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WALBACH TOWER, BATTERY FARNSWORTH, ASSOCIATED STRUCTURES, AND ENVIRONS

Fort Point
New Castle, New Hampshire

Historic Structures Report

Part II

WALBACH TOWER,
BATTERY ELON FARNSWORTH,
ASSOCIATED STRUCTURES,
AND ENVIRONS

Fort Point, New Castle
New Hampshire

HISTORIC STRUCTURES REPORT

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SECTION 1.

INTRODUCTION, SUMMARY OF FINDINGS, AND TREATMENT RECOMMENDATIONS

Introduction

The Fort Point structures covered in this report are located on a 5.5- acre parcel of land owned by the University of New Hampshire (UNH) adjacent to the boundaries of the existing Fort Constitution Historic District (owned and managed by the State of New Hampshire as a State Park) and the U.S. Coast Guard Station, and consist of the following:

- Walbach Tower, an 1814 brick casemated Martello- type tower;
- Battery Elon Farnsworth, an 1897- 1898 Endicott- era concrete battery, originally equipped with two 8- inch breech- loading rifles on disappearing carriages;
- a 1901 first- generation Mining Casemate, within Battery Farnsworth at Gun Emplacement No. 2;
- a 1920 Mining Casemate, with 1941- 42 improvements;
- a 1921 Power Plant; and
- a 1943 Observation Station, which sits on top of Gun Emplacement No. 1 of Battery Farnsworth.

The New Hampshire Division of Historic Resources (NHDHR) approved a Determination of Eligibility (DOE) for the National Register of Historic Places to include the six structures owned by the University of New Hampshire, as well as the adjacent Fort Constitution Historic District, on June 27, 2002.

Purpose and Methodology

This report was prepared for the University of New Hampshire as Part II of an historic structures report (HSR) for select 19^{th}- and 20^{th}- century coastal fortifications at Fort Point, New Castle, New Hampshire. Part I of the HSR addresses the contextual history of these fortifications, their construction and developmental history, their preservation history, and their significance and character- defining features. Part II contains existing- condition descriptions, assessment, and treatment recommendations for the structures.

Findings were documented as a feature inventory, using a Microsoft Access 2003 database developed for this project. The following categories of information were included for each feature as appropriate: existing condition, historical evolution, conditions assessment, treatment recommendations, cost estimates, and references. In addition, measures were considered to make limited portions of the site accessible for viewing by visitors, subject to provision of adequate fencing and security to prevent entry to unsafe areas.

The purpose of Part II of the HSR is to identify and evaluate options and associated costs for treatment of the six historic structures at Fort Point in the context of their existing physical condition. While the primary focus was on developing measures for stabilization, preservation, and long- term maintenance of the site and structures, the feasibility of options for restoration, rehabilitation, and/or reconstruction were also considered. Treatment recommendations were evaluated on the basis of the identified significance of the resources, comprehensiveness of the existing documentation, and probable degree of success in mitigating the causes of deterioration.

In addition to on- site investigation and documentation of existing conditions, development of this report included review of the historical documentation, evaluation of significance, and identification of "character- defining features" documented in Part I of the HSR. Also, a program of visual investigation, laboratory evaluation of concrete core samples, and nondestructive testing of structural components conducted in 2004 by the University of New Hampshire Civil Engineering Laboratories provided data on the physical and chemical properties of the constituent structural materials, which was integral to the development of treatment recommendations. Additional petrographic analysis of concrete samples was performed by engineers and materials scientists from the Michigan Technological University, Department of Civil & Environmental Engineering.

Context of the Report

With the completion of Parts I and II of the HSR, and an independent review of the materials testing and analysis results by the Construction Technology Laboratories of Skokie, IL, an independent subsidiary of the Portland Cement Association (PCA), the Fort Point structures have been thoroughly researched and documented at a level equivalent to "exhaustive investigation" as defined by the National Park Service:

> For historical studies this means employing all published and documentary sources of known or presumed relevance, interviewing all knowledgeable persons regardless of location, and thoroughly analyzing and presenting findings from all data of direct and indirect relevance…. For architectural and landscape studies it means investigating all features, with destructive investigation as necessary, to establish as exactly as possible all recoverable detail (usually in response to a restoration or reconstruction management objective).[1]

As noted, this level of investigation is rarely undertaken for structures not scheduled for large-scale restoration or reconstruction efforts.

