consolidant **100** or W100. Wood to be epoxied should be ***clean & dry*** with moisture content **below 20%.** Porous areas to be filled with Epoxy Patch **200** should be ***primed*** with **ConServ 100** or W100 so the 200 patch adheres to stabilized wood. For vulnerable moisture prone areas that have sustained decay, consider treating with liquid borate preservative 700-BC or 700-BD.

MIXING EPOXY: ***In hot weather put the can of* A *resin on ice*** & keep it in the shade to slow the curing process and increase pot life. ***This can be done with the* S200*, but is especially important for faster curing large batches of the* W200 *or* 200**.** The ***preferred*** mixing method is to pour the entire contents of bottle **B** (curing agent) into can **A** (epoxy resin). Blend ***thoroughly*** for three minutes by hand with a firm flat stick or use a power mixer. Blend in the entire bag **C** (reddish brown filler) with stick or mixer. Slowly add **D** (white thickener) ***as needed*** to achieve the desired consistency. If you intend to use less than a full matched set, the ***easiest basic method*** is to break down components A & B into as many sets as you choose of equal volume, using clear wide mouth plastic bottles, then return **A** into metal cans and keep **B** in the bottles. (CSE offers various sizes of bottles and cans). Filler **C** should then be broken down into equal parts and match the number of A&B components that were made up from the original matched set. Thickener **D** can be left in the original bag and used as needed with each batch. A simple break down video of this method is on our website. Or, see the Technical Data sheet for more ***advanced options*** by vol. or wt.

CAUTION: The **A** resin may ***crystallize*** in prolonged cool storage and become cloudy or form crystals on the bottom of the can. This condition can easily be corrected and ***does not*** in any way alter or inhibit the effectiveness of the epoxy. ***Dissolve*** by gradually warming in direct sun, use a hair dryer, heat gun or carefully place the **A** can in boiling water or a double boiler and stir gently until the material is almost clear. **Do not over heat.** Allow epoxy to regain normal room temperature before using. Large quantities of mixed epoxy will generate heat in 5 to 10 minutes. ***To prolong pot life, put cans on ice, roughly spread out small globs of epoxy to lessen the volume and or use quickly***. This is important with **200** and especially with the faster W200.

APPLY PATCH ideally in a temperature range of 50°-90°F to achieve a reasonable cure time. Use W200 when the temperature is below 50°F and as low as 35°F. Use S200 to slow the cure in hot temps. from 80°F to 95°F. If possible, avoid applying epoxy in direct sunlight or rain. Preferably use a wet on wet application over the **ConServ 100** consolidant for the best chemical bond, but **200** patch can be applied after the **100** has cured. The **ConServ Mini Hawk 900-MH** is a convenient way to handle the epoxy patch. Plastic or metal putty knives, straight edges etc. are good tools for applying the patch. Two sizes of empty caulk tubes are available to load with patch for specific applications. Fill large voids (over 1½" deep) in layers. Allow a few hours or more between lifts unless working in large timber, using wood infill, using S200 or if temps. are cool. This will keep the epoxy from curing too fast. Cover treated areas with poly wrapped/tented over work to keep warm & dry until epoxy has set.

CURING of ConServ 200 Patch is 1½-2½ days at 72° F or room temp, S200 is 3-5 days at 72° F, W200 is 1-2 days at 72° F. Temperature is the determining factor. Heat will cause epoxy to cure faster and cool temperatures will slow down the cure. As a guide, use S200 to slow the cure in hot temps. from 80°F to 95°F, use W200 when the temperature is below 50°F and as low as 35°F and use the original 200 formula for midrange temperatures. Choosing the right speed will help maintain good quality. Expect to double the cure time for approx. every 20°F drop in temperature.

CLEAN-UP: Reusable tools may be wiped clean with dry paper towels ASAP after the epoxy has been applied. Discard paper towels, non-reusable containers, brushes etc. according to local regulations. White vinegar will soften cured epoxy on tools or equipment if allowed to soak for an extended period of time. Acetone, Methylene chloride and MEK softens cured epoxy for easy removal, but should be avoided due to their toxicity.

EPOXY SAFETY is a function of common sense and good housekeeping. ***Wear chemical resistant disposable gloves, eye protection, and old clothing.*** Don't get epoxy on your skin or clothes. Work with good ventilation.

STORAGE: ConServ 200 series epoxy patch has a one year shelf life if stored at cool temperatures and kept dry in tightly sealed containers. Epoxy stored at 50°F to 75°F is a guideline for an ideal long term storage temperature.

(See reverse side for TECHNICAL DATA)

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TECHNICAL DATA

FLEXIBLE EPOXY PATCH 200, S200 & W200

ConServ 200 FLEXIBLE EPOXY PATCH is a non-structural epoxy system for filling cavities, voids and surface imperfections in wood. There are three speeds: S200 is an **extra slow** curing version designed esp. for hot weather 80°F to 95°F, 200 original formula is **slow** curing midway between the other two speeds and is used over a wide temp. range of 45°F-85°F, W200 is **fast** curing for cold weather below 50°F and as low as 35°F and also used for a quicker cure when using small quantities in warmer Temps. These speed choices and temperature ranges are only guidelines for achieving reasonable cure rates. **ConServ 200** system is flexible enough to withstand most of the ongoing expansion and contraction of the wood. It is easily tooled, carved, planed, drilled and sanded. It will accept nails and screws, and can be painted or stained with a solid stain. Used on windows, doors, trim, siding, porch elements, stair parts, framing, logs, timbers, and ornamental components etc.

MEASURING EPOXY: Website Breakdown Video shows one method, or by volume and weight as follows:

	By Volume	By Weight
200	ratio of 3.25 A : 1 B	ratio of 3.5 A : 1 B
S200	ratio of 4 A : 1 B	ratio of 4.5 A : 1 B
W200	ratio of 3 A : 1 B	ratio of 3 A : 1 B

Gauge the amount of the filler component **C** by consistency if you have experience mixing the **200** patch with our matched sets or use ratio 1 A & B : 1.4 C by vol. or 7.89 A & B : 1 C by wt.

CURE SCHEDULE

Pot Life **200**	6 fl oz - approx. 1-2 hrs. @ 72°F
Gel Time	6 fl oz - approx. 1-2 hrs. @ 72°F
Cure Time	1½ -2½ days @ 72°F (approx. 75% cured, tack free)
Pot Life S200	6 fl oz - approx. 3-5 hrs. @ 72°F
Gel Time	6 fl oz - approx. 3-5 hrs. @ 72°F
Cure Time	3-5 days @ 72°F (approx. 75% cured, tack free)
Pot Life W200	6 fl oz - approx. 30-60 min. @ 72°F
Gel Time	6 fl oz - approx. 30-60 min. @ 72°F
Cure Time	1-2 days @ 72°F (approx. 75% cured)

Cold temperature extends cure time, but W200 can be used down to 35°F with wind protection.
Hot temperature speeds cure time, but S200 can be used up to 95°F in shade and small qty.
In hot weather avoid exposure to intense sunlight until final cure is complete.
Large volumes speed up cure time due to heat generating exothermic reaction of the epoxy.

PROPERTIES

Color	Reddish brown, can tint with dry mortar colorant, Contact CSE if a **white C** powder option is needed
Viscosity	Consistency @ 72°F from a slurry to stiff mashed potatoes depending on amount of thickener **D** used
Operating range	-30°F to 160°F for cured epoxy
Mixing range	50°F to 90°F is ideal, but in colder temperature pre-warm epoxy or mix for 3-5min. to start a reaction
Shelf life	1 year in unopened original containers

PACKAGING & YIELD

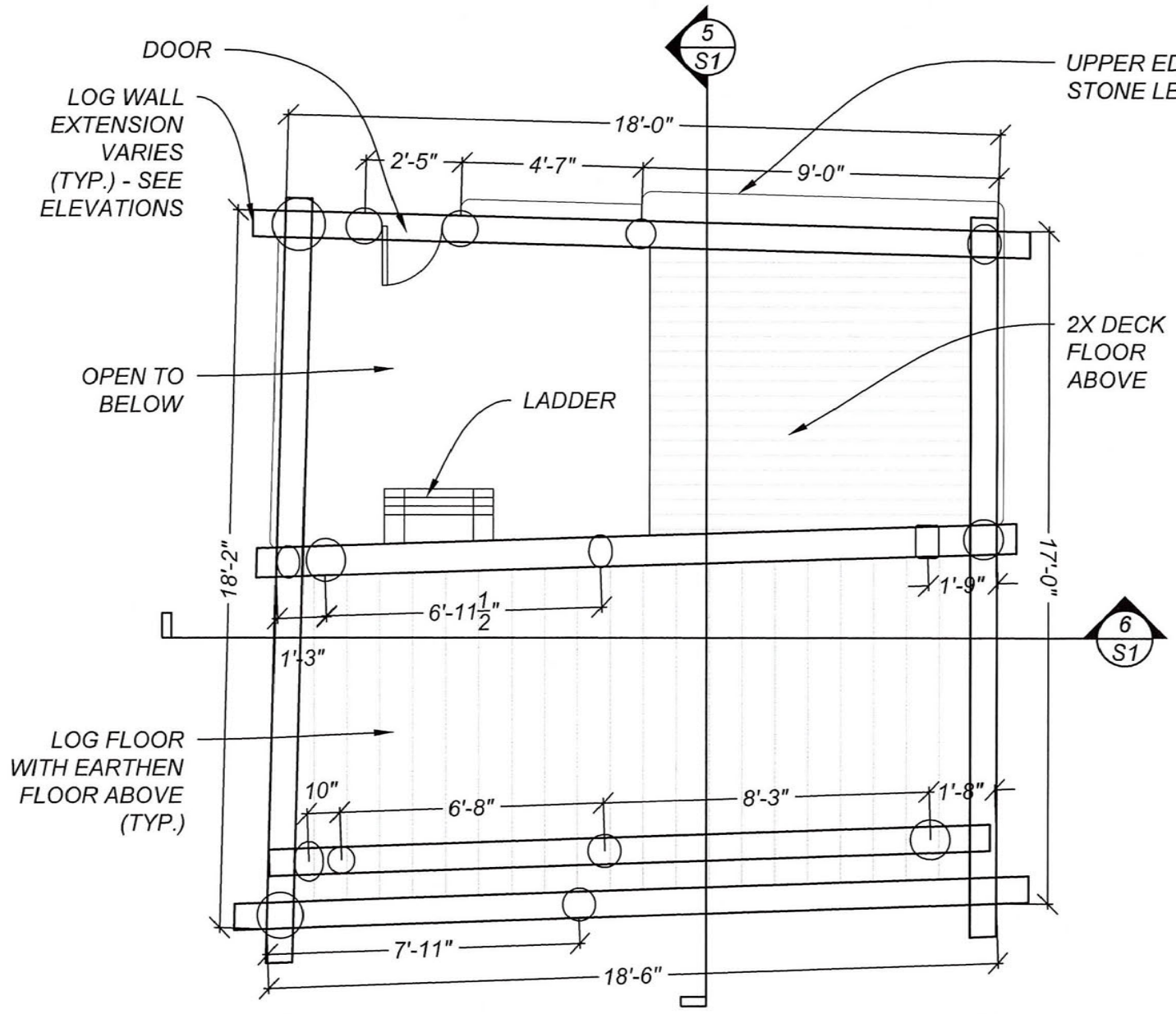
ConServ 200, S200 and W200 are supplied in ¾ gallon, 3/8 gallon, ¾ quart, ¾ pint, 3/8 pint and 3 fl oz quantities and 1½ gallon, 3 gallon and 6 gallon on request. Yield is equivalent to the set size purchased. Maximum use of fillers and thickeners supplied will produce the amount indicated.

