612/D-91

Point Reyes Lightstation
Conditions Assessment Report

Point Reyes, California

Color Scans
3/26/2003

Conditions Assessment Report
Point Reyes Lightstation
Point Reyes, California

ARCHITECTURAL RESOURCES GROUP
Architects, Planners & Conservators, Inc.

November 10, 1999

TABLE OF CONTENTS

INTRODUCTION

Architectural Resources Group was retained by the National Park Service Point Reyes National Seashore to conduct a conditions evaluation of the Point Reyes Light Station, its associated Equipment buildings, the concrete stairway leading to the Light Station, water cistern and sandstone retaining wall. This report summarizes the findings of the on-site survey with a description of observations, analysis of the nature and extent of conditions and recommendations for treatment. The recommendations in this report were developed with consideration to provide preservation maintenance for long term protection or stabilization against further deterioration and are identified as such in the recommendation section of the report.

EXECUTIVE SUMMARY

Overall, the structural condition of the Lighthouse and Equipment buildings are sound. In summary, the recommended repair treatments for the Equipment and Transformer building is repainting, and on the Equipment building, reflashing at the chimney. Repairs to the Lighthouse focus on repainting, repairing cracks in the iron cornice, restoring the operation of the base plate vents, and investigating the joint details at the windows on the second gallery and ground levels. Consideration should be given to the replacement of the acrylic sheeting used for glazing. In addition, the door hinges and lock mechanism on the first gallery level door need restoring. Deterioration of the concrete steps leading to the Lighthouse is limited to some movement of the concrete curbs away from stairs and minor spalling of the curbs. The unit masonry retaining wall has a large crack which is allowing water to infiltrate from behind and cause erosion of the stone faces. Preservation of the watershed and water cistern will focus on stabilization.

INVESTIGATIVE METHODOLOGY

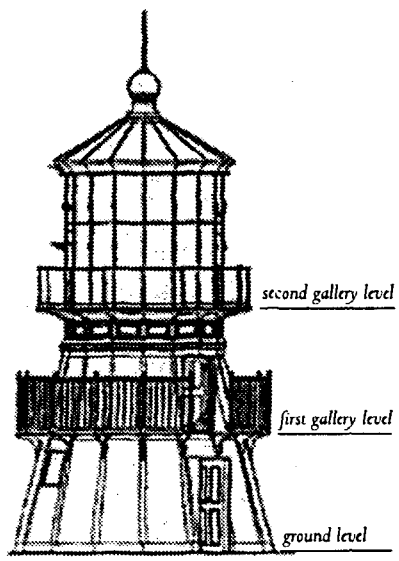
The Historic Structures Report prepared in 1990 by Dewey Livingston and Dave Snow was reviewed in advance of the survey for prior treatments performed on the Light Station. National Park Service architects Craig Kenkel and Tom McGrath, who were involved in previous lighthouse projects were interviewed. On site, a visual survey was conducted of all levels, including the roofs, of both the Light Station and Equipment buildings. The condition of each stair was surveyed and noted, and the construction of the stairs were ascertained by excavating the dirt on either side of the stairs. Observed occurrences of deterioration were photographed and their respective locations noted on drawings prepared by Architectural Resources Group.

BUILDING DESCRIPTION

The Point Reyes Light Station is located on the westernmost tip of the Point Reyes peninsula, approximately 35 miles northwest of San Francisco. The microclimate of the Light Station is characterized as one of the foggiest and windiest places in the United States. The Lighthouse and surrounding structures are subjected to a severe marine environment which is saturated with humidity and marine salts. Winds typically blow from the southwest. The concrete stairway which leads to the lighthouse runs east-west. The unit masonry retaining wall and water cistern are located at the top of the stairs and face southwest.

Lighthouse

The Point Reyes Lighthouse, completed in 1870, is described as one of the finest examples of iron plate lighthouses in the country. The lighthouse is a sixteen-sided pyramidal tower with three levels: a ground level watch room, a first gallery level for mechanisms, and second gallery level which houses the lantern.



Ground Level

The base of the lighthouse is composed of sixteen canted and tapered iron plates. These plates are bolted at the seams with steel bolts and to a concrete base. There is one hooded door located between rib segments and two windows. The windows are single light plexiglass sheets that sit flush in the wall plate and sealed with caulking. At the top of the iron wall plates are cast iron brackets which support the first level gallery deck. All metal components are painted.

First Gallery Level

The first gallery is the second level of the lighthouse. It is encircled by a deck and an iron guard rail. Sixteen decorative panel castings break the cant of the base level's panel assemblies. Above these recessed panels are exposed cast iron, semi-arched brackets which support the second gallery deck. Directly below the deck, base plates which vent the second gallery level are located between every other bracket. There is one hooded, cast iron entry door on the northwest facade.

Second Gallery Level

The second gallery is largely a glass (now plexiglass) lantern with metal astragals, an iron cornice, and a standing seam copper roof over cast iron rafters and cornice. The standing seam copper roof is painted and divided into the same sixteen segments as the wall panels on the ground and first level galleries. The roof panels intersect at the circular mount for the ventilator. A concave iron cornice and horizontal iron pipe rail, which spans between the astragals within the cornice, intersects the top of the glass panels at a copper alloy transom bar. The sixteen glass panels which enclose the second gallery level are divided horizontally into three sections. Interior gutters, composed of copper alloy, catch condensation from the glass. The gutters are drained by weep holes.

Equipment Buildings


equipment building

Built in 1928, the fog signal building is a 20' x 46' wood frame one story building on a concrete slab foundation. There is an entry door on the west elevation and a set of rolling doors on the east elevation. The roof is pitched and the roofing material is red composition tile. There is one concrete chimney on the west side. The transformer building (not pictured,) built in 1910 and located on the same concrete platform as the lighthouse, is a 10' x 11' concrete box with a metal door on the west elevation. It has an almost flat, concrete hipped roof. This building is painted in the same white with green trim color scheme as the equipment building.

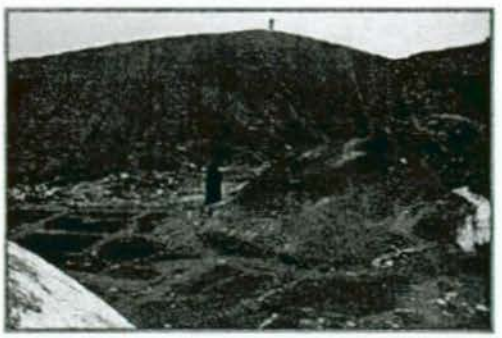
Stairway

There are 304 steps and two ramp sections which make up the stairway which leads from the visitor center to the lighthouse. The stairs are reinforced concrete with concrete curbs on either side which accommodate the wheels of a hauling cart. Aluminum railings with light fixtures are located on either side of the stairway.

Retaining Wall

The retaining wall supports the watershed and cistern which were both built in 1898. Although the wall is not specifically dated to this year, it is likely that it too was constructed in 1898. It is located directly below the watershed and faces northwest. The wall is constructed of unfinished sandstone layed in uneven courses with mortar joints. The top of the wall is approximately 2'-0" above the top of the watershed and is parged with cement plaster.

Water Cistern



The water cistern and watershed were constructed in 1871 to collect and store water for general use and to provide steam to power the fog signal. The cistern was constructed out of concrete and brick and the watershed out of concrete.

OBSERVATIONS & ANALYSIS

Lighthouse

Paint Coatings

Observations
Ground level paint coating failures are limited to small areas of loss around the perimeter of the base. There is heavy rust staining under the two ground level windows (see Figure 1 at the end of lighthouse section). A consistent loss of paint is occurring on all sides of the first gallery level deck. This coating failure is occurring at a height of approximately 4'-0" and below and it is marked by random areas of the primer coat showing through the top coat (Figure 2). Slightly discolored areas of white paint reveal previous patches. Rust staining is occurring under each of the base plate on the first gallery level. Light organic growth exists under the second gallery deck on the northeast elevation.