[1] *NPS- 28, Cultural Resources Management Guideline*. http://www.cr.nps.gov/history/online_books/nps28/28chap2.htm, assessed 7/11/05.

Principal Findings

The structural condition of the major features of Fort Point is directly and inextricably linked to the physical and chemical makeup of the predominant building material. Inherent properties of the constituent materials of the Rosendale natural cement concrete used extensively in the late 19th- century construction program (Battery Farnsworth and the 1901 Mining Casemate), combined with the effect of a variety of environmental factors, are responsible for a condition known as Alkali Silica Reaction (ASR). This condition causes expansive forces resulting in large- scale structural movement, and massive internal cracking on both a micro and macro scale.

In March 2004, a group of engineers and materials scientists from the Michigan Technological University, Department of Civil & Environmental Engineering, performed petrographic analysis to determine the presence of ASR in four representative 6- inch concrete cores from Battery Farnsworth. Three samples were obtained from Gun Emplacement No. 1. The fourth sample was obtained from the surface of the protective concrete apron. A number of analytical tests – including scanning electron and X- ray microscopy, and petrographic microscopic observations – were performed. The conclusion of the researchers was as follows:

> The concrete has undergone a severe deleterious alkali silica reaction between the coarse aggregate and the cement paste, resulting in abundant cracks. The lack of entrained air also suggests that the concrete is not durable for an environment with freeze- thaw cycles, which may have contributed to additional cracking. The thick crust of calcium carbonate on the exterior portions of the concrete indicates that substantial leaching of calcium hydroxide in the cement paste has occurred.[2]

These findings support and corroborate data obtained through field investigation and observation of the existing condition of the Battery Farnsworth structures, as well as laboratory testing to determine the nature and extent of the physical processes affecting the structures. The findings of the materials testing and analysis program at the University of New Hampshire are documented in a report entitled "Condition Assessment: Battery Elon Farnsworth and Associated Structures," by David L. Gress, PhD, P.E., completed in December 2004.

The endemic presence of ASR in the late 19th- century structures has been conclusively demonstrated by the program of materials testing and analysis. In addition to explaining the extent and severity of the existing structural damage, testing has confirmed continuing ASR expansion potential, particularly in areas exposed to salt spray and fog.[3] Because these findings are a critical predictor of future structural failure, they are being independently reviewed by Construction Technology Laboratories .

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[2] K. Peterson, T. Van Dam, and L. Sutter, "Examination of Historic Cores from an Historic Fort in New Hampshire" (Department of Civil & Environmental Engineering, Michigan Technological University, Houghton, MI; March, 2004), p. 5.

[3] David L. Gress, PhD, "Condition Assessment: Battery Elon Farnsworth and Associated Structures, Fort Point, New Castle, New Hampshire" (University of New Hampshire, December 2004), p. 17.

Options for mitigating ASR in existing concrete structures are limited even in contemporary structures such as pavements and bridges. They are also substantially dependent on controlling other environmental factors such as moisture and freeze- thaw action. In addition to the direct deleterious effects of ASR, there are a number of other mechanisms of deterioration that affect all of the Fort Point structures to varying degrees. Environmental causes are one of the most prevalent, resulting from the presence of water in all forms. High moisture levels have been a well- documented problem in most of the buildings since construction was completed. Moisture problems affecting the structures result from groundwater infiltration through the building envelope, condensation, and freeze- thaw cycles, as well as salt- laden atmospheric moisture. Both the presence of moisture and atmospheric conditions high in soluble alkalis exacerbate ASR. Freeze- thaw effects worsen existing defects by reducing structural viability in areas already impacted by ASR, and by establishing new routes for water penetration.