(See reverse side for INSTRUCTIONS)

Revised 12-2013

APPENDIX G

Existing Drawings



1 / S1 FLOOR PLAN

SCALE: 1/4"=1'-0"

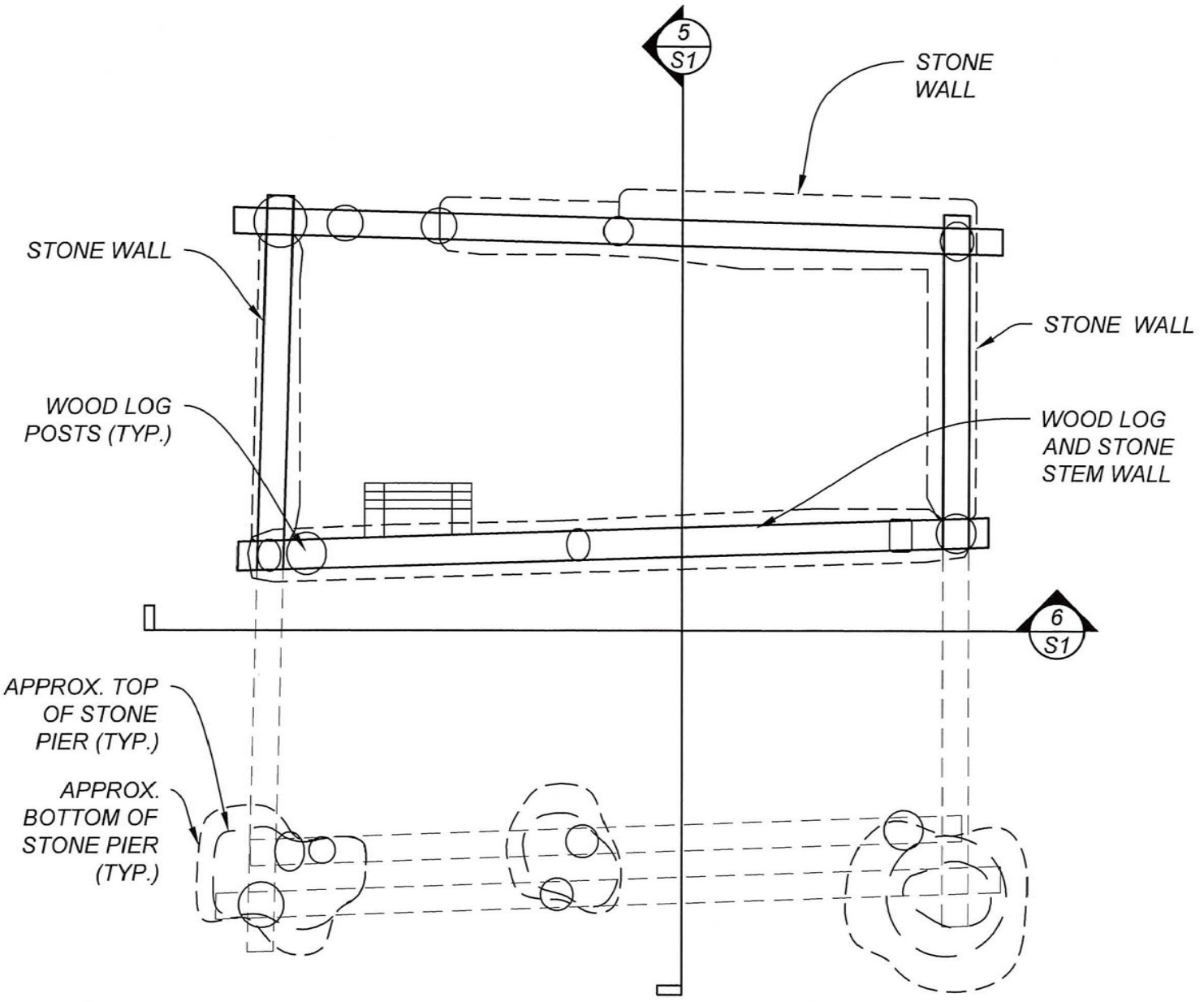
DRUC ENGINEERING
Structural Engineers
430 Apodaca Hill
Santa Fe,
New Mexico 87501
tel 505.983.4992
fax 505.984.0792
bill@druceng.com

MOLINO DE LOS DURANES
RANCHOS DE TAOS, NM

DATE: 9.30.14
DRAWN BY: JLLCC
CHECK BY: WMD
JOB #: 14028

SHEET

SHEET ____ OF ____



2/S1 FOUNDATION PLAN

SCALE: 1/4"=1'-0"

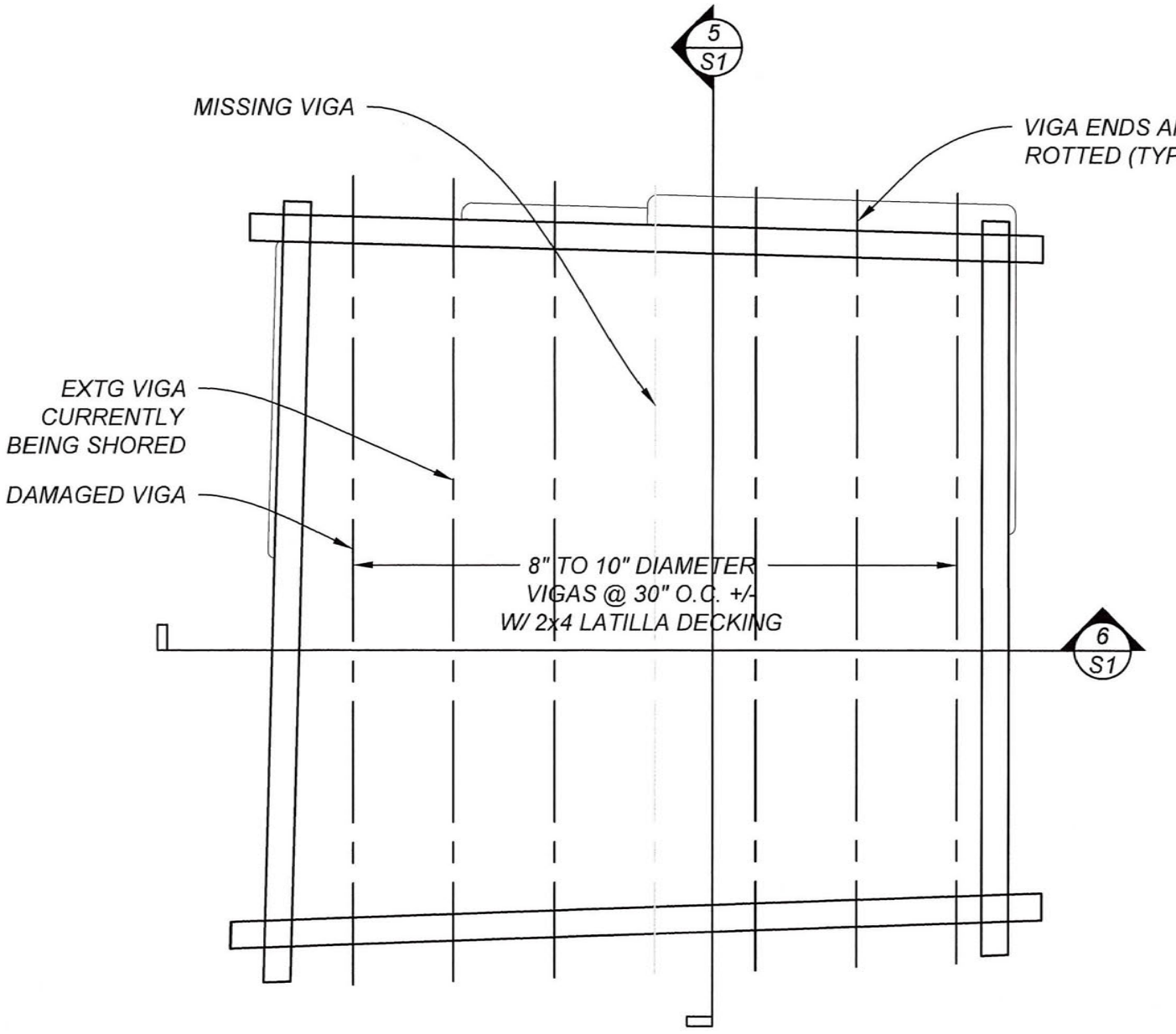
DRUC ENGINEERING
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New Mexico 87501
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fax 505.984.0792
bill@druceng.com

MOLINO DE LOS DURANES
RANCHOS DE TAOS, NM

DATE: 9.30.14
DRAWN BY: JLLCC
CHECK BY: WMD
JOB #: 14028

SHEET

SHEET ____ OF ____



3
S1 ROOF FRAMING PLAN

SCALE: 1/4"=1'-0"

N

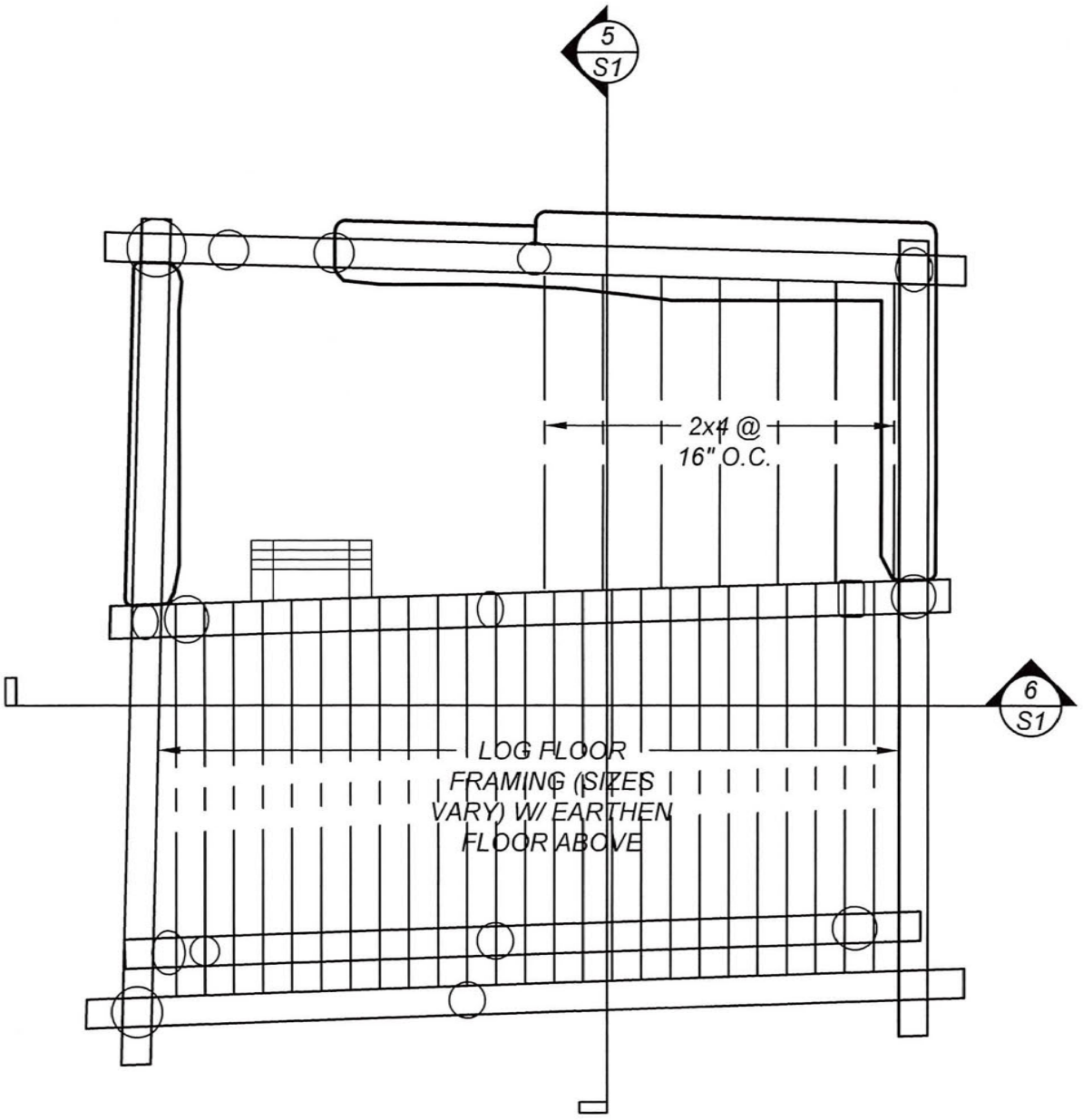
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MOLINO DE LOS DURANES
RANCHOS DE TAOS, NM

DATE: 9.30.14
DRAWN BY: JLLCC
CHECK BY: WMD
JOB #: 14028

SHEET

SHEET ____ OF ____



4 / S1 FLOOR FRAMING PLAN

SCALE: 1/4"=1'-0"

N

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Santa Fe,
New Mexico 87501
tel 505.983.4992
fax 505.984.0792
bill@druceng.com