Analysis
The rust staining under the windows on the ground level suggests that water is penetrating the glazing caulking. There are a few occurrences of grafitti and there is rust staining at 10% of the cast iron bolt connections. The loss of paint on the first gallery level is the result of impact from visitor bags and equipment. There is rust staining on the cleats and astragals on the second gallery level and evidence of corrosion on the cast iron cornice (Figures 3 & 4).

Lantern Glazing & Cracks

Observations
A large (1/8"- 1/4" wide) crack was observed in the iron cornice directly above the head of a glazed panel on the south elevation (Figure 5). In addition, hairline cracks in the cornice span above three of the windows to the far right on the south elevation (Figure 6). Corrosion in the form of rust surrounds these cracks and is staining the plexiglass panels below where the cracks occur.

Analysis
The cracks in the cast iron cornice may be caused by water entering through leaks, perhaps in the glazing sealant, and corroding the metal components of the joints (Figure 3.) Consequently, the metal components of the joints would then be rusting and expanding and their increased cross sectional diameters creating an upward pressure on the cornice thereby causing it to crack. The glazing sealant may also not be capable of accommodating movement of the plastic sheeting due to thermal expansion. A 30° temperature differential can cause a 1/2" expansion of the plastic sheeting. This expansion must be absorbed either by the sealant or by air space. If either of these allowance details are unable to accommodate the expansion force, then the sealant can fail and water will enter the frame assembly. Leaks in the glazing assemblies are evident by rust stains which run down the interior and exterior mullions (Figure 4). Another potential cause

for the cracks is corrosion due to galvanic action. The screws, bolts and transom components of the glazing frames are a copper alloy whereas the cornice is cast iron. In the presence of water, ions from the iron will flow to the nobler copper metal to protect it from corroding. In the process of sacrificing ions to the copper, the cast iron is subjected to corrosion.

Base Gutters

Observations
The base gutters located on the interior deck of the second gallery level have corroded to the point that it is difficult to slide the vent plates. Consequently, some of the vents are sealed and condensation is no longer vented out of the lantern.

Analysis
The corrosion of the base plates is likely due to galvanic action between two dissimilar metals. The baseplates, which are a copper alloy, are bolted to the cast iron window base plate with copper alloy bolts. In the presence of an electrolyte (water) the copper will corrode the iron. The result of this corrosion is rusting of the cast iron. The rusting causes the cast iron to expand and put pressure on the base plate yielding it difficult for the vent plate to slide evenly. In addition, sections of the cast iron are splitting under the pressure of corrosive forces (Figures 7 & 8).

Weep Holes

Observations
The weep holes below the condensation gutter transom have been sealed by paint.

Analysis
Water, from condensation, is retained in the gutters and causing the ferrous metal adjacent to the gutters to corrode because drainage cannot occur through the weep holes.

Doors

Observations
There is heavy rust and rust staining at the hinges and most of the perimeter of the cast iron entry door on the first gallery level (Figure 9). The original bronze lock mechanism no longer functions. In its place, a latch has been added to secure the door. There is paint loss on the strike side of the door and on the edges of the hood.

Analysis
The corrosion at the hinges appears to be due to galvanic action. The door is cast iron and the hinges and pins are a copper alloy. Copper, being the more nobler metal, will corrode the cast iron. The corrosion along the perimeter of the door may be a subsequent result of the corrosion occurring at the hinges. The door does not hang flush in the frame due to the loss of surface metal in the hinges, and so is scraping within the frame. The resulting abrasion has removed the cast iron's protective surface and is

allowing the door's edges to corrode (Figure 10). Similarly, because the door does not close easily within its frame, the latch does not fit comfortably either. The scraping of the latch is causing paint loss on the neighboring surfaces.

Windows

Observations
There is heavy rust staining on the single light plexiglass windows on the ground level (Figure 1). The ground level windows are set flush in the cast iron panel without frames and sealed with caulking.

Analysis
The caulking which was used to seal the glazing into the recessed frame of the cast iron plate has dried out and is allowing water to enter. The cast iron is reacting with the oxygen and water and forming rust.

Lantern Curtain

Observations
Burn holes are appearing randomly throughout the curtain in the lantern which shields the Fresnel lens.

Analysis
The curtain is just short of the bottom of the lantern glazing. Therefore, rays from the sun are radiating onto the fabric and the resulting heat is burning the curtain. The curtain which shields the lens must extend to the lantern's floor level to prevent this condition.

RECOMMENDATIONS

Paint Coatings

In order to ensure that the metal is protected, a continuous layer of paint must be maintained. This is especially important in a severe marine environment such as the Point Reyes Lightstation. Repainting of all metal materials in the lighthouse is necessary to prevent further corrosion. The 1979 painting contract specified that all metal parts from the glass lantern to grade be sandblasted to white metal. This was confirmed by conversations with Park Service personnel who were involved with the painting restorations. No lead-based paints were reapplied to these surfaces after 1979; therefore, lead abatement will not be a consideration in the paint restoration of the lighthouse. Red lead, although considered a health and environmental hazard, is still considered one of the best protective pigments as it inhibits rust-forming reactions. The absence of this coating may actually explain why materials have corroded at an accelerated rate.

All of the lighthouse metals should be sandblasted to white metal and repainted. The cuprious metals should be primed with an epoxy coat followed by a second epoxy coating, then a colored urethane topcoat applied over the epoxy coatings and finished with a final acrylic clear coat. A zinc based primer coating followed by two epoxy coats, a colored urethane topcoat protected by an acrylic clear coat is recommended at this time to insulate the ferrous metals.

The pattern of rust staining on the lighthouse suggests that concealed metal surfaces surrounding the windows on the ground level, and in the window frame assemblies of the lantern level are corroding. These surfaces must be exposed for preparation and painting. This will require removal of the glazing cleats and glazing prior to painting and their subsequent reassembly. An enclosure should be temporarily erected to protect the exposed metals during the paint applications from the marine environment.

The National Park Service may consider the addition of a sign which explains to visitors the importance of maintaining the integrity of paint coatings to the preservation of the Lightstation.

Lantern Glazing and Cracks

In order to determine which process is causing the cracks in the cornice, it will be necessary to pull a section of the top transom cleat away to observe the condition of the joint connection between the cornice and the glazing. If it is evident that water is entering through the joint and corroding the rabbet assembly materials, then re-sealing the joint after painting with silicon may prevent further corrosion. Additionally, existing rust should be removed from the assembly materials. Rust which remains provides a source of further corrosion. Cracks in the cast iron may be repaired by welding, filling with metal filled epoxy or with sealant. If forces of thermal expansion seem to be responsible for the leaks and cracks, then the glazing detail may need to be studied or replacing the panel material may need to be explored. The selection of the repair technique will be made after the mechanism of failure is understood.

RECOMMENDATIONS *cont.*

Corrosion of Metals: Base plates and Entry Door

Historically, the bolt and screw heads were caulked with a white lead paste or were separated with gaskets to prevent galvanic action from corroding dissimilar metals. This detail needs to be replaced wherever there are copper screws which connect the lantern base plates to the cast iron and the hinges of the entry door to the cast iron door. Stainless steel fasteners sunk through rubber washers should replace the copper alloy fasteners and neoprene gaskets should be installed between the dissimilar metals to insulate them from each other in order to prevent further galvanic corrosion.

The base and vent plates should be cleaned of all existing rust and reinstalled. The functioning of the vents is necessary to vent heat and condensation out of the lantern. The cast iron doors on the ground and first gallery levels should be repaired to operate smoothly and not scrap the jambs. The operation of the bronze lock mechanism should be restored and covered with new paint coatings as specified above to protect the metals from exposure.