Construction defects are prevalent, particularly in Battery Farnsworth and the 1901 Mining Casemate. Hand mixing and placement of concrete generally led to poor compaction and consolidation of concrete pours, resulting in de- bonding of cold joints. The presence of voids in the wall masses and fill (some caused by poor construction practices, some from deterioration of the concrete) provide additional routes for water infiltration.

Existing Conditions Summary

Initial failure of the predominant building materials began shortly after the completion of construction due to the action of ASR. The deterioration processes caused by ASR are inherently present in the properties of the principal construction materials. ASR cannot be successfully mitigated through known treatment methods, although there are materials and techniques that can slow the rate of deterioration associated with ASR. Existing structural problems resulting from ASR have created conditions that exacerbate and accelerate concrete deterioration through other mechanisms such as moisture penetration and freeze- thaw cycles.

Nondestructive testing has identified construction anomalies such as large internal voids in masonry masses that may be representative of more widespread conditions, and potentially pose a significant threat to structural integrity of features.

Large- scale structural movement in Gun Emplacement No. 1 and portions of Gun Emplacement No. 2 have resulted in the threat of major structural failure of key building components. With the exception of the noted areas of the two gun emplacements, the remaining structures have the potential to be stabilized/preserved without significant additional loss of building fabric or architectural integrity.

General Treatment Recommendations

Mitigating Alkali Silica Reaction (ASR)

Techniques that have been used to mitigate the effects of ASR in existing concrete structures include:

- Providing adequate or improved drainage (to minimize availability of moisture).
- Applying claddings or coatings to further limit moisture ingress.
- Treating existing cracks to minimize future expansion and direct moisture intrusion.
- Minimizing exposure to salts that will increase alkali content within the structure.
- Restraining or confining expansion of structural elements.
- Chemically suppressing ASR using lithium compounds.[4]

Some form of any or all of these treatments would be feasible and effective for a program of preservation or stabilization for most types of structure. However, the constellation of inherent structural and material defects, as well as the difficult site conditions and the unusual building geometry present in Battery Farnsworth, have resulted in conditions of extreme structural deterioration and failure that limit the effectiveness of conventional treatment approaches.

Providing Adequate or Improved Drainage

The southeast (front) face of Battery Farnsworth is covered by a protective concrete apron, and mass earth and concrete fill. There is nothing that could be interpreted as a "foundation wall" against which to excavate and install a perimeter drainage system. Where the mass of the fill below the protective concrete apron has been tested, there is evidence of extensive voids. s'MASH (impulse response) testing by the UNH Civil Engineering Laboratories in the Shot Room of Battery Farnsworth, Gun Emplacement No. 1, indicated that there was "extensive voiding" and that "most of the panel is heavily voided."[5]

Applying Claddings or Coatings to Further Limit Moisture Ingress

Installation of an EPDM or liquid applied membrane "roof" system has been proposed for the horizontal surfaces of Battery Farnsworth. Because the concrete mass, void spaces, and earth fill already contain a high moisture level, and with continuing infiltration of groundwater, a roof membrane would have little effect on intrusion of moisture from other sources. This option was discussed during on- site consultation with Dr. David Gress of the UNH Civil Engineering Laboratories, and Steve Stokowski of Stone Products Consultants, Ashland, MA. Based on the

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[4] Kevin J. Folliard, Michael D.A. Thomas, and Kimberly E. Kurtis, "Guidelines for the Use of Lithium to Mitigate or Prevent Alkali- Silica Reaction (ASR)" (U.S. Department of Transportation Federal Highway Administration, Publication No. FHWA- RD- 03- 047, June 2003), Section 2.4.2.

[5] Gress, p. 8.

fact that heat accelerates the ASR process in concrete, their judgment was that even a light-colored roof membrane could actually worsen the ASR reaction within the concrete mass.