MOLINO DE LOS DURANES
RANCHOS DE TAOS, NM

DATE: 9.30.14
DRAWN BY: JLLCC
CHECK BY: WMD
JOB #: 14028

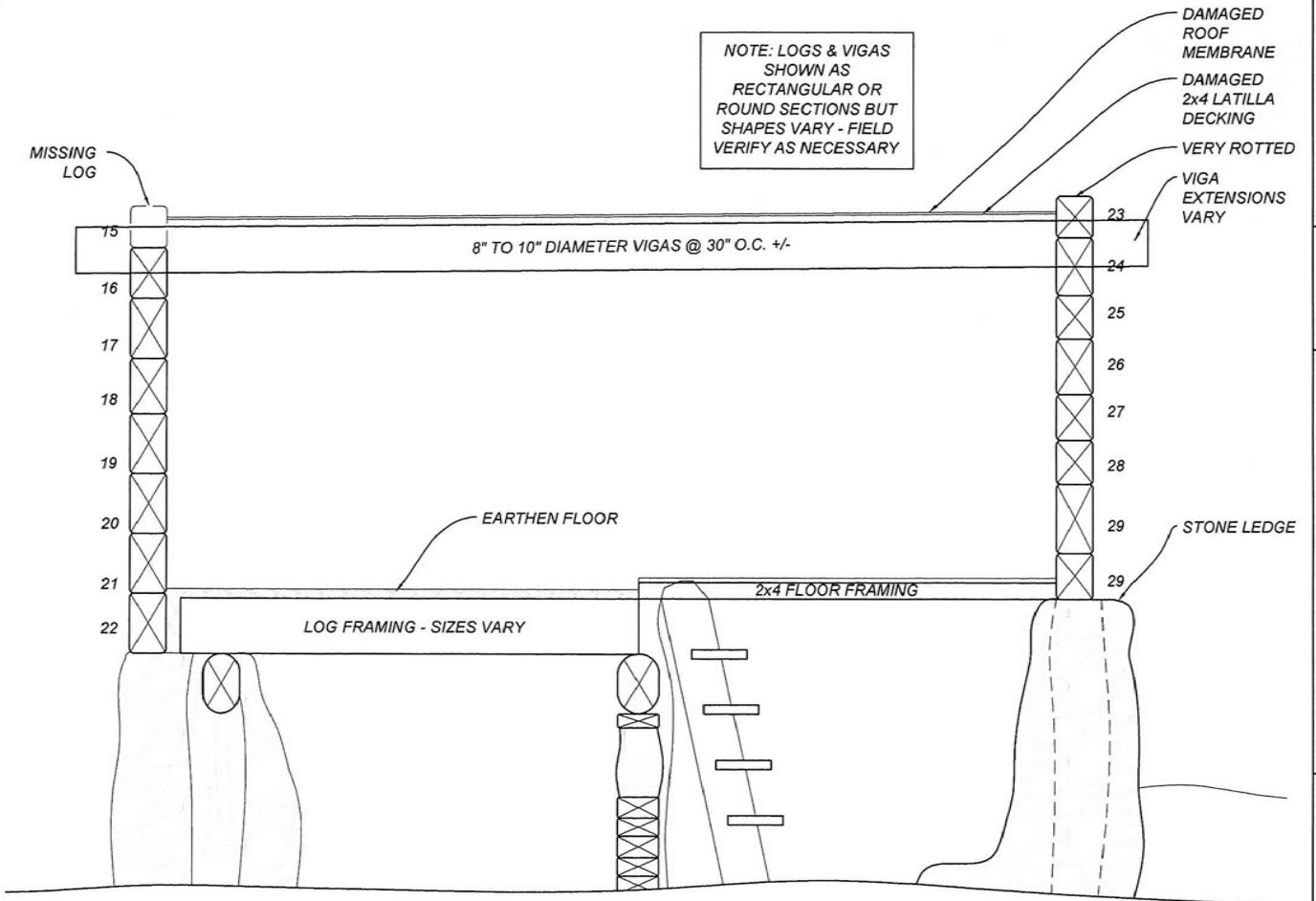
SHEET

SHEET ___ OF ___

LEGEND

WALL LOGS (NOTE: ALL LOGS ARE SHOWN AS 8" WIDE BUT WIDTHS VARY FROM 7" TO 8½")	FLOOR LOGS (NOTE: DEPTHS VARY BUT WERE GENERALLY APPROXIMATELY 12" DEEP)
1. 8" x 12"	a. 8½" x 12" (ROTTING)
2. 8" x 12"	b. MISSING
3. 8" x 13"	c. 8½" x 12" (ROTTING)
4. 8" x 10½"	d. 8" x 12" (ROTTING)
5. 8" x 13"	e. MISSING
6. 8" x 12"	f. 7½" x 12"
7. 8½" x 13½"	g. 6½" x 12"
8. 8" x 8"	h. 8" x 12"
9. 8" x 11½"	i. 7½" x 12"
10. 8" x 10½"	j. 6" x 12"
11. 8" x 10"	k. MISSING
12. 8" x 12½"	l. MISSING
13. 8" x 10½"	m. 4" x 4" TO 6" x 6" (HEAVILY ROTTED)
14. 8" x 14"	n. 4" x 4" TO 6" x 6" (HEAVILY ROTTED)
15. MISSING	o. 8½" x 12"
16. 8" x 11"	p. 11" x 12"
17. 8" x 13"	q. 10" x 12"
18. 8" x 12"	r. 9½" x 12"
19. 8" x 13"	s. 7" x 12"
20. 8" x 13"	t. 7" x 12"
21. 8" x 13"	u. 9" x 12"
22. 8" x 13"	v. 9" x 12"
23. 8" x 9" (VERY ROTTED)	w. 9" x 12"
24. 8" x 12½"	
25. 8" x 9½"	
26. 8" x 12"	
27. 8" x 10" (ROTTED ON EXTERIOR)	
28. 8" x 9½"	
29. 8" x 15"	
30. 8" x 10"	

NOTE: LOGS & VIGAS SHOWN AS RECTANGULAR OR ROUND SECTIONS BUT SHAPES VARY - FIELD VERIFY AS NECESSARY



5 / S1 STRUCTURAL SECTION

SCALE: ½"=1'-0"

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fax 505.984.0792
bill@druceng.com

MOLINO DE LOS DURANES
RANCHOS DE TAOS, NM

DATE: 9.30.14
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CHECK BY: WMD
JOB #: 14028

SHEET

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GENERAL NOTES:

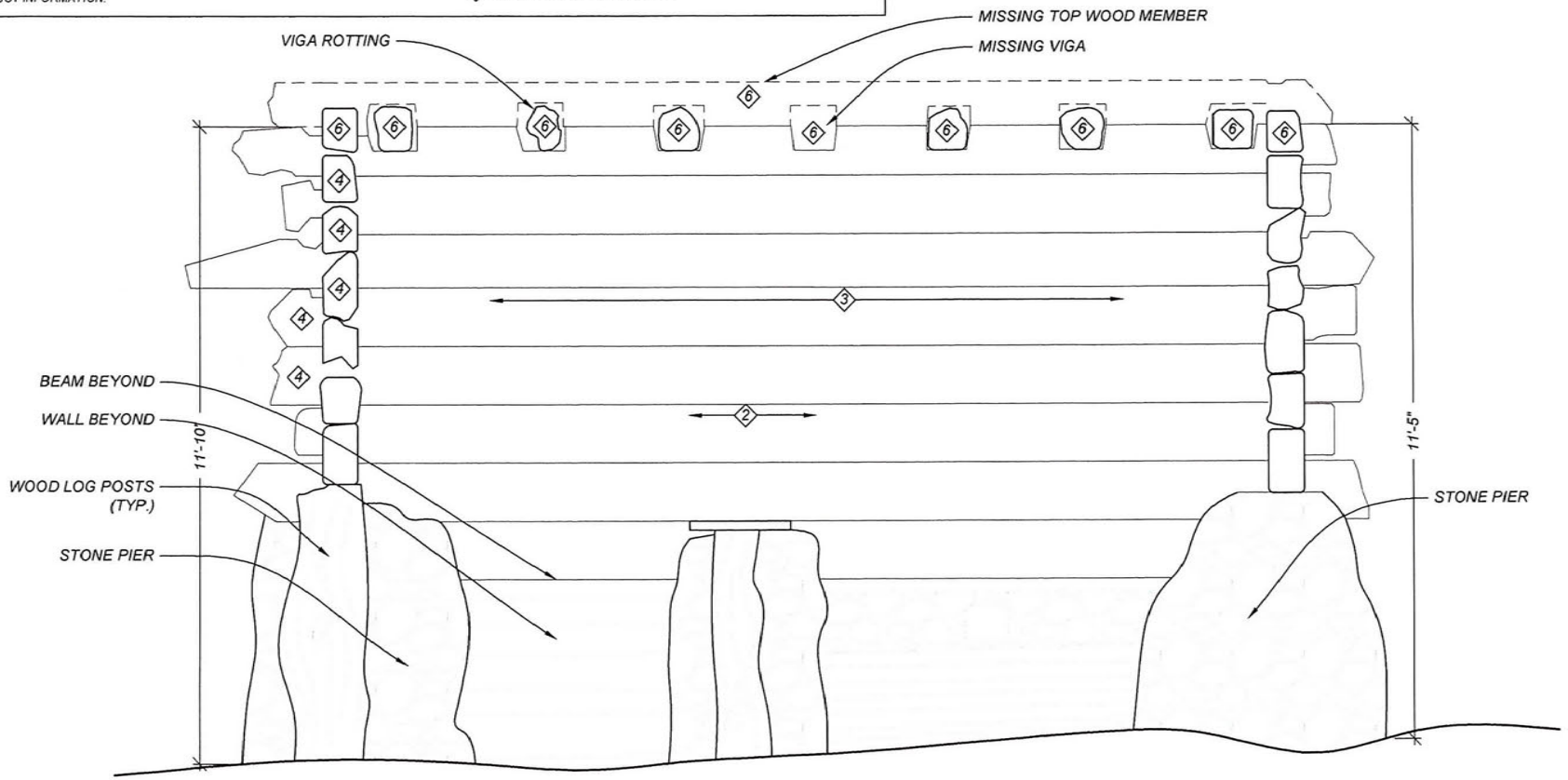
1. MAJOR DEFICIENCIES ARE IDENTIFIED ON THESE ELEVATIONS, HOWEVER SOME MAY BE MISSING AND FIELD VERIFIED. SEE APPENDIX D OF THE REPORT FOR DETAILED PHOTOGRAPHS SHOWING THE WOOD LOG MEMBERS FOR A MORE COMPLETE UNDERSTANDING OF THE EXISTING CONDITIONS AND VARYING DEFICIENCIES.

2. SEE PAGE 15 OF THE REPORT FOR RESTORATION RECOMMENDATIONS FOR THE DEFICIENCIES IDENTIFIED ON THESE ELEVATIONS.

3. SEE APPENDIX F OF THE REPORT FOR TECHNICAL PROCEDURES AND PRODUCT INFORMATION.

4. DEFICIENCIES ARE SEPARATED INTO 6 CATEGORIES AS FOLLOWS:

1. NATURAL AGING AND WEATHERING (NOTE: FOUND THROUGHOUT)
2. TERMITE, INSECT OR FUNGI INFESTATION
3. WOOD DECAY/DRY ROT
4. MEDIUM TO EXTENSIVE WOOD DECAY
5. EXTENSIVE WOOD DECAY
6. COMPROMISED WOOD MEMBERS



1/S2 SOUTHWEST ELEVATION
SCALE: ½"=1'-0"