MAINTENANCE RECOMMENDATIONS

There are ongoing preventive measures that the Park Service can undertake that will aid in the preservation of the lighthouse. Paint coatings should be maintained so that the metals are continually protected. Any areas of deteriorating paint coatings should be spot painted to match the existing color. Additionally, the glazing sealants must be maintained to prevent water from entering the glazing assemblies. If leaks occur, then sealing the edges of the window frames with caulking will temporarily mitigate the entrance of water into the glazing assemblies. Similarly, the bolts at the cleats should be checked and tightened. The vent plates in the lantern should be kept open to vent the lantern of heat and condensation.

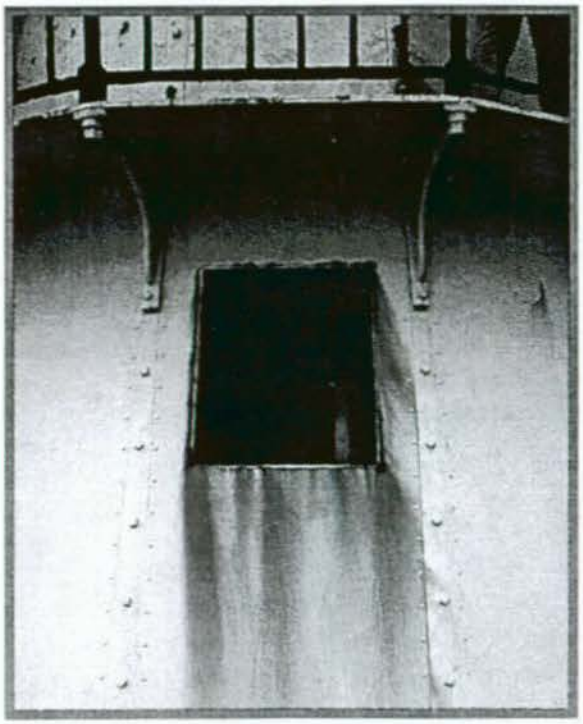


Figure 1. Rust staining under the ground level windows.

Figure 2. Through the railing, the 4'-0" and lower areas of paint loss are evident.

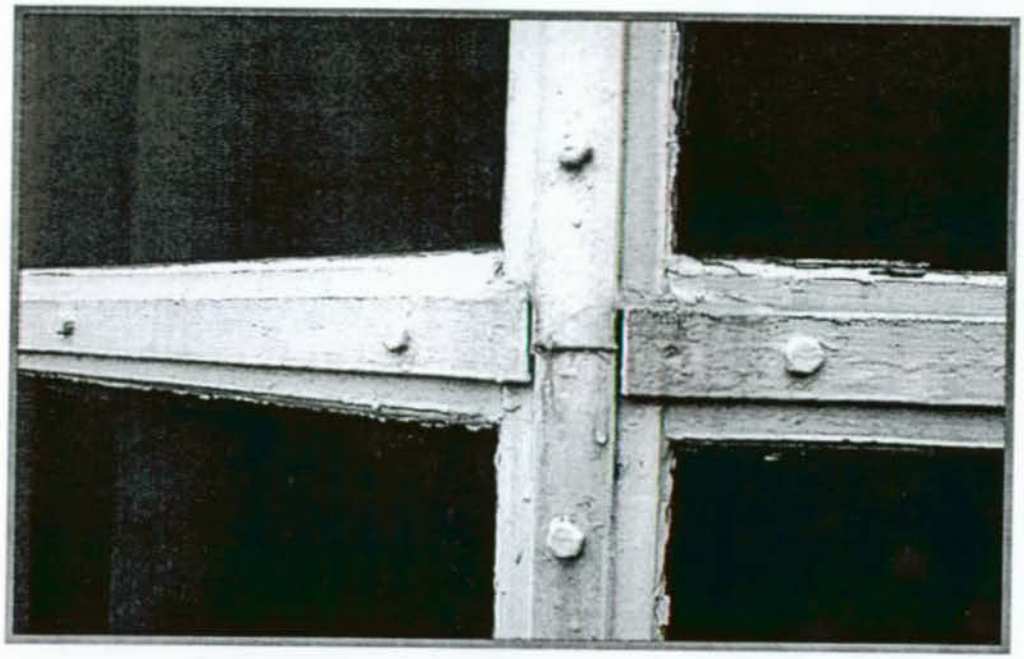


Figure 3. Rust or rust staining on mullion & muntin joint.

Figure 4. Rust stains and collected water on interior astragal and water trough.

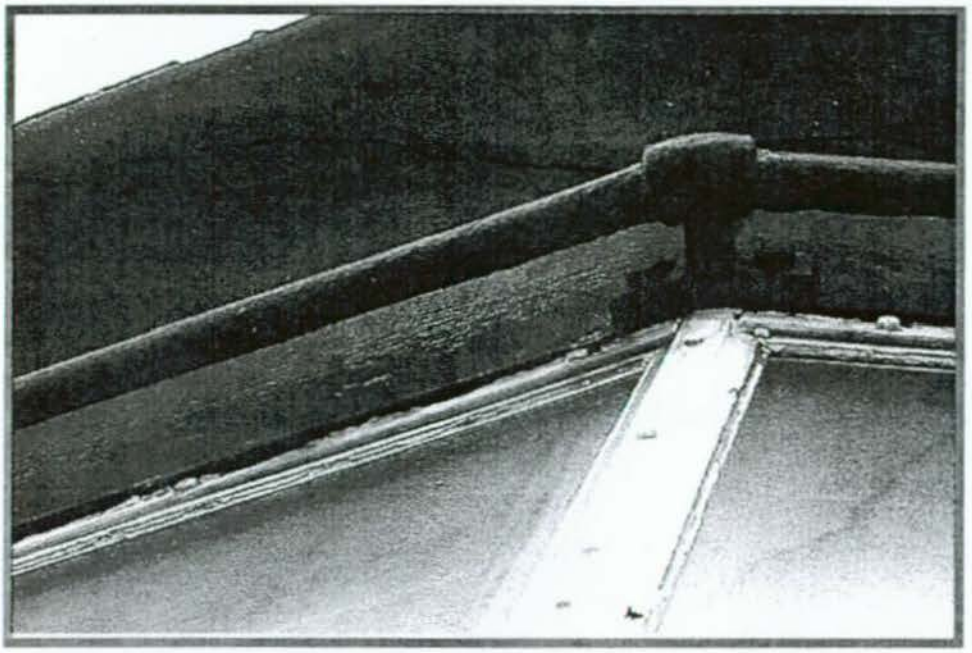


Figure 5. Large crack in cornice on south elevation.

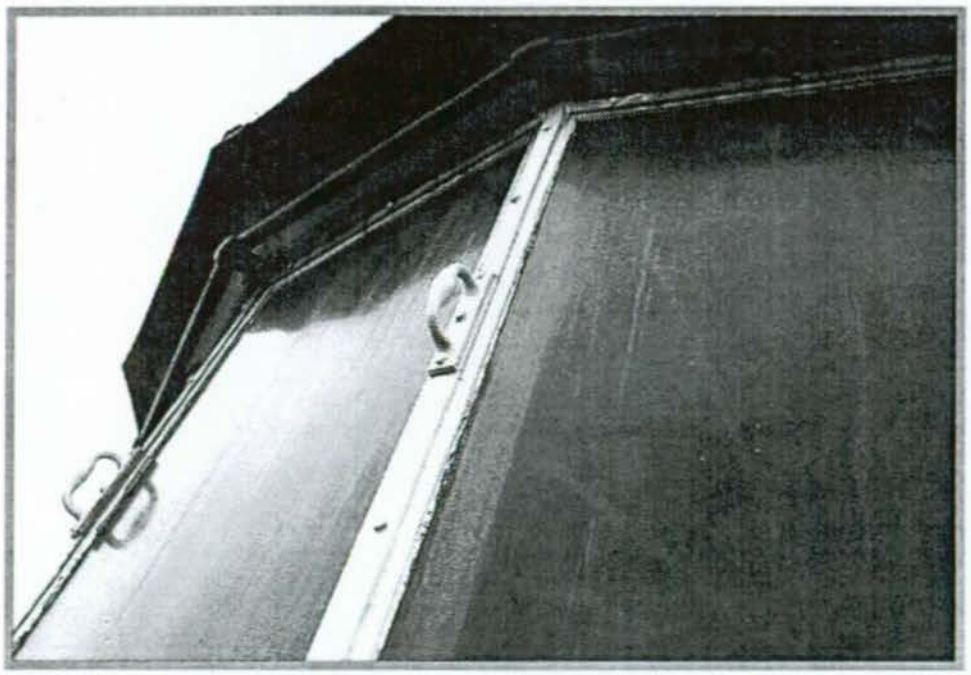


Figure 6. Hairline cracks in cornice above pipe connections, note rust stains on plexiglass sheeting.