Treating Existing Cracks to Minimize Future Expansion

The magnitude of the water infiltration from all sources is such that localized grouting and patching of large- scale cracks would offer relatively little relief from moisture intrusion from local and superficial cracking. In the presence of active ASR, traditional grout repairs and masonry patching can be expected to fail due to continued expansion of the substrate. Fresh cementitious materials may also exacerbate ASR by providing fresh alkalis. There may be some limited value in controlling water infiltration through the extremely large open cracks in the horizontal surfaces of the gun emplacement Loading Platforms, by the use of membrane roofing applied directly over the area of the cracks.

Minimize Exposure to Salts That Will Increase Alkali Content Within The Structure

The UNH Civil Engineering Laboratories tested concrete test samples from three locations, along with a sample of the aggregate for available soluble alkali. The testing demonstrated that alkali content is a function of exposure to the salt spray and fog in the marine environment. Available soluble alkali is one of the conditions that are required for propagation of ASR. The fact that concrete deterioration was found to be highest in areas most exposed to the weather is consistent with this finding.[6]

Restraining or Confining Expansion of Structural Elements

The most dramatic structural movement is evident at the Loading Platform of Gun Emplacement No.1, and in the outward tipping of the Guard Room wall below. (The same is happening to a lesser degree in a similar location and pattern on Gun Emplacement No. 2.) Based on the finding that the present expansive movement of the concrete will continue, especially where aggravated by exposure to the marine atmosphere, it is inevitable that a catastrophic structural failure of the Guard Room wall of Gun Emplacement No. 1 will occur at some point without major structural intervention.[7]

Means for preventing catastrophic structural failure are relatively limited. Reversible stabilization measures include a combination of internal shoring using wood cribbing and/or steel shoring and partially burying the outward- tilting wall segment of Gun Emplacement No. 1. This option, while 100% reversible, would create a significant visual impact to the site. More aggressive means of structural stabilization have been proposed using steel cables and plates to “tie” the outer wall of Gun Emplacement No. 1 together to keep the wall from overturning. This would be combined with making relieving cuts through the Loading Platform slab where the outward motion of the Loading Platform is hinging and binding at the junction of the outer wall and slab.

[6] Gress, p. 14.
[7] Gress, p. 21.

Chemically Suppressing ASR Using Lithium Compounds

The July 2003 publication “Guidelines for the Use of Lithium to Mitigate of Prevent Alkali-Silica Reaction (ASR),” issued by the U.S. Department of Transportation, Federal Highway Administration, states that

> Although the parameters that affect the efficiency of lithium- based compounds as chemical admixtures for controlling expansion due to ASR in new concrete have been established by laboratory studies and confirmed by field evaluations, the efficacy of the products in terms of treating existing ASR- affected concrete have not.[8]

Field treatment of ASR in existing concrete structures is generally focused on increasing service life of engineered structures with generally consistent material and structural properties. A major problem in using lithium compounds is the difficulty in achieving complete penetration of the concrete, which is required for suppression of ASR effects. This is known to be a significant problem in treating pavement slabs, bridge decks, and similar structures with relatively small sectional depths. There is no known precedent for treating a structure in which concrete has been placed in depths greater than 13 feet.

The long- term effect and continued action of ASR in Battery Farnsworth is responsible for the extreme structural displacement of the Loading Platform and outer walls that poses the significant threat of structural failure. None of the other causes of deterioration present, including freeze- thaw damage and defects in construction resulting from the method of placing the concrete, could have resulted in similar large- scale structural movement. Corrosion of embedded iron reinforcing, which is a frequent cause of large- scale structural failure in concrete structures, is not an issue at Battery Farnsworth. This is because metal reinforcing was not used, except as a superficial (and largely nonstructural) element in the lower surfaces of slabs. Similarly, there is no evidence of structural settlement resulting from inadequate bearing. The battery is, in fact, largely constructed on bedrock, with large quantities of ledge having been removed to create the site.

While other structures on the site do not suffer from ASR as badly as Battery Farnsworth does, they share some of the same problematic issues with regard to specifying treatments. This is especially true of the 1901 and 1920 Mining Casemates, The ultimate fate of the 1943 Observation Station literally rests on that of Battery Farnsworth, on which it was built. The 1814 Walbach Tower ruin, and the 1921 Power Plant, are the only structures on the Fort Point UNH site for which standard stabilization or preservation treatments are generally applicable.