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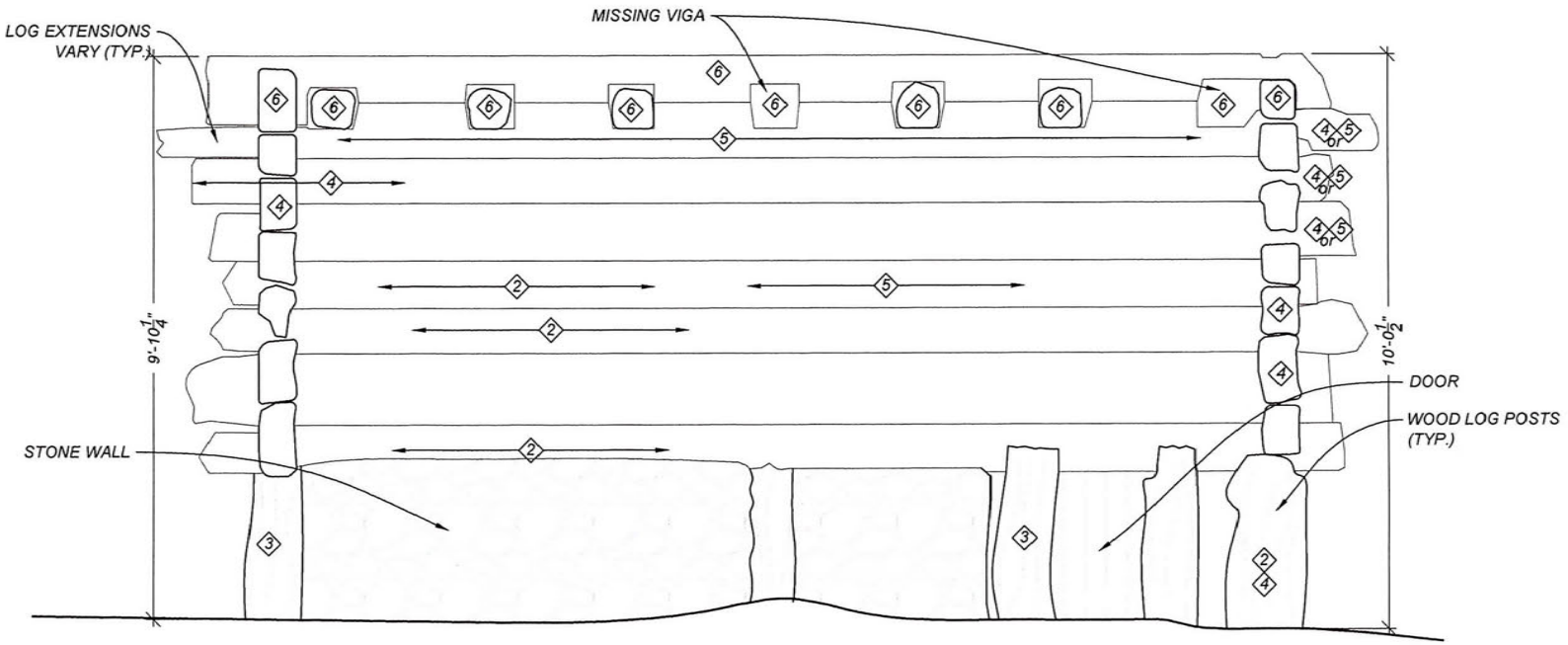
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3. WOOD DECAY/DRY ROT
4. MEDIUM TO EXTENSIVE WOOD DECAY
5. EXTENSIVE WOOD DECAY
6. COMPROMISED WOOD MEMBERS



3/S2 NORTHEAST ELEVATION
SCALE: ½"=1'-0"

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GENERAL NOTES:

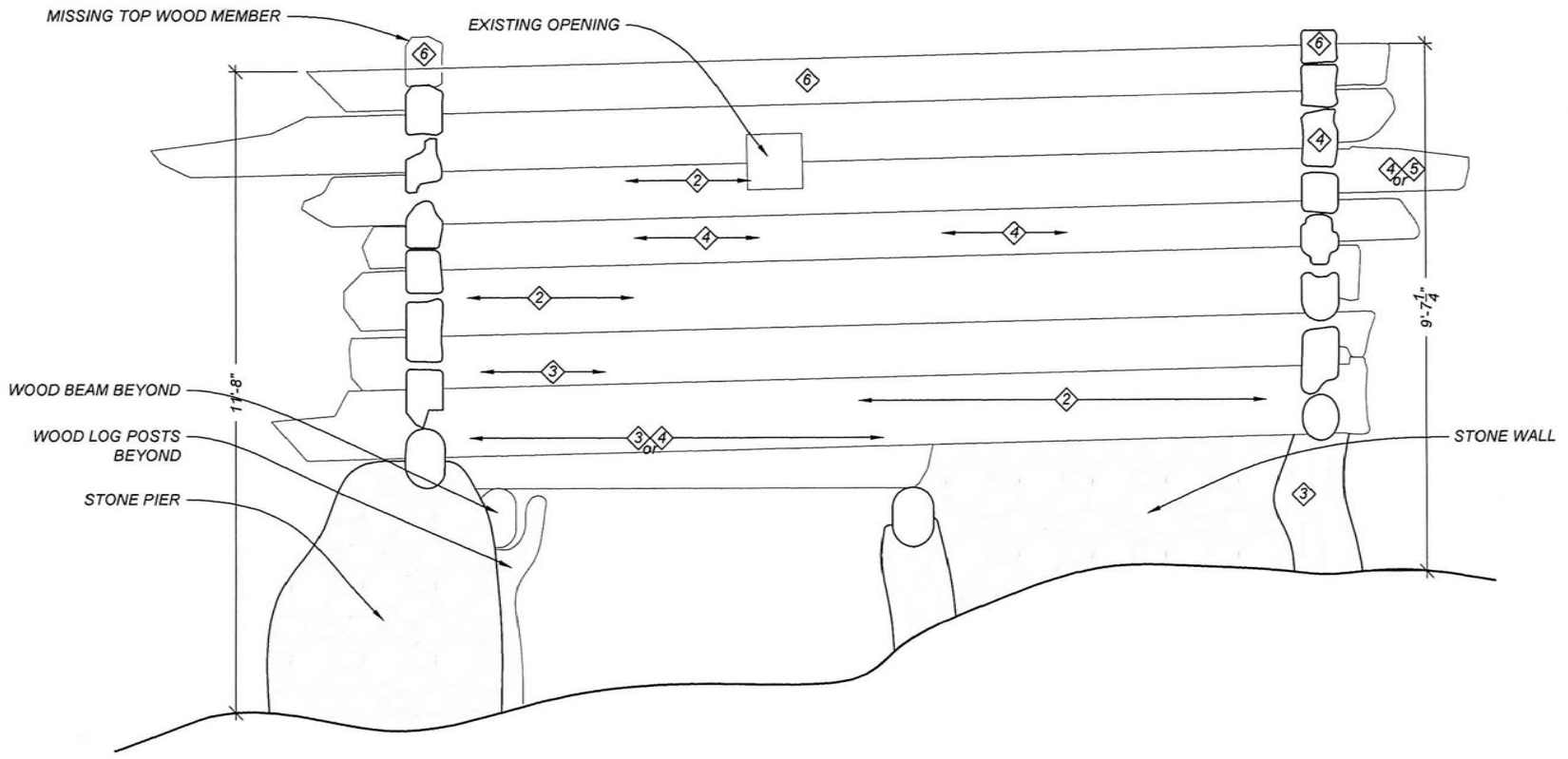
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5. EXTENSIVE WOOD DECAY
6. COMPROMISED WOOD MEMBERS



4 / S2 SOUTHEAST ELEVATION

SCALE: ½"=1'-0"

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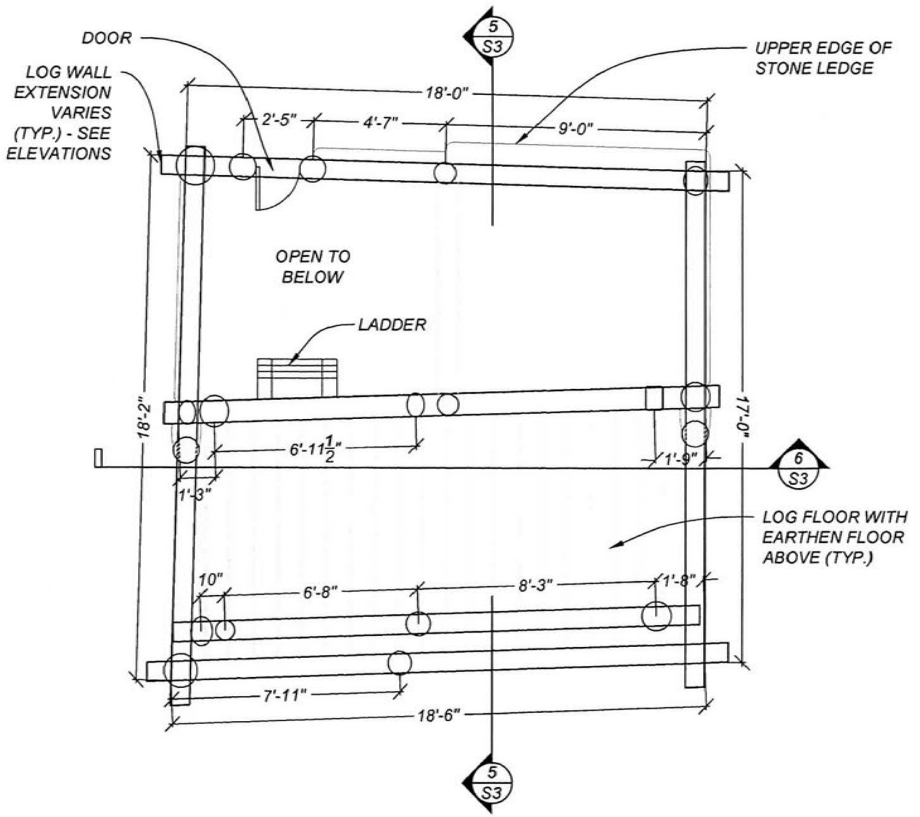
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SHEET

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APPENDIX H

Proposed Drawings



1 / S3 FLOOR PLAN

SCALE: 1/4"=1'-0"

N

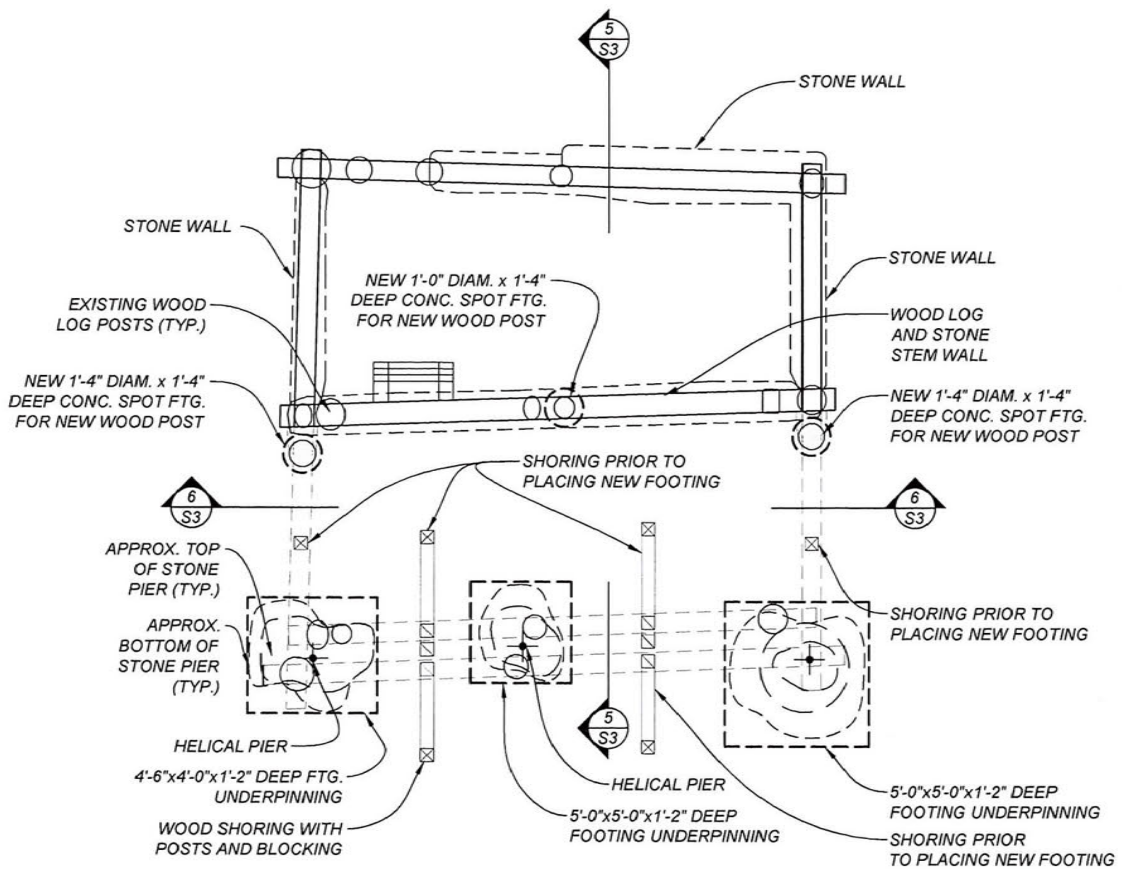
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2 / S3 FOUNDATION PLAN

SCALE: ¼"=1'-0"