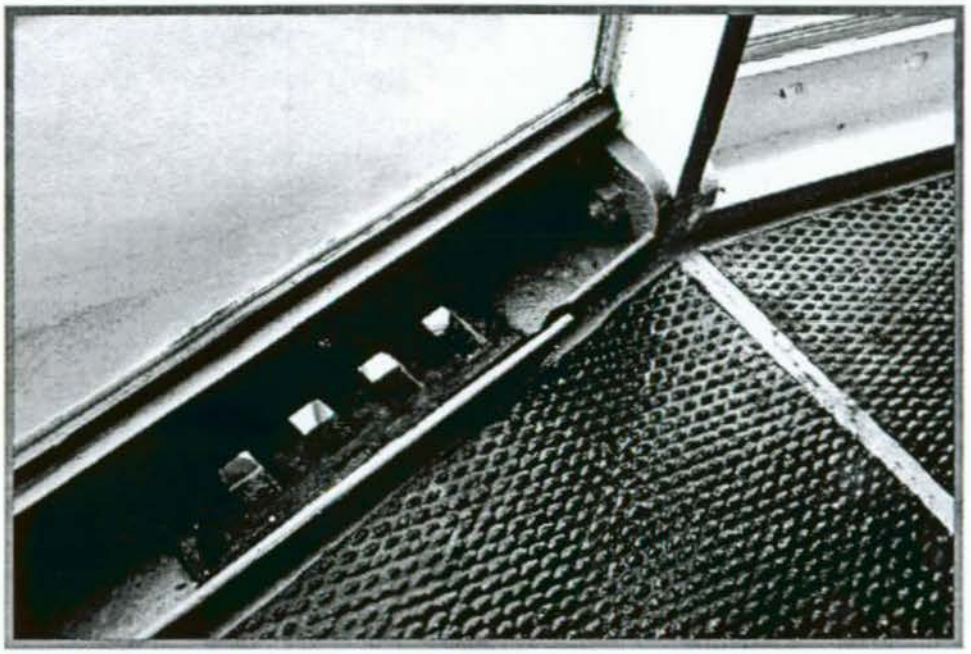


Figure 7. A base plate in the second gallery level interior decking. The cast iron sill plate has been sheared due to corrosion.

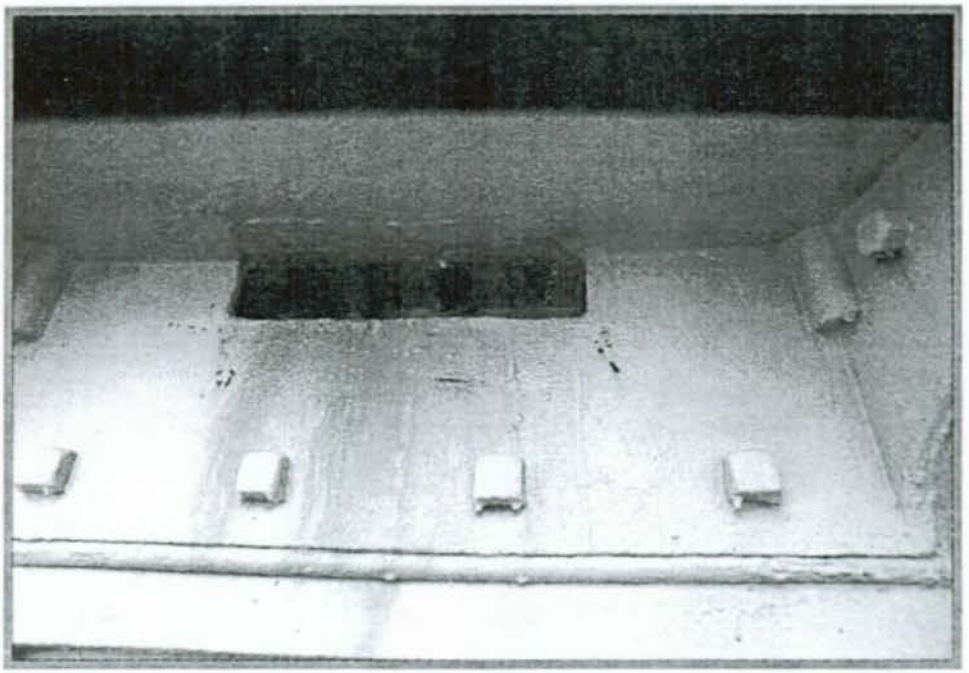
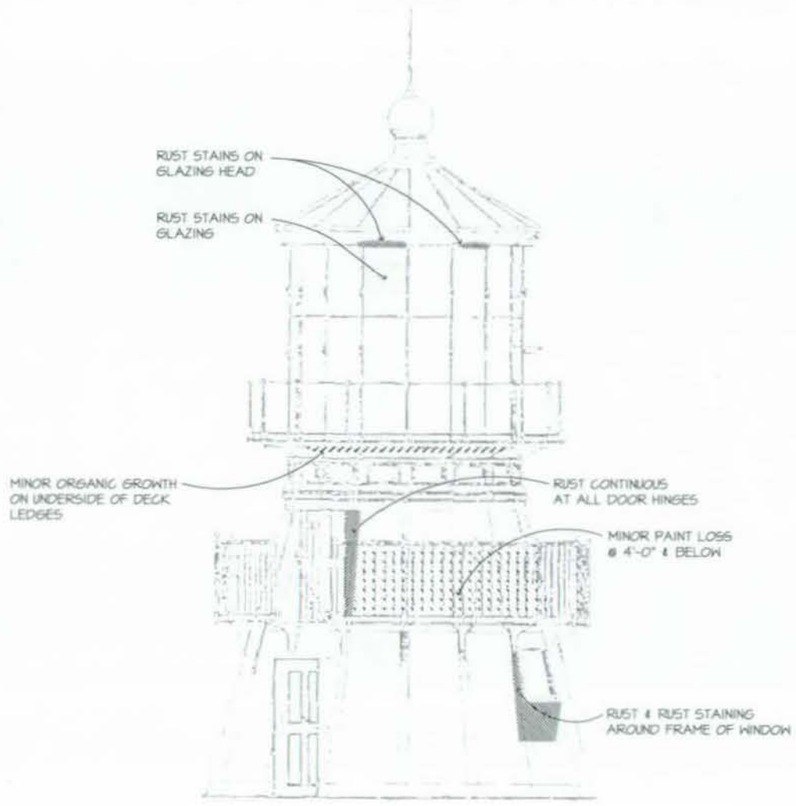