[8] Folliard et al., Section 5.3.

Structure- Specific Treatment Recommendations

Walbach Tower

Walbach Tower is a ruin, or fragmentary structure in an advanced state of deterioration. Historical photographs from the late 19th century and documentary sources indicate that the structure has been effectively a ruin for more than 100 years. The above- grade masonry remains are in unstable condition. The mortar bonding the brick and stone courses and wythes is failing, causing the extant wall areas to unravel as the masonry units at the edges fall off or become dislodged, which exposes the units behind them to the same fate. Water penetrates at all faces of the walls, as well as directly from above. This uncontrolled, omni- directional moisture infiltration is accelerating the deterioration of the wall structure.

The tower walls are situated partially within the rock outcropping. This, in combination with the infill of the above- grade casemates, results in differential drainage conditions that further encourage moisture movement through the walls, draining from the filled/buried side of wall to the other side – i.e., the interior of the powder magazine and the exterior wall of the upper casemates. There is ample evidence of moisture infiltration in these areas: water flowing through walls, which can lead to differential settlement; deterioration of adjacent materials (rusting iron anchors or rotting window lintels); washing out of internal bonding and mortar; and other structural problems. Excessive moisture within the masonry creates conditions for the expansive crystallization action of soluble salts, as well as freeze- and- thaw, expansion- and- contraction action in a marine environment The brick of the exterior is porous and worn, with mortar deterioration. The bricks and mortar of the interior vault are also deteriorating, with numerous cracks through both bricks and mortar and open joints. The west side of the vault is damp, and there is thick biological growth. Unchecked vegetation growth on the exterior has contributed to destabilizing the walls through the levering action of root systems, and trapping moisture in proximity to the walls.

Primary requirements for stabilization of Walbach Tower include:

- control of vegetation and surface drainage, plus installation of a ballasted geotextile mat to prevent regrowth of vegetation and channel water away from the structure;
- repointing of masonry with an appropriate high- lime soft mortar, and selective reinstatement of fallen building masonry units to insure bonding continuity and structural stability in the extant masonry features;
- installation of masonry parging and coping at areas of exposed interior walls cores and vulnerable horizontal surfaces; and
- fabrication and installation of a secure metal gate within the vaulted opening to prevent unauthorized access to the powder magazine. The gate should be constructed in an open bar or grid system to provide ventilation to the powder magazine interior.

Completed stabilization work will require monitoring and periodic maintenance.

Battery Farnsworth

Battery Farnsworth is essentially a single, massive, unreinforced, earth- sheltered concrete structure. Its structural properties and behavior are dependent on the qualities of its major constituent material in relation to the environment. Gun Emplacement No. 1 at the southwest end of the structure has experienced major structural movement

Battery Farnsworth was built in 1897- 1898 as part of the nationwide system of concrete coastal defenses known as the Endicott System (1886- 1905). Battery Farnsworth consists of Gun Emplacement No. 1 and Gun Emplacement No. 2 and their associated components. The two are in reality a continuous structure built at the same time, and concurrently with the construction of the 1901 Mining Casemate within the northeastern flank of Gun Emplacement No. 2. Battery Farnsworth was designed and built for one purpose – to support, operate, and protect the two 8- inch “disappearing” guns of the harbor defense battery with maximum efficiency. One of the most distinctive aspects of Endicott- era batteries was the way in which they were concealed and protected by massive amounts of earth, landscaped to resemble natural hillsides. The Farnsworth battery also exhibits the transitional use of concrete as a principle construction material, replacing the stone and brick of earlier fortifications. It was one of the first large- scale concrete structures, in New Hampshire, containing about 8,000 cubic yards of hand- placed Rosendale cement concrete, along with significant quantities of Portland cement which was, at that time, a relatively new and unproven construction material.