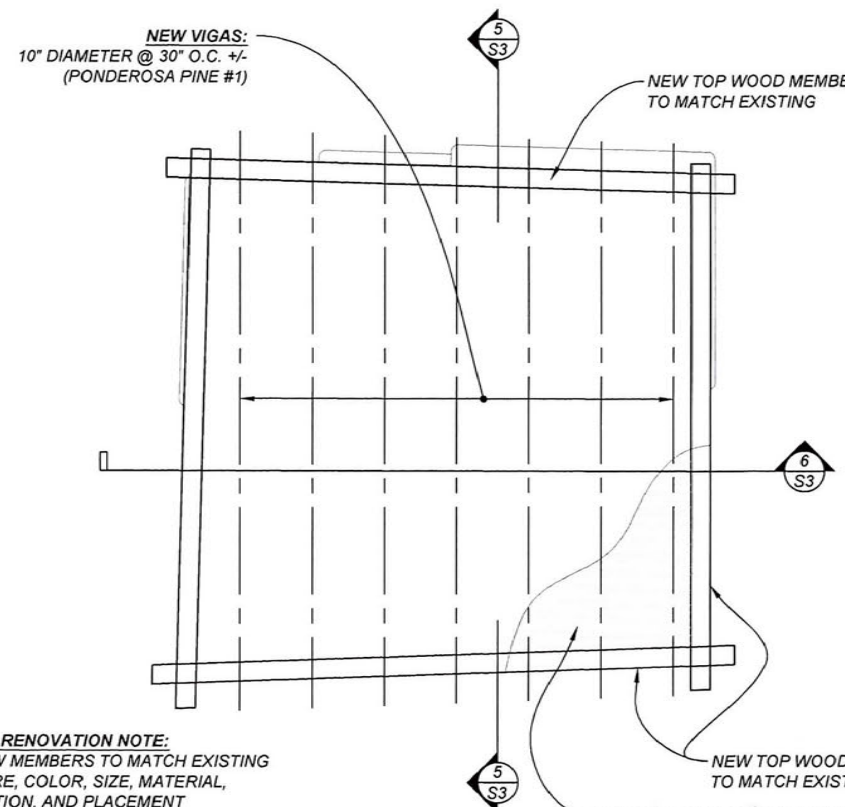
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GENERAL RENOVATION NOTE:

1. ALL NEW MEMBERS TO MATCH EXISTING IN TEXTURE, COLOR, SIZE, MATERIAL, COMPOSITION, AND PLACEMENT
2. VERIFY WOOD SEALANT FOR ALL NEW AND EXISTING EXPOSED WOOD MEMBERS

3/S3 ROOF FRAMING PLAN

SCALE: ¼"=1'-0"

N

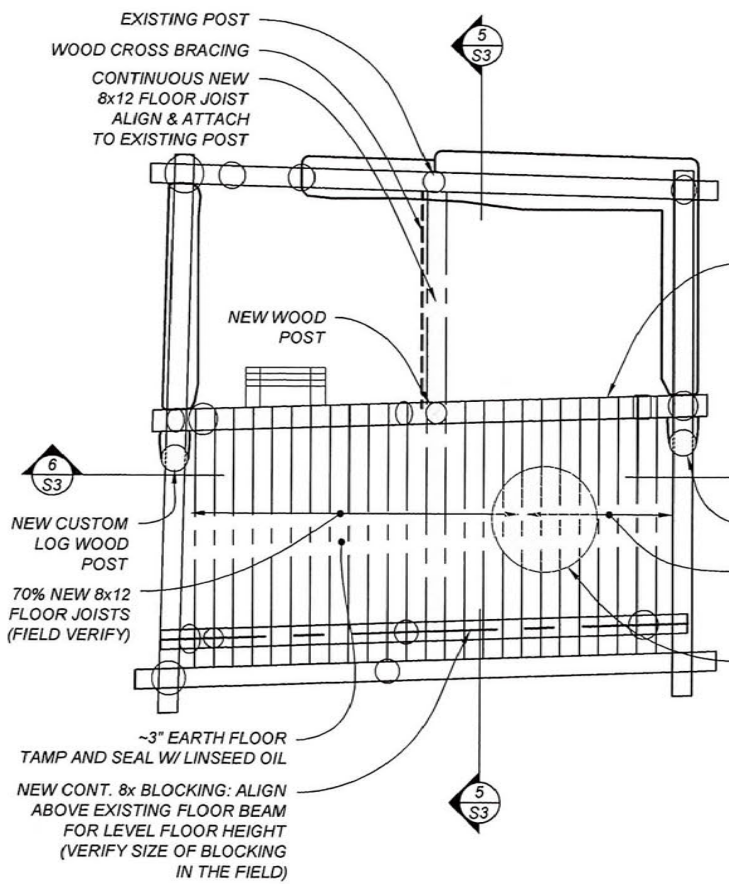
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4 / S3 FLOOR FRAMING PLAN

SCALE: 1/4"=1'-0"

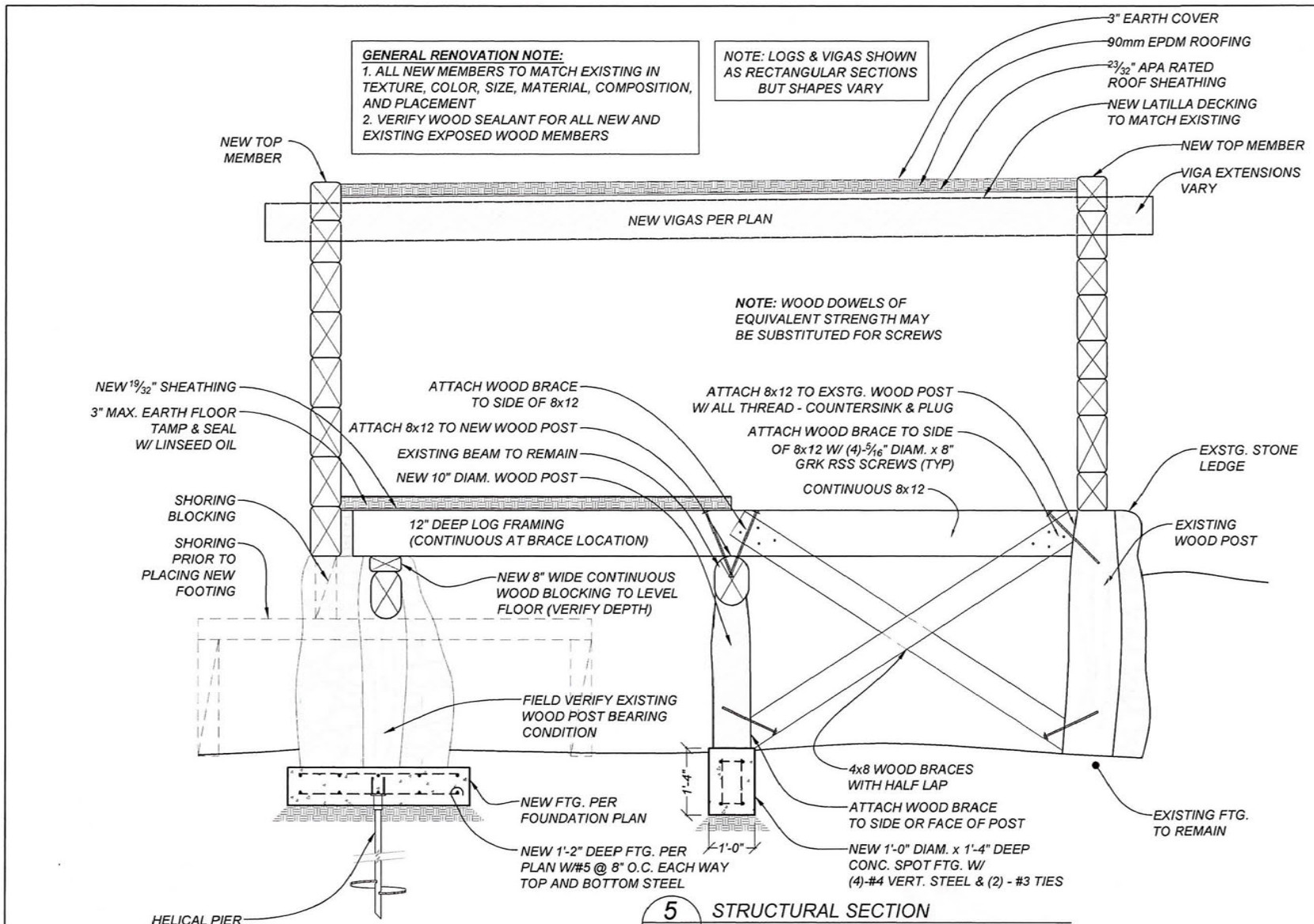
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5 / S3 STRUCTURAL SECTION

SCALE: ½"=1'-0"

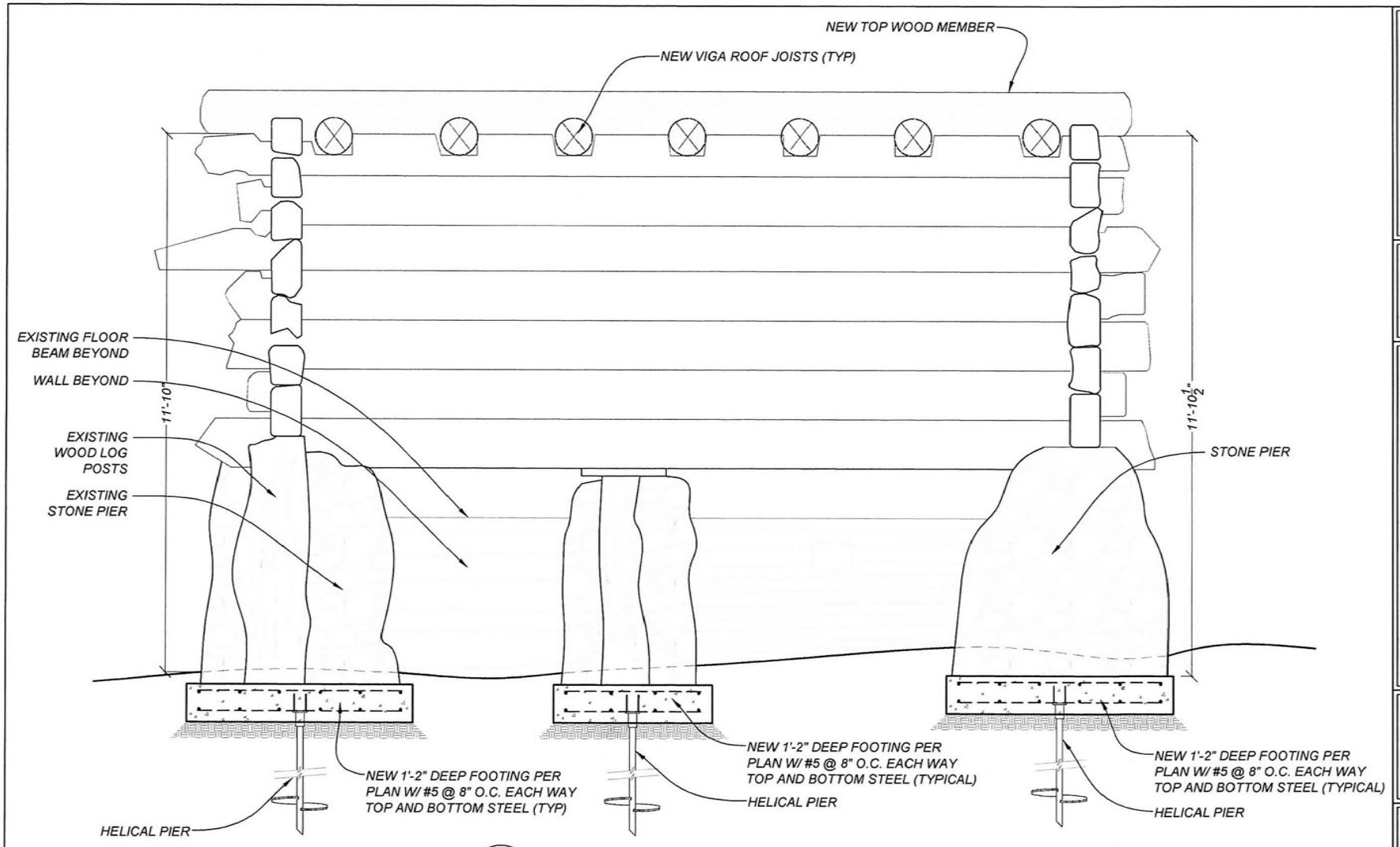
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1/S4 SOUTHWEST ELEVATION

SCALE: ½"=1'-0"