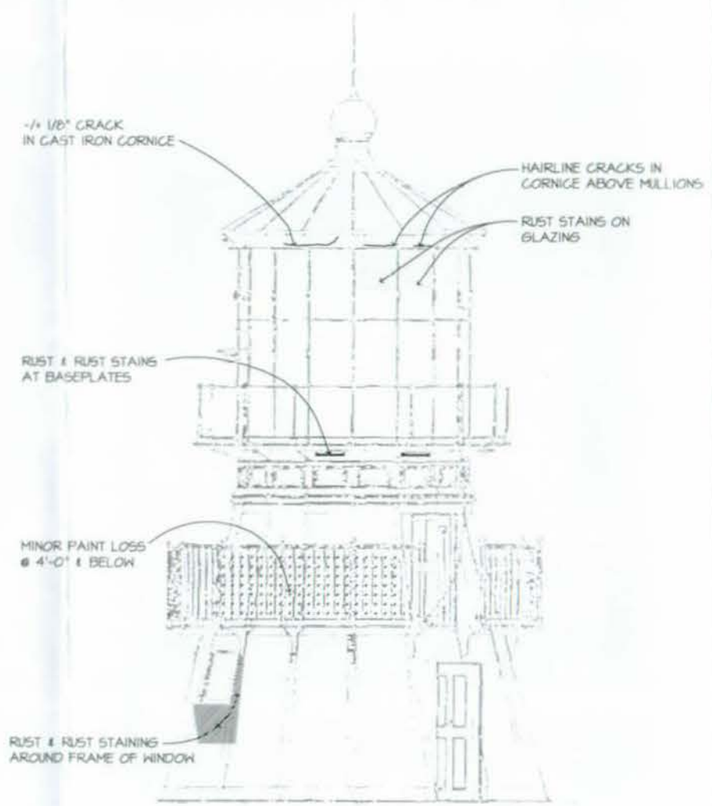
Figure 8. Rust stains caused by the corrosion of the base plates on the first gallery level.

Figure 9. Signs of corrosion on the hinges, edges, and locking mechanism on the first gallery level entry door.

Figure 10. Rust on the bottom hinge of the first gallery entry door.



2 NORTH ELEVATION
SCALE: 1/8" = 1'-0"



1 SOUTH ELEVATION
SCALE: 1/8" = 1'-0"

OBSERVATIONS & ANALYSIS

Equipment Building

Observations
There are areas of paint loss on the north and west elevations (see Figure 11at the end of this section). There is some minor rust staining on the gutters, north and west walls, and under metal conduit (Figure 12). The flashing at the chimney has fallen away and is allowing water to enter at the roof joint (Figure 13). A section of the conduits on the west elevation has broken off the handrail (Figure 14). All of the window sashes have been replaced.

Analysis
The paint coatings are failing principally on the south and west elevations. These elevations suffer the most exposure to wind and moisture. Metal components throughout the building are rusting, revealing evidence of paint coating failure in these locations.

Transformer Building

Observations
The concrete transformer building has lost a fair amount of the paint coating on all sides. Rust stains occur directly around metal components. Despite these conditions, the concrete appears to in good condition.

Analysis
The paint coatings are failing due to age and exposure to a severe environment.

RECOMMENDATIONS

Equipment Building

All surfaces of the Equipment buildings should be repainted. The owner should determine if any lead based coatings are present and provide this information to the painting contractor. The chimney flashing should be repaired to prevent water infiltration through the open roof joint. In addition, the broken conduit should be repaired and secured to the handrail.

Transformer Building

All surfaces of the Transformer building should be repainted.

MAINTENANCE RECOMMENDATIONS

Maintenance recommendations for the Equipment and Transformer buildings involve maintaining the paint coatings. Spot painting should be conducted at areas of paint loss. Gutters and downspouts should be kept clean so that water can drain away from the buildings.

Figure 11. The west elevation of the Equipment building showing coating failure.

Figure 12. Coating failure at the gutters on the Equipment building.

Figure 13. Joint at chimney where water flashing has fallen away.

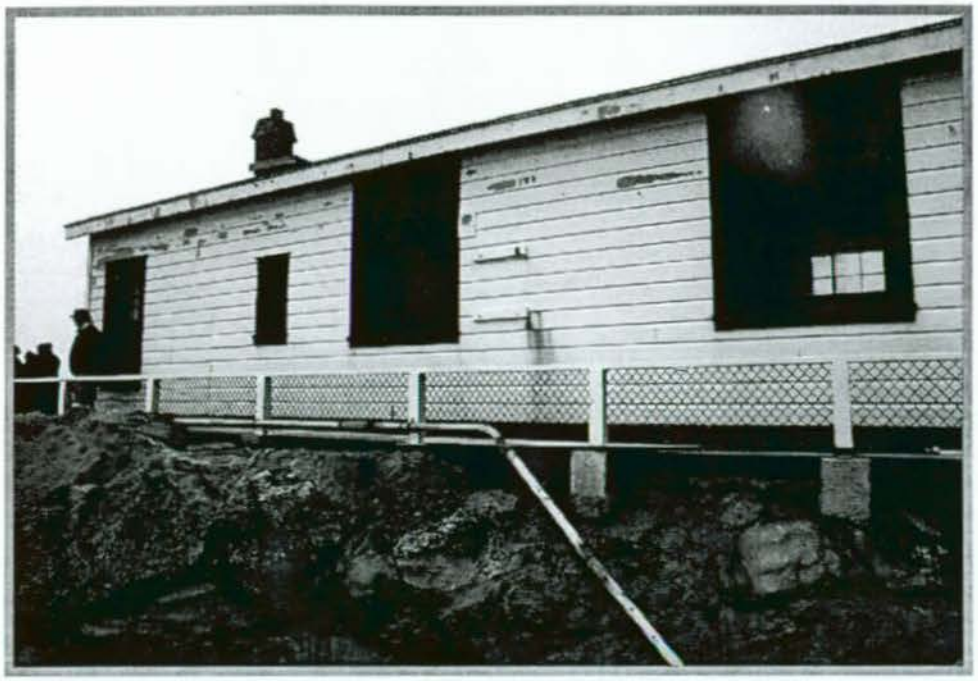


Figure 14. The west elevation of the Equipment building showing paint loss and the broken conduit.

OBSERVATIONS & ANALYSIS

Stairway

Observations

The most prevalent occurrence of deterioration on the concrete stairs leading to the lighthouse and equipment buildings is the separation of the concrete curbs from the stairs (see DW-1). The joint between the curb and the stairs has opened and widened from 1/8" to 1 1/2" depending on location. This condition exists on 90% of the stair run (see Figure 15 at the end of this section). Adding to the deterioration, plants have invaded the separation space between the stairs and the curbs. Trench drains occur approximately every 100 stairs and are filled with dirt (Figure 17). Approximately 50% of the concrete curbs are missing or have top cracks (Figure 16).

Analysis

Table 1 depicts the following conditions. The curb separation (curb separation) from the stairs appears to be the result of land on either side eroding outward from the stairway. This conclusion is supported by the fact that where there are outcroppings of rock bracing the stairway, there is negligible to no separation of the curbs. Missing curbs (missing curbs) are likely to be caused by erosion and impact from the Coast Guard's hauling cart. The cart is operated by a winch at the top of the stairs; deep scrapes mark the location where the cart is hauled over the top step. The wheels of this cart knock out sections of the curb as it rolls between the lower and upper curbs. The horizontal cracks (joint separation) are cold joints which form from thermal expansion forces.