Farnsworth served as a battery for less than 10 years and was virtually abandoned within 20 years of its construction. Apart from the 1943 Observation Station built on the Loading Platform of Gun Emplacement No. 1, the form of Battery Farnsworth remains much as it was built in 1897- 1898, as a largely unmodified example of the Endicott Period of coastal defense fortifications. Battery Farnsworth is also significant as an integral part of the history of Fort Constitution and the defense of Portsmouth Harbor from the period 1808 through the Second World War.

As documented in Part I of the HSR, one of the primary reasons that Battery Farnsworth experienced relatively little alteration was due to structural and functional flaws that, in spite of repeated repair attempts, contributed to a number of well- documented maintenance problems that hastened its obsolescence. Largely abandoned after 1945, the installation has been neglected for 60 years. During that time, the effects of weather, unchecked vegetation growth, and a constellation of inherent structural and material conditions have resulted in conditions of extreme structural deterioration and potential failure that do not lend themselves to conventional stabilization, preservation, or rehabilitation treatment approaches.

The semicircular exterior of Gun Emplacement No. 1 – consisting of the slab of the Loading Platform and the exterior wall of the battery, and the Guard and Shot Rooms below it – is severely deflected outward. The platform slab is restrained on the north, south, and east directions by the rest of the massive structure, and so has moved westward in an outward radial direction. There is secondary movement southward, resulting in the southwest displacement of the slab/ceiling of the three semicircular rooms. The back wall of the three rooms has remained in place, along with the stub walls that are part of it. The exact amount and direction of the Loading Platform slab movement away from the back wall and stub walls can be seen in the ceiling of the three rooms that retain indicators of the slab's original placement, including the upper part of the stub walls.

There is 2 ½ - inch lateral displacement in the ceiling slab at the northeast end of the Battery Room, but no forward (radial) movement. The rear stub wall at the Battery Room is shifted 6 inches laterally. At the opposite end (the southwest end of the Battery Room), there is no deflection because of the weight of the Observation Station above bearing down. The forward displacement increases along the length of the Guard Room and Shot Room to the maximum point of displacement near the center – the south rear stub wall of the Guard Room – where the slab has moved 14 inches away from its original position on the back wall.

The outward movement of the Loading Platform slab has pushed the segments of the exterior wall below it forward; it has also rotated the middle two segments forward at their top edges. The exterior wall segments at the northeast and southwest ends (the outside walls of the Battery Room and Shot Room, respectively) remain plumb; they are not rotated forward like the middle two segments are. The southwest end of the northeast segment is displaced 5 inches forward, and the northeast end of the southwest segment is displaced 4 inches forward. At the point of maximum slab displacement, the exterior wall segment across from this point (the wall outside of the Guard and Shot Rooms) is 14 inches horizontal from plumb. This section has also moved forward 2 inches. There is a 3- inch opening between the top edge of the rotated wall and the slab above.

There are two large cracks through the slab thickness where the portion of the slab has detached from the rest of the structure and moved forward. These occur radially from the semicircular steps out to the exterior edge. One, near the northeast end of the slab, is 4 ½ inches wide and traverses the ceiling of the Battery Room. The other, near the southwest end of the slab, crosses the Shot Room ceiling in front of the Observation Station. The movement of the slab, and the resulting structural displacement, is largely within the area circumscribed by these cracks, the semicircular steps, and the exterior edge of this part of the structure.

On the top surface of the Loading Platform, there are several large cracks in addition to the ones described previously. One is along the top semicircular step, one is radially through the middle, and a third begins close to the middle crack and moves laterally to the northeast corner of the exterior semicircular wall.

Gun Emplacement No. 1 is in substantially worse condition structurally than Gun Emplacement No. 2, which shows a similar but less pronounced pattern of structural movement. The overturning movement of the curved wall is a result of the expansion of the roof slab, which has caused a hinging effect in the top rear corner of the wall slab. At both gun emplacements, the primary treatment recommendation to prolong the life of the structures is to make a saw cut to relieve the lateral force from the expansion of the roof slab at the hinge point in the upper wall edge. At Gun Emplacement No. 1, cribbing and shoring should be installed at the exterior wall face prior to making the relieving cut in the curved wall.