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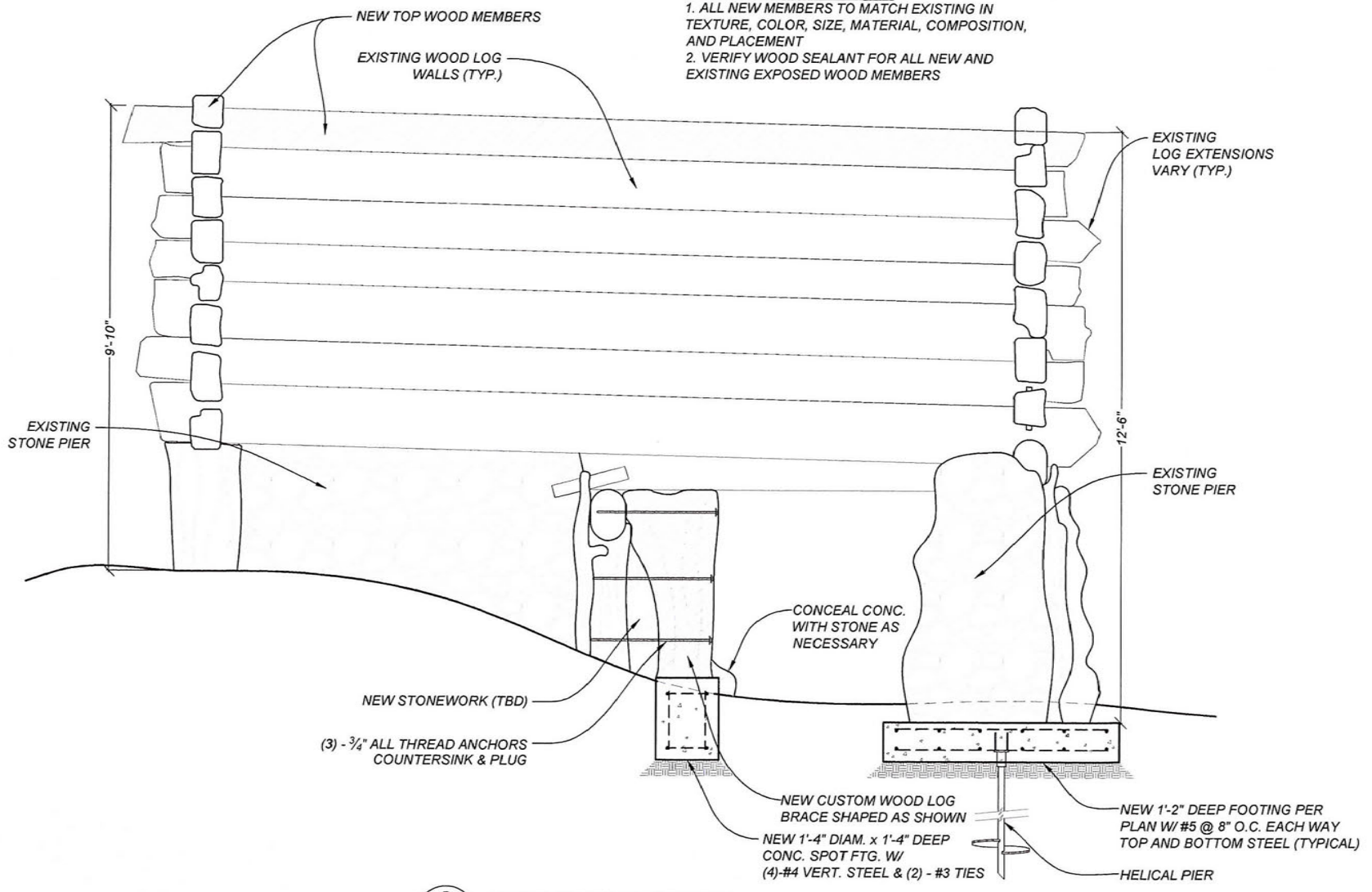
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SHEET ___ OF ___

GENERAL RENOVATION NOTE:

1. ALL NEW MEMBERS TO MATCH EXISTING IN TEXTURE, COLOR, SIZE, MATERIAL, COMPOSITION, AND PLACEMENT
2. VERIFY WOOD SEALANT FOR ALL NEW AND EXISTING EXPOSED WOOD MEMBERS



2/S4 NORTHWEST ELEVATION

SCALE: ½"=1'-0"

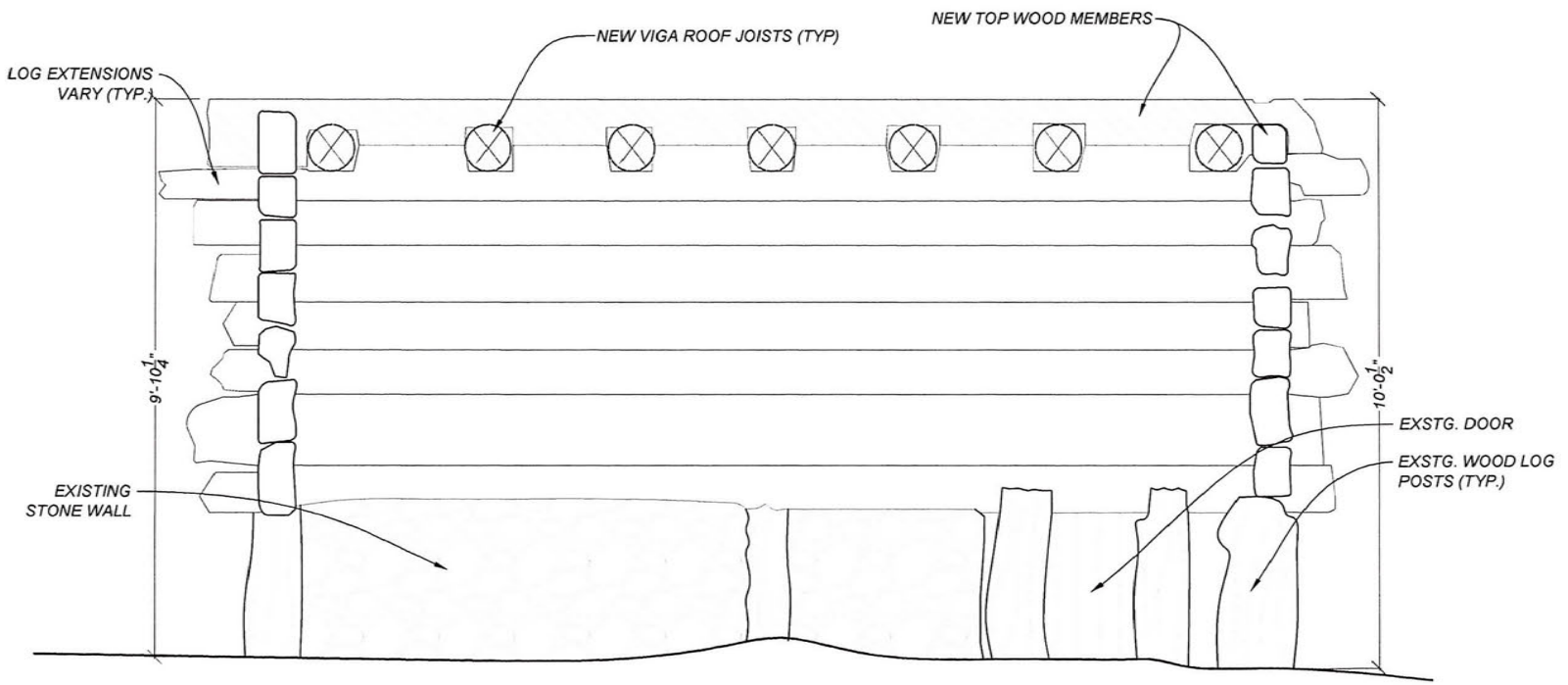
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SHEET ___ OF ___



GENERAL NOTE:

1. SEE AS-BUILT DRAWINGS FOR WOOD LOG WALL RESTORATION
2. REPAIR STONE WALLS, TO MATCH AS NECESSARY
3. NEW STRUCTURAL SCOPE OF WORK SHOWN ON ARCHITECTURAL ELEVATIONS
4. ALL TOP RIM WOOD MEMBERS TO BE REPLACED
5. ALL NEW WOOD MEMBERS TO MATCH EXISTING IN TEXTURE, COLOR, SIZE, MATERIAL, COMPOSITION, AND PLACEMENT
6. VERIFY WOOD SEALANT FOR ALL NEW AND EXISTING EXPOSED WOOD MEMBERS

HELICAL PIER FOUNDATION SYSTEM:

a) TOTAL # OF SCREW PILES: 3
b) SIZE AND # OF HELICES PER SCREW PILE: (2) 8" DIAM HELICES
c) MINIMUM INSTALLED DEPTH OF HELICAL PIER: 8'
d) FINAL INSTALLATION TORQUE REQUIREMENT:
TORQUE= 5,500 FT-LB, OR REFUSAL,
OR AS APPROVED BY PROJECT ENGINEER.
e) FOLLOW ALL 'CHANCE' MANUFACTURER GUIDELINES FOR INSTALLATION
f) SCREW TYPE = SS5
g) CONTRACTOR TO PERFORM TEST INSTALLATION PRIOR TO CONSTRUCTION

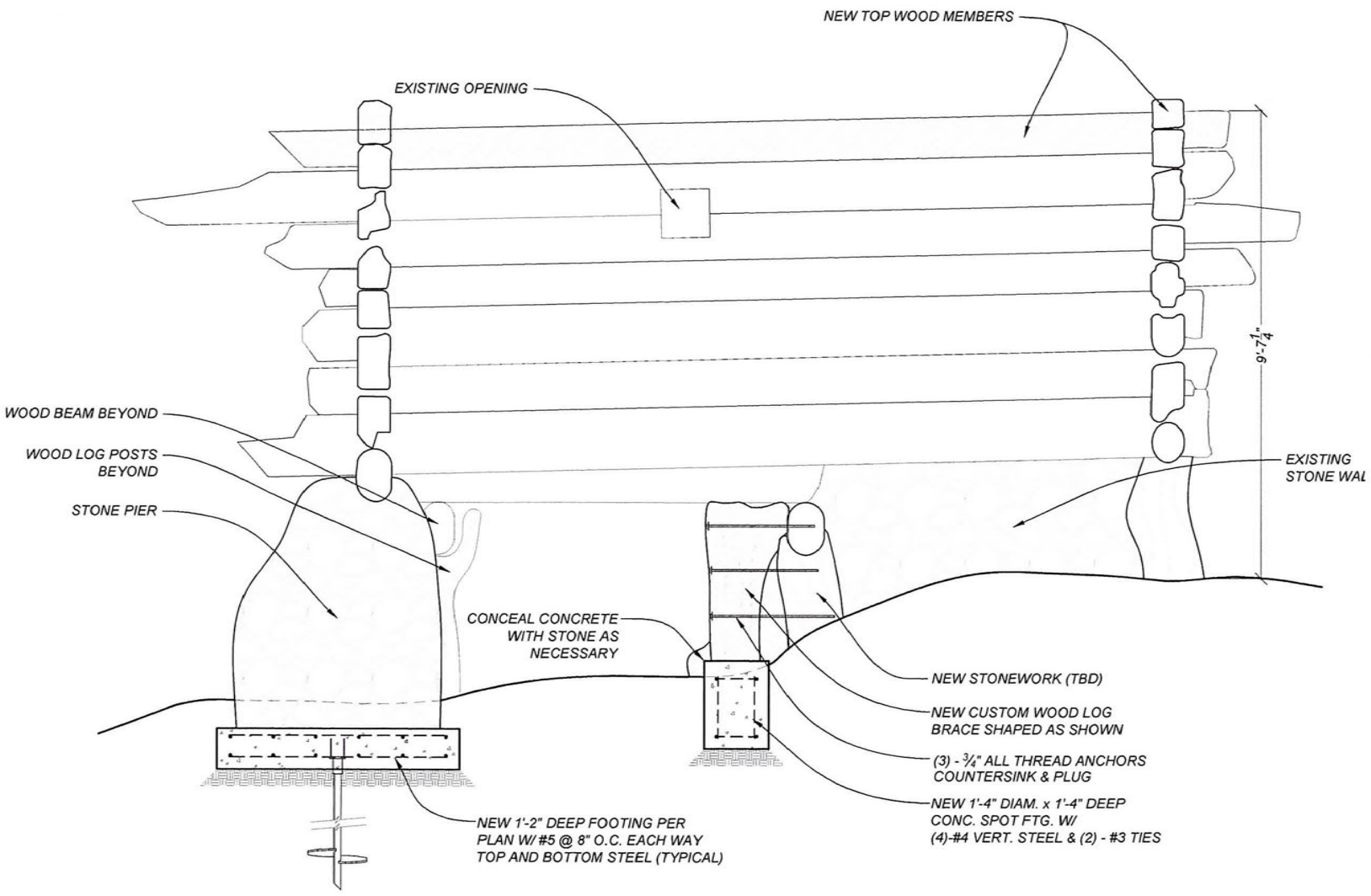
3/S4 NORTHEAST ELEVATION
SCALE: ½"=1'-0"

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4/S4 SOUTHEAST ELEVATION

SCALE: ½"=1'-0"