Table 1 Stairway Conditions

STAIR	CURB CRACKS	MISSING CURBS	CURB SEPARATION	JOINT SEPARATION	NOTES
1-50	L. 15'ft. R. 10'ft.	L. 0'ft. R. 0'ft.	L. 0'ft. R. 0'ft.	L. 0' ft. R. 0' ft.	section braced by land L.&R.
51-100	L. 0'ft. R. 12'ft.	L. 0'ft. R. 15'ft.	L. 15'ft. R. 20'ft.	L. 6' ft. R. 2' ft.	severe side crack 80-85
101-150	L. 5'ft. R. 15'ft.	L. 0'ft. R. 5'ft.	L. 50'ft. R. 35'ft.	L. 5'ft. R. 5'ft.	
151-200	L. 2'ft. R. 10'ft.	L. 0'ft. R. 10'ft.	L. 50'ft. R. 50'ft.	L. 10'ft. R. 10'ft.	
201-250	L. 0'ft. R. 0'ft.	L. 50'ft. R. 0'ft.	L. 50'ft. R. 0'ft.	L. 2'ft. R. 10'ft.	rock cropping bracing R.
251-304	L. 0'ft. R. 0'ft.	L. 15'ft. R. 15'ft.	L. 5'ft. R. 5'ft.	L. 0'ft. R. 0'ft.	
TOTAL	**69' ft.**	**110' ft.**	**280' ft.**	**50' ft.**	

RECOMMENDATIONS

Stairway

Despite the separation of the curb from the stairs and cart damage, the stair assembly remains in good overall condition. For this reason, repair rather than replacement is recommended. The separation of the concrete curbs from the stairway can be arrested by bracing either side from slipping outward and away from the stairs. The existing gap separations should be plugged with a flexible, urethane sealant to match the color of the existing concrete. The section of curbs which are missing should be replaced and the areas that have deteriorated should be removed and replaced (Figure 17). New curbs should be detailed so that they can withstand impact damage from the cart. The trench drains should be cleaned so that water can drain away from the stair foundations. Water infiltration may be causing further deterioration due to corrosion of the concrete reinforcing bars.

MAINTENANCE RECOMMENDATIONS

Stairway

Trench drains should be kept clean of debris so that water can drain away from the stairs and not accumulate and corrode the concrete and reinforcing bars. Ideally, dirt should be swept away from separations between the stairs and curbs to prevent plants from establishing roots. Plants which do appear should be removed.

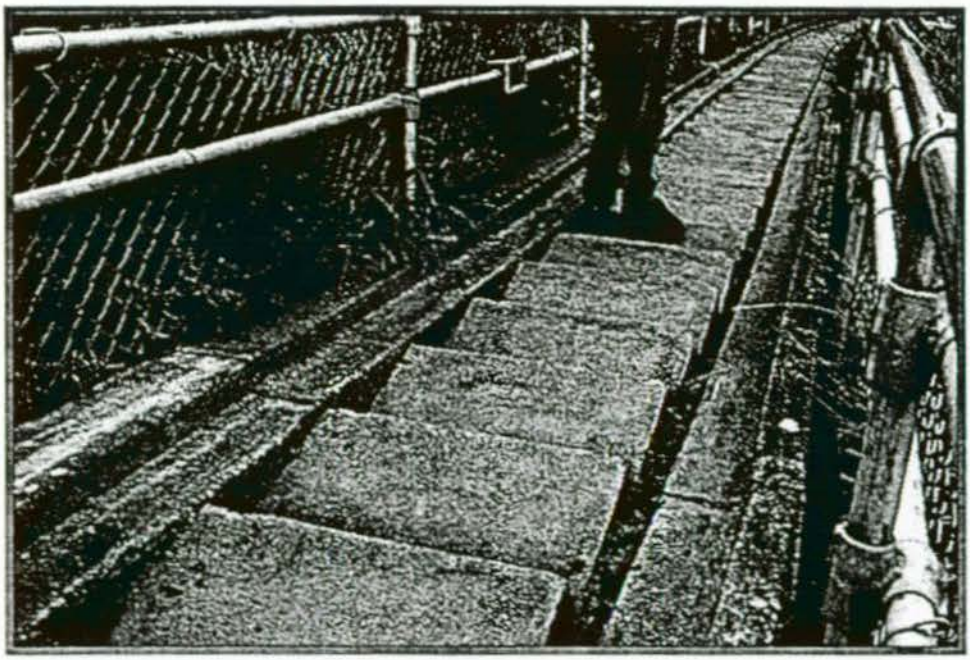


Figure 15. A greater than 3/8" separation between the stair and curb.

Figure 16. A missing curb section on the right side of the stairway.

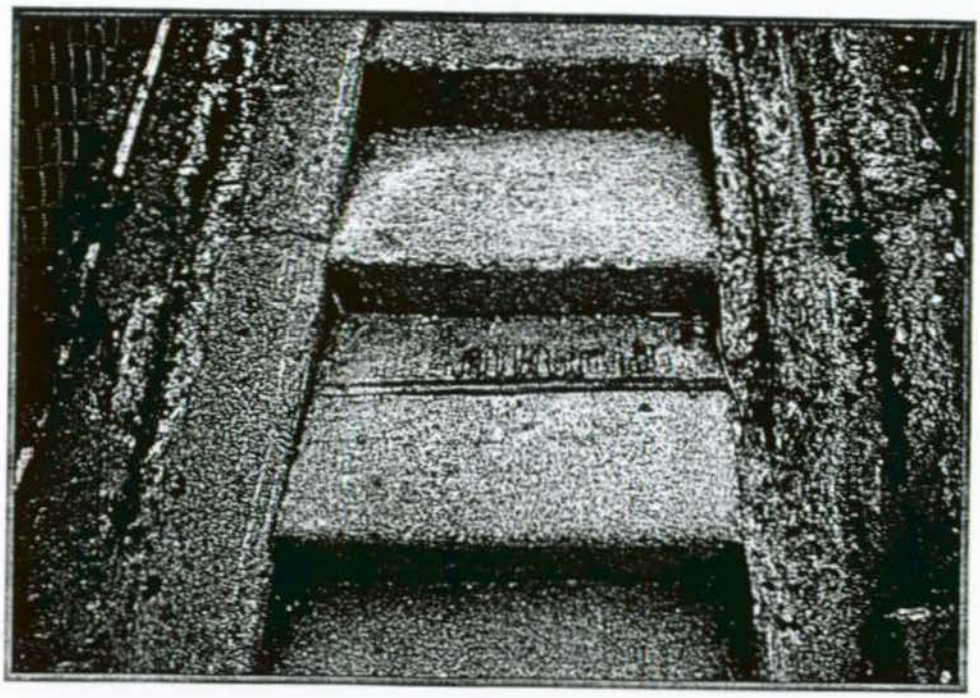


Figure 17. A filled trench drain, missing curb sections on both sides of the stairway, a horizontal cold joint, and exposed reinforcing bars.