The installation of cribbing and shoring at Gun Emplacement No. 1 would substantially reduce the threat of structural failure. It is, however, a stabilization measure with an anticipated lifespan of 15- 20 years, rather than a long- term preservation treatment. Restoration of Gun Emplacement No. 1 – by jacking the curved wall segments into plumb, and pinning them to the concrete floor slab with stainless steel rods and epoxy grout – is technically feasible, but it would be extremely challenging technically and prohibitively expensive. It would also be of doubtful value in the long- term preservation of the structure, since the expansion of the Loading Platform slab is expected to continue.

Another means of stabilization proposed by the University of New Hampshire is a system of steel plates and cables as shown in Figure 1, designed to restrain the outward movement of the wall at Gun Emplacement No. 1. A more detailed review by a structural engineer would possibly result in the addition of more vertical bracing and/or shoring, but this is a feasible means of providing a significant level of protection against catastrophic structural failure. This is a moderately reversible treatment, and will have minimal visual impact on the structure as proposed. As with other stabilization measure, the effective life span of this treatment would be in the range of 15- 20 years.

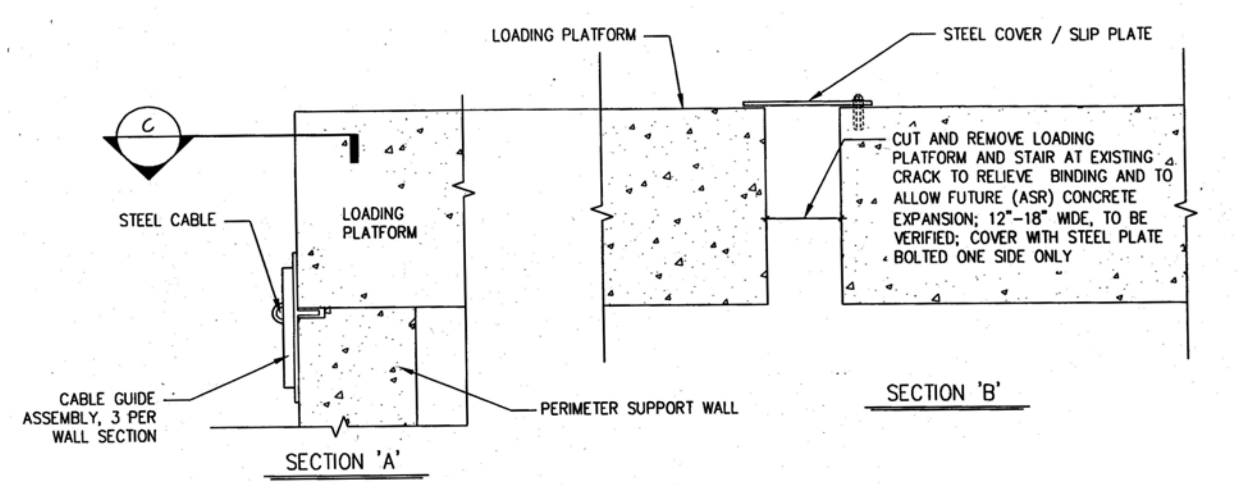


Figure 1. Detail of conceptual stabilization recommendations including relieving cut in loading platform slab and use of steel cable and plate to restrain outward movement of wall.

Figure 2. Conceptual Loading Platform stabilization plan.

With the exception of the stabilization/preservation alternatives detailed above, the realm of potential treatments for Battery Farnsworth is severely constrained by the lack of presently available means of permanently mitigating the ASR reaction. Also, all stabilization treatments will require ongoing periodic inspections and maintenance.

1901 Mining Casemate

The structure consists of a single 16- foot- square room (or casemate) buried in the northeast flank of Battery Farnsworth, Gun Emplacement No. 2. This room housed the apparatus used to send detonation signals to the harbor mines through electrical cables. The cables exited the casemate through a hatchway in the floor that led to the Cable Gallery, a long concrete- lined tunnel that runs at a slope to the low- water level of the harbor. A single ventilation shaft in the vaulted ceiling is the sole opening in the casemate aside from the entrance portal. The casemate is accessed at grade through a portal in the earth berm at the end of Gun Emplacement No. 2. Flanking walls retain the earth berm at both sides of the opening. The hallway is recessed near the entrance to accommodate heavy wood double doors. The 38- foot- long corridor from the entry portal to the mining casemate takes a 90- degree turn at the opening to the casemate to muffle blast effects. There is approximately 13 feet of fill above the vaulted ceiling of the casemate, which lies directly below the concrete apron on the harbor side of Battery Farnsworth.

As is typical of Battery Farnsworth, the 1901 Mining Casemate is constructed of unreinforced Rosendale cement concrete, hand placed in clearly visible lifts, with little compaction. This method of construction resulted in the formation of cold joints at irregular intervals of 12 to 24 inches for the full height of the corridor walls, and to the top of the arched ceiling of the casemate. The poor bond between the lifts has provided numerous routes for water intrusion. Since the entire structure is buried in earth and poorly consolidated concrete fill, water intrusion takes place throughout the entire structural envelope. The problem is exacerbated by the lack of natural ventilation in the structure, and the absence of any functional drainage system.

Two concrete core samples were taken from the interior of the 1901 Mining Casemate for testing by the University of New Hampshire Civil Engineering Laboratory. Sample no. 1- 1 was taken from the interior face of the north wall of the casemate; sample no. 1- 2 was taken from the floor. The samples were evaluated in the University of New Hampshire Civil Engineering Laboratories for their physical and chemical properties. A polished section of the wall sample (sample no. 1- 1) appears to have a skim coat of mortar on its outer surface, whereas the floor sample (sample no. 2- 1) does not. The concrete was found to be very porous due lack of compaction during construction, and highly carbonated, as shown by the brownish color paste fraction. Massive cracking was visible within the aggregate particles, along with deposits of white gel characteristic of ASR.[9] Visual observation of the interior of the core holes revealed consistent cracking of the concrete parallel to the wall face. The battered flanking walls at the entry portal to the mining casemate exhibit significant freeze- thaw failure, particularly of the coping at the upper surfaces. Map cracking of the type consistent with expansion due to ASR is also present.

Overall, the condition of the 1901 Mining Casemate is deteriorated but structurally stable. As an earth- sheltered building, with massive structural redundancy resulting from the thick wall and corridor roof slab mass, and the inherent stability of the vaulted arch roof system, there is no probability of structural failure of any major component. Although the concrete from which the building is constructed has been demonstrated to have poor physical cohesiveness, based on porosity and internal cracking, the overall mass of the structure retains significant integrity. There is no sign of any large- scale structural movement in the building as a whole. ASR is indeed present in the concrete; however, the expansive effects within the concrete mass appear to be constrained by the geometry of the building envelope and the retaining fill. In addition, the building is significantly more protected from the effects of the marine environment than the more exposed structures of Battery Farnsworth. The limited area of the building exposed to the weather at the entry portal continues to suffer surface loss and delamination resulting from freeze- thaw damage and other deleterious processes at work in the concrete. This damage is largely superficial and does not indicate a potential for structural failure. As a result, there are no measures required to stabilize the mining casemate from a purely structural standpoint.

[9] Gress, p. 12.

While large- scale structural failure is not an issue, the structure is both unusable for any foreseeable contemporary purpose, and is in many respects a hazard. Although the site is not accessible to the public, and public use is not considered an option, there are potential liability issues associated with unauthorized access to the site by trespassers, or even by legitimate researchers. The floor opening in the casemate to the cable gallery should be secured with a barrier to prevent accidental falls. Also, there is a minor possibility that surface sections of the masonry lintel and flank wall copings could delaminate and drop. Installation of a lockable, covered gate is recommended at the entry portal, to prevent access from above as well as through the doorway.

Issues impacting any potential use of the structure, other than passive preservation as a structural artifact, are rooted in