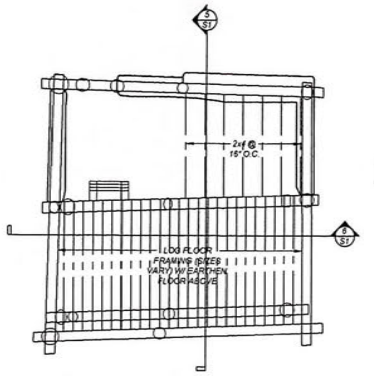
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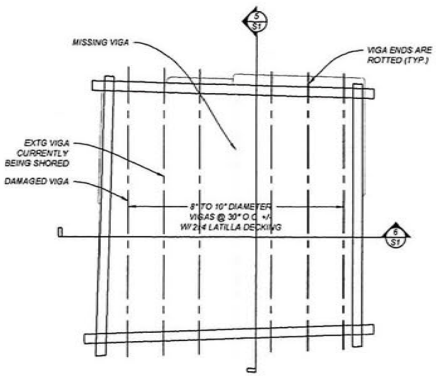
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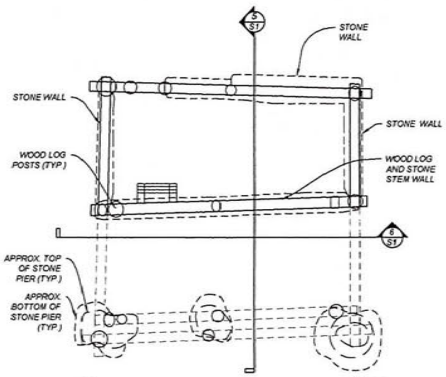
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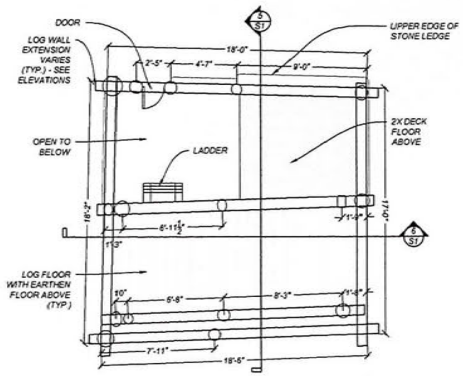
4 S1 FLOOR FRAMING PLAN
SCALE: ¼"=1'-0"



3 S1 ROOF FRAMING PLAN
SCALE: ¼"=1'-0"



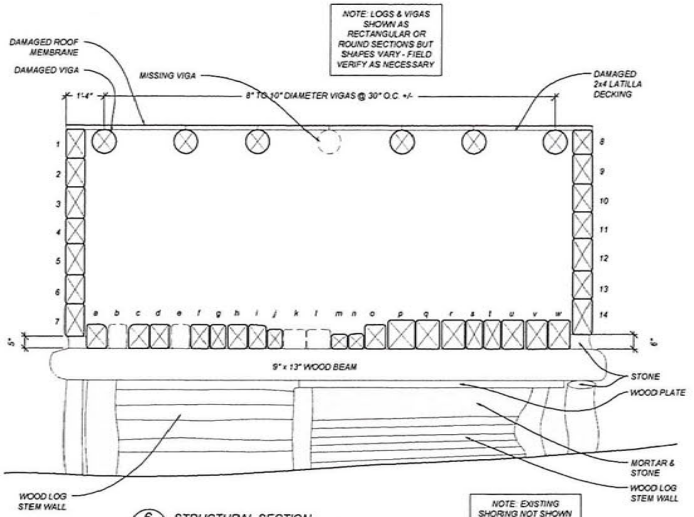
2 S1 FOUNDATION PLAN
SCALE: ¼"=1'-0"



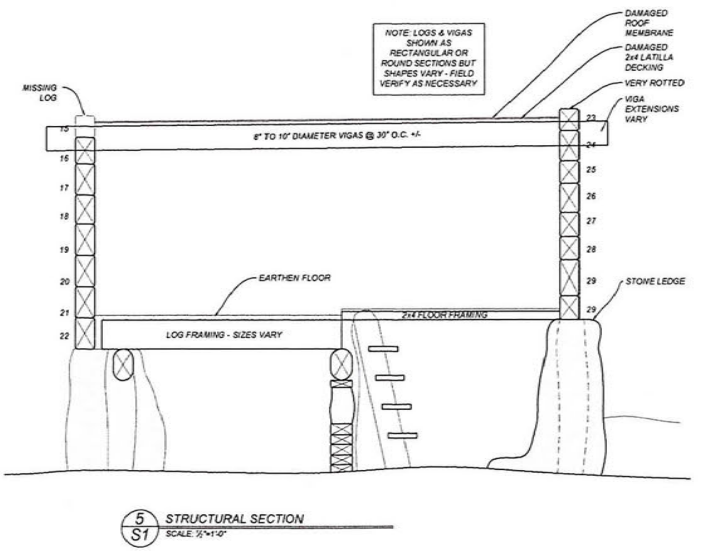
1 S1 FLOOR PLAN
SCALE: ¼"=1'-0"

LEGEND

WALL LOGS (NOTE: ALL LOGS ARE SHOWN AS 8" WIDE BUT WIDTHS VARY FROM 7" TO 8½")	FLOOR LOGS (NOTE: DEPTHS VARY BUT WERE GENERALLY APPROXIMATELY 12" DEEP)
1. 8" x 12"	a. 8 ½" x 12" (ROTTING)
2. 8" x 12"	b. MISSING
3. 8" x 13"	c. 8 ½" x 12" (ROTTING)
4. 8" x 10 ½"	d. 8" x 12" (ROTTING)
5. 8" x 13"	e. MISSING
6. 8" x 12"	f. 7 ½" x 12"
7. 8 ½" x 13 ½"	g. 6 ½" x 12"
8. 8" x 8"	h. 8" x 12"
9. 8" x 11 ½"	i. 7 ½" x 12"
10. 8" x 10 ½"	j. 6" x 12"
11. 8" x 10"	k. MISSING
12. 8" x 12 ½"	l. MISSING
13. 8" x 10 ½"	m. 4" x 4" TO 6" x 6" (HEAVILY ROTTED)
14. 8" x 14"	n. 4" x 4" TO 6" x 6" (HEAVILY ROTTED)
15. MISSING	o. 8 ½" x 12"
16. 8" x 11"	p. 11" x 12"
17. 8" x 13"	q. 10" x 12"
18. 8" x 12"	r. 9 ½" x 12"
19. 8" x 13"	s. 7" x 12"
20. 8" x 13"	t. 7" x 12"
21. 8" x 13"	u. 9" x 12"
22. 8" x 13"	v. 9" x 12"
23. 8" x 9" (VERY ROTTED)	w. 9" x 12"
24. 8" x 12 ½"	
25. 8" x 9 ½"	
26. 8" x 12"	
27. 8" x 10" (ROTTED ON EXTERIOR)	
28. 8" x 9 ½"	
29. 8" x 16"	
30. 8" x 10"	



6 S1 STRUCTURAL SECTION
SCALE: ½"=1'-0"



5 S1 STRUCTURAL SECTION
SCALE: ½"=1'-0"

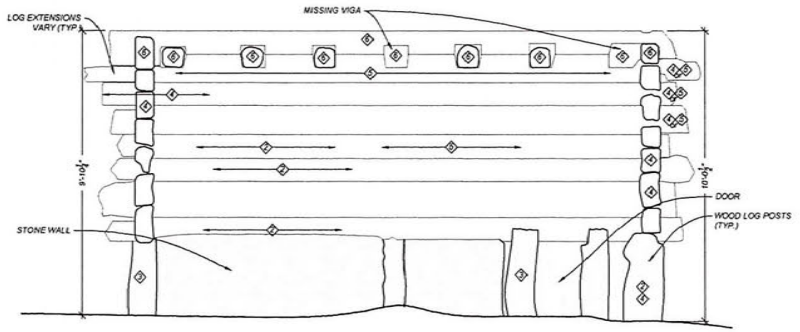
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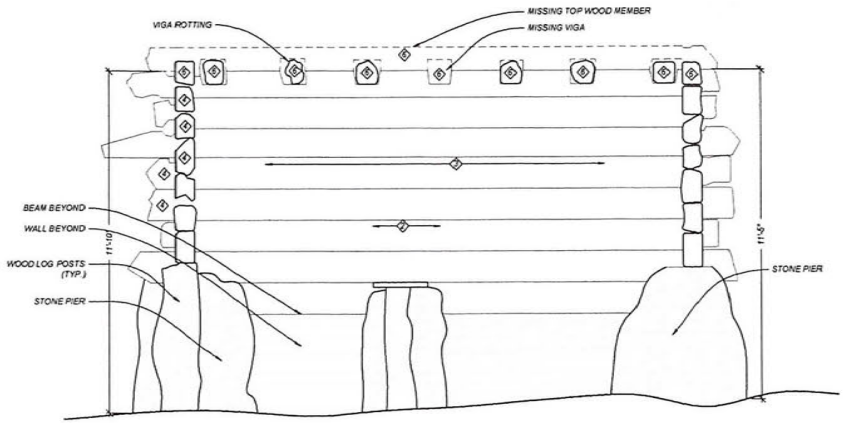
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PLANS SECTIONS & NOTES

SHEET S1
SHEET 1 OF 4



3 S2 NORTHEAST ELEVATION
SCALE: ½"=1'-0"



1 S2 SOUTHWEST ELEVATION
SCALE: ½"=1'-0"

GENERAL NOTES:

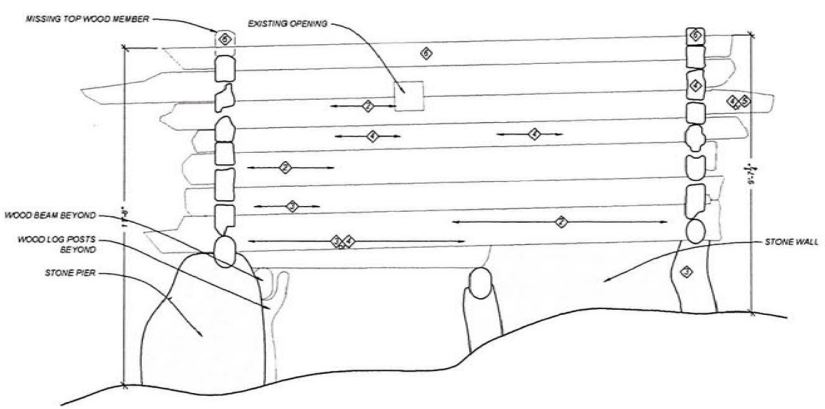
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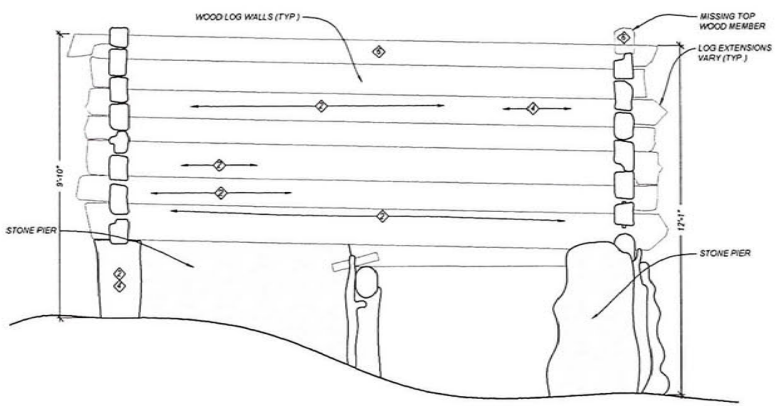
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5. EXTENSIVE WOOD DECAY
6. COMPROMISED WOOD MEMBERS