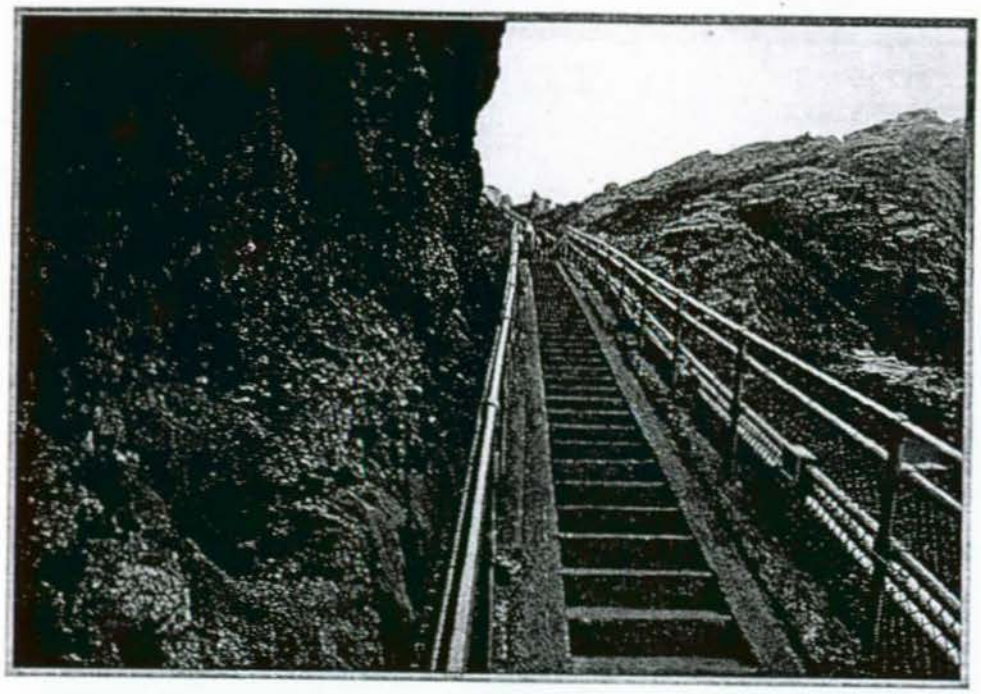
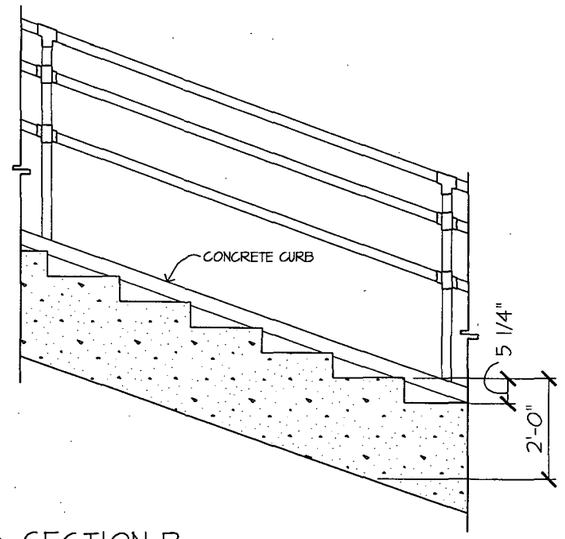
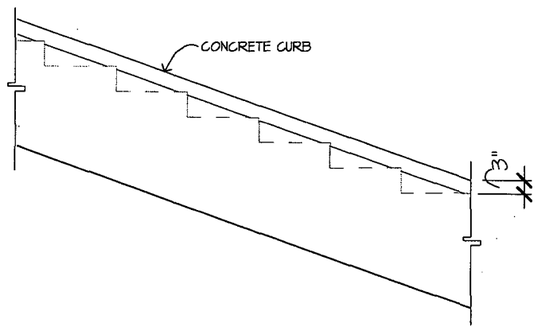


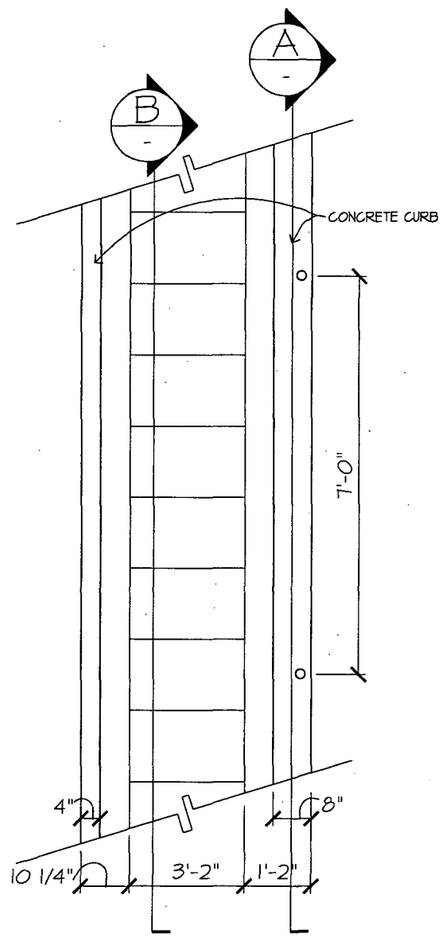
Figure 18. The rock cropping on the right (right side in direction of stairs) near stairs 201-250 appears to be preventing erosion and curb separation.



3/- SECTION B
SCALE: 3/8" = 1'-0"



2/- SECTION A
SCALE: 3/8" = 1'-0"



1/- TYPICAL STAIR PLAN
SCALE: 3/8" = 1'-0"

OBSERVATIONS & ANALYSIS

Retaining Wall

Observations

All of the mortar joints in this wall have deteriorated (Figures 19 & 20 at the end of this section). The absence of mortar has allowed water to infiltrate the wall and plants to invade the joints. The two feet of wall which rises above the surface of the watershed is parged with plaster (Figure 21). A large crack spans over half the length of this knee wall. Severe deterioration is occurring at the top edges of the wall where it meets the cliff side.

Analysis

Water is the major factor in the deterioration of the wall. The large crack on the top of the knee wall is allowing water to enter and seep down the back side of the wall. Severe weathering has eroded the surface of the wall and caused erosion of the soil behind the wall (Figure 22). It is also possible that the cement that was used to patch the mortar joints is incompatible with the sandstone, prohibiting the sandstone from expanding without fracturing. The water that is entering through the crack is also draining around the side of the wall causing the stone and cliff to erode.

RECOMMENDATIONS

Retaining Wall

A petrographic analysis of the sandstone was conducted to determine the chemical composition of the stone (Appendix A.) The conclusions of the analysis need to be examined further. A similar analysis conducted on the mortar will be necessary. Architectural Resources Group will analyze the mortar. This survey is necessary to determine the original composition of the mortar and to ensure a compatibility with the sandstone. All mortar joints should be repointed. The crack on the top of the wall should be routed and cleaned to provide a good bonding surface, and then sealed with a polyurethane based elastomeric sealant.

MAINTENANCE RECOMMENDATIONS

Retaining Wall

After the crack along the top of the wall has been sealed, it should be monitored to determine that it has been stabilized. Mortar joints should be kept free of plant growth at all times.

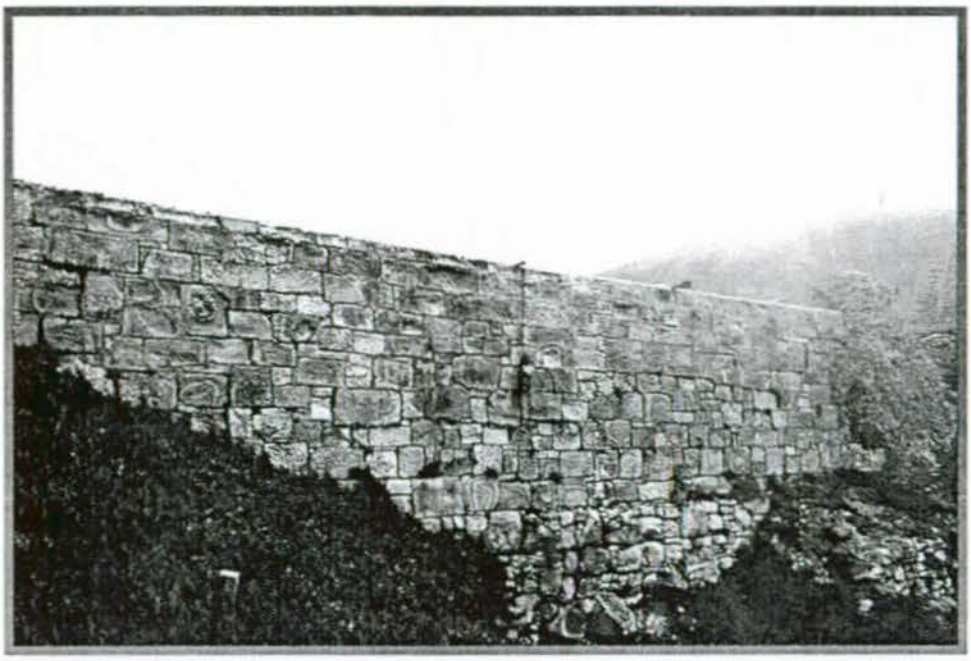
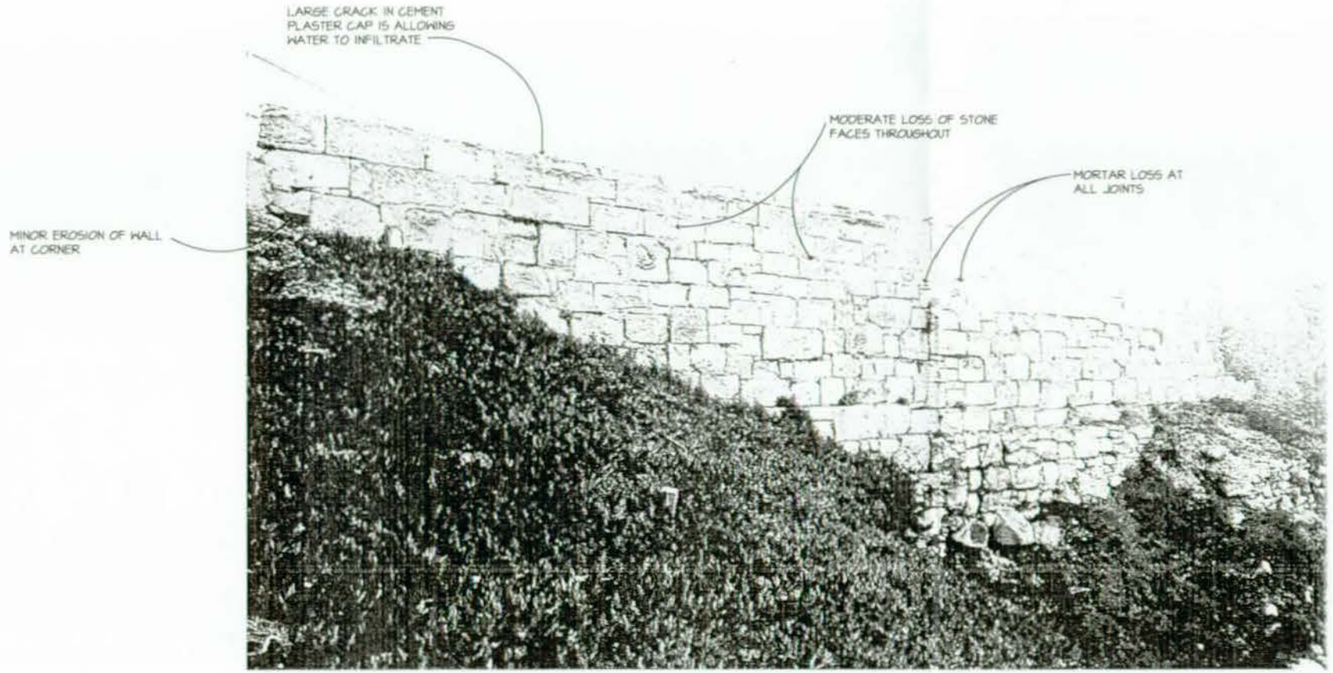


Figure 19. Full view of sandstone wall; deterioration of the mortar joints and stone faces is continuous along length of wall.

Figure 20. Far north edge of the wall illustrating where water is draining from behind and eroding edge.

Figure 21. Crack on the top at the watershed and cistern where water is infiltrating from behind.

Figure 22. Previous patches are spalling along with original stone face.


LARGE CRACK IN CEMENT PLASTER CAP IS ALLOWING WATER TO INFILTRATE
MODERATE LOSS OF STONE FACES THROUGHOUT
MORTAR LOSS AT ALL JOINTS
MINOR EROSION OF WALL AT CORNER

OBSERVATIONS & ANALYSIS

Water Cistern & Watershed

Observations
The watershed appears to be covered with a thin, unreinforced, concrete plaster. This covering appears to have been spread over the hill without expansion joints. Cracks have occurred throughout and plants have taken root in these cracks (see Figures 22 & 23 at the end of this section).

Analysis
The concrete of the watershed has cracked and deteriorated due to the age of the concrete and the thinness of the layer.

RECOMMENDATIONS

Water Cistern & Watershed

There are a few treatment options to consider for the cistern and watershed. The least intrusive option is to elect not to perform any kind of treatment on the watershed's concrete. In this case, ongoing maintenance would be required to keep the concrete free of plants and sitting water. Without continuous attention to plants and water, the watershed will continue to deteriorate. A second option is to seal the existing cracks with an elastomeric sealant. This treatment would provide a flexible material for the existing, thermal expansion cracks to move within, and yet prevent water from entering and causing further deterioration of the concrete. This solution is temporary since additional cracks are inevitably going to occur due the age, quality and thin layer of the original concrete. Additionally, this treatment may also change the character of this historic feature. Another option is to cover the existing concrete with a new layer of concrete. This treatment would permanently and irreversibly cover historic fabric, yet would maintain the original shape of the watershed for park visitors to interpret. Furthermore, this treatment would defer further treatment for a longer period than the other two options. Further discussions with the National Park Service and study of treatment options for the cistern is recommended.

MAINTENANCE RECOMMENDATIONS

As previously stated, ongoing Park Service maintenance of the cistern and watershed should involve maintaining the concrete free of plants and water.

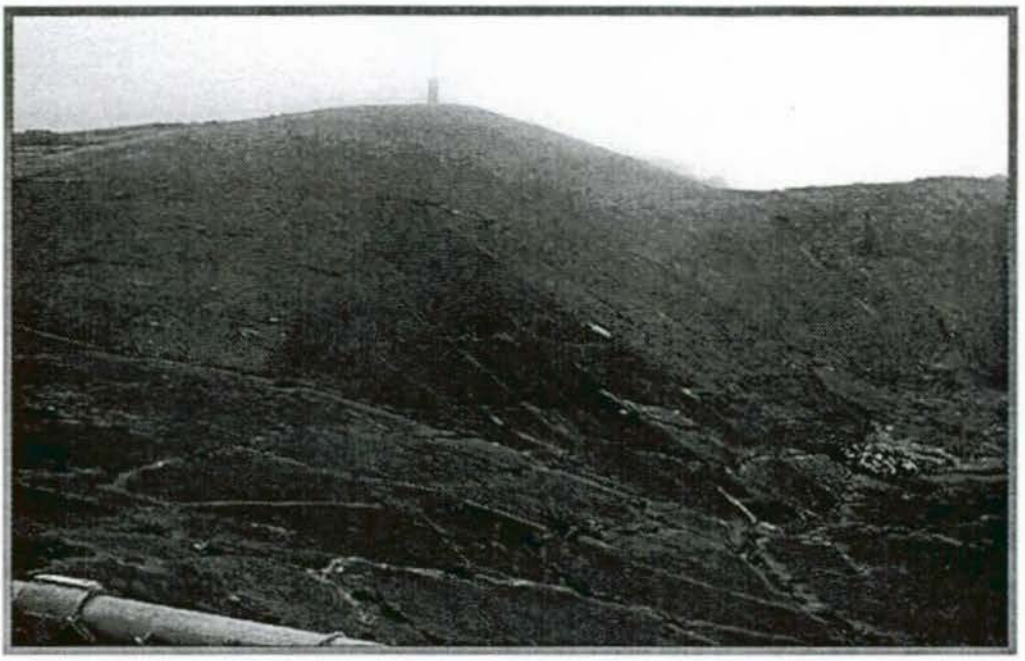


Figure 22. Southwest view of watershed illustrating severe cracking of concrete and plant invasions at cracks.

Figure 23. View of cistern, in lower left, and watershed showing severe cracking, elastomeric joints, and plant invasions.

PROJECT TEAM

National Park Service:

Gordon White, Cultural Resource Manager, Point Reyes National Seashore
Larry Harris, Chief of Maintenance, Point Reyes National Seashore
Kim Bailey, Project Manager, Denver Service Center

Architectural Resources Group:

David Wessel, Project Manager
Kellie Phipps, Job Captain

PSOMAS:

Michael G. Thalhamer, PE Project Manager