4 S2 SOUTHEAST ELEVATION
SCALE: ½"=1'-0"



2 S2 NORTHWEST ELEVATION
SCALE: ½"=1'-0"

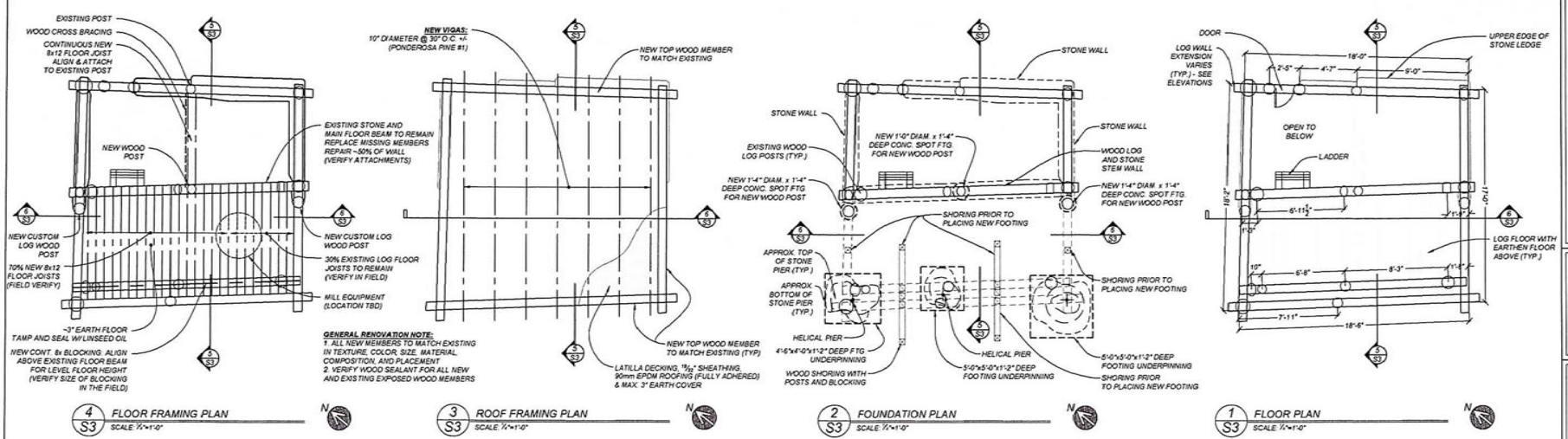
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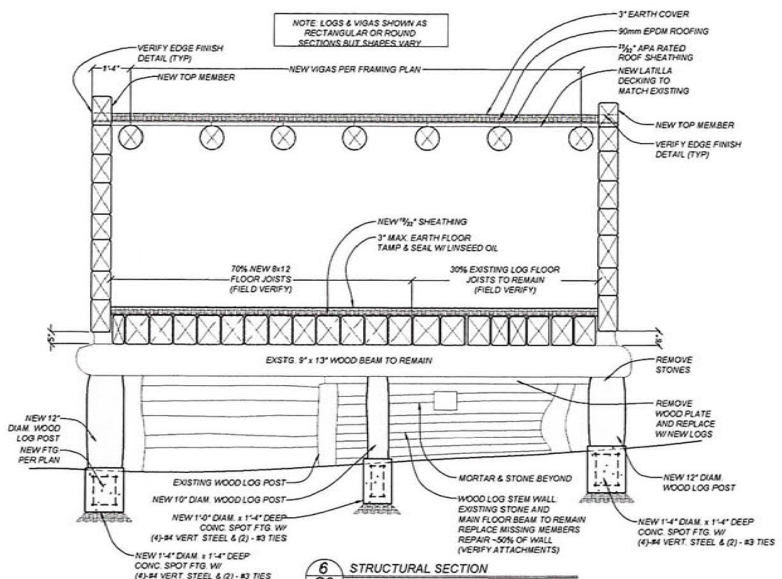
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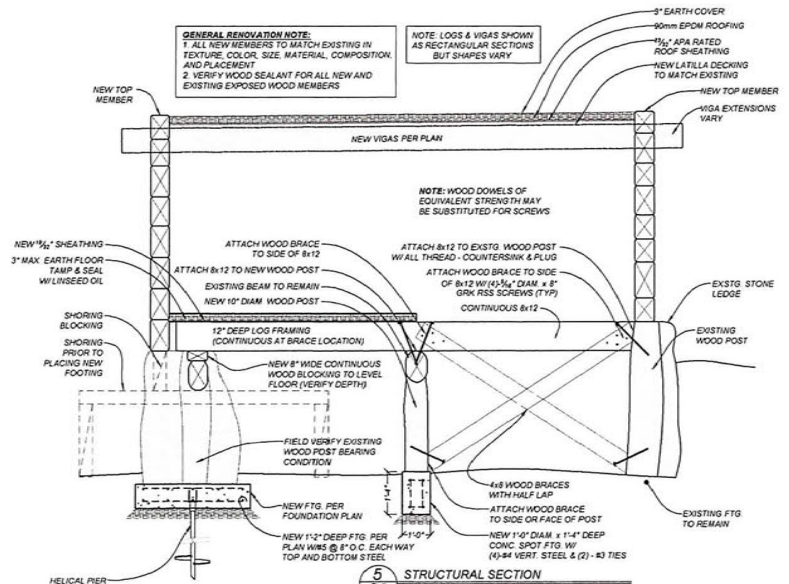
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BUILDING ELEVATIONS

SHEET
S2
SHEET 2 OF 4







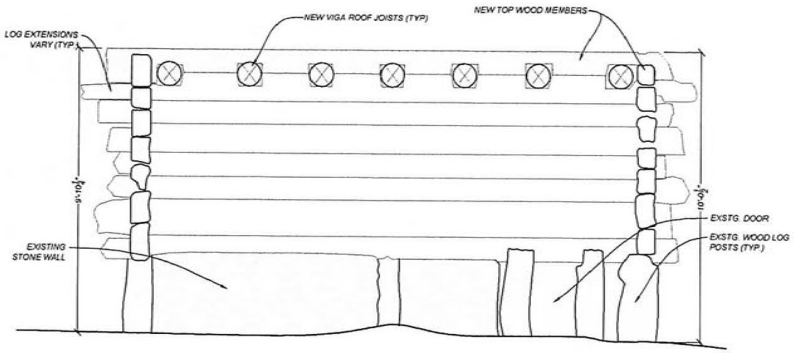
DRUC ENGINEERING
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Santa Fe,
New Mexico 87501
tel 505.983.4992
fax 505.984.0792
bill@druceng.com

MOLINO DE LOS DURANES
RANCHOS DE TAOS, NM

DATE: 9.30.14
DRAWN BY: JLLCC/ANT
CHECK BY: WMD
JOB #: 14028

PROPOSED PLANS & SECTIONS

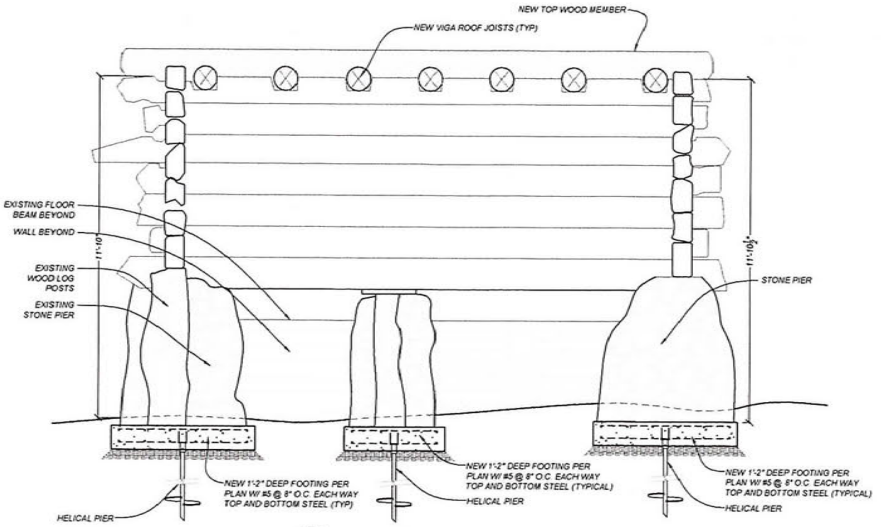
SHEET
S3



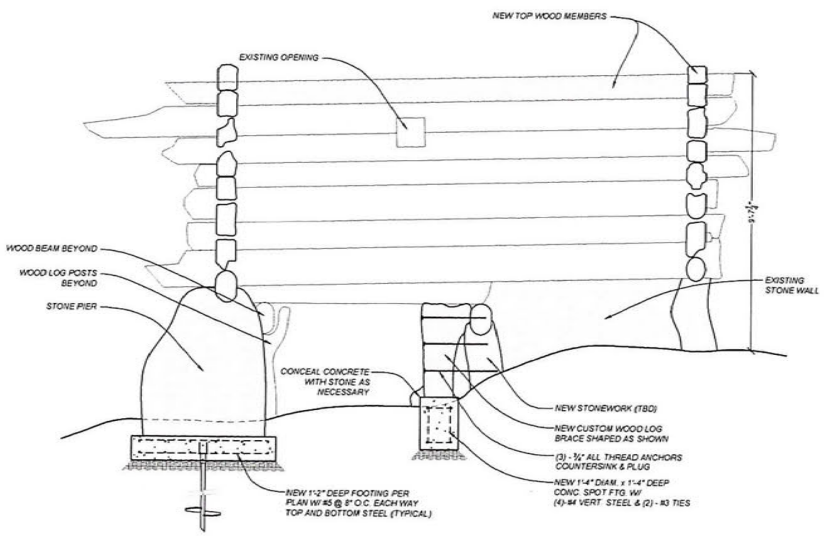
GENERAL NOTE:
1. SEE AS-BUILT DRAWINGS FOR WOOD LOG WALL RESTORATION
2. REPAIR STONE WALLS. TO MATCH AS NECESSARY
3. NEW STRUCTURAL SCOPE OF WORK SHOWN ON ARCHITECTURAL ELEVATIONS
4. ALL TOP RIM WOOD MEMBERS TO BE REPLACED
5. ALL NEW WOOD MEMBERS TO MATCH EXISTING IN TEXTURE, COLOR, SIZE, MATERIAL, COMPOSITION, AND PLACEMENT
6. VERIFY WOOD SEALANT FOR ALL NEW AND EXISTING EXPOSED WOOD MEMBERS

HELICAL PIER FOUNDATION SYSTEM:
a) TOTAL # OF SCREW PILES: 3
b) SIZE AND # OF HELICES PER SCREW PILE: (2) 8" DIAM HELICES
c) MINIMUM INSTALLED DEPTH OF HELICAL PIER: 8'
d) FINAL INSTALLATION TORQUE REQUIREMENT: TORQUE= 5,500 FT-LB, OR REFUSAL, OR AS APPROVED BY PROJECT ENGINEER
e) FOLLOW ALL 'CHANCE' MANUFACTURER GUIDELINES FOR INSTALLATION
f) SCREW TYPE = SS5
g) CONTRACTOR TO PERFORM TEST INSTALLATION PRIOR TO CONSTRUCTION

3/S4 NORTHEAST ELEVATION
SCALE: ½"=1'-0"

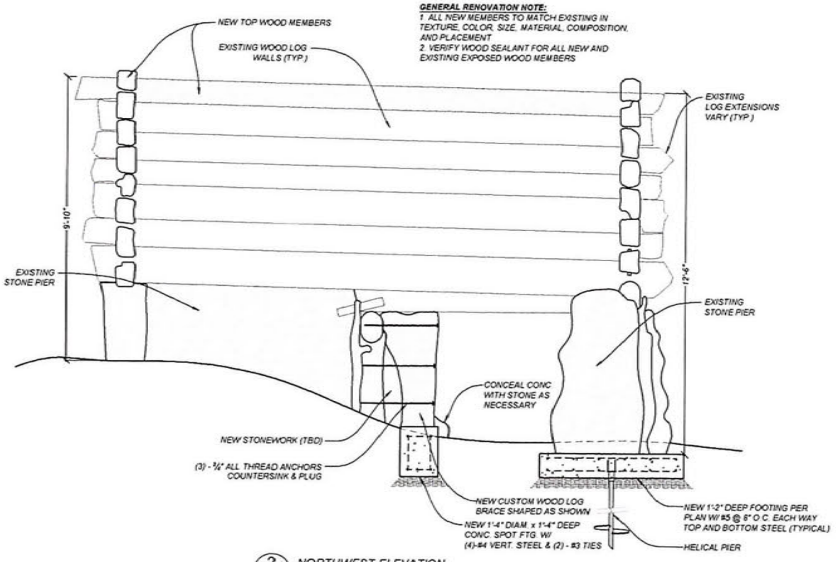


1/S4 SOUTHWEST ELEVATION
SCALE: ½"=1'-0"



4/S4 SOUTHEAST ELEVATION
SCALE: ½"=1'-0"

GENERAL RENOVATION NOTE:
1. ALL NEW MEMBERS TO MATCH EXISTING IN TEXTURE, COLOR, SIZE, MATERIAL, COMPOSITION, AND PLACEMENT
2. VERIFY WOOD SEALANT FOR ALL NEW AND EXISTING EXPOSED WOOD MEMBERS



2/S4 NORTHWEST ELEVATION
SCALE: ½"=1'-0"

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PROPOSED STRUCTURAL ELEVATIONS

SHEET
S4
SHEET 4 OF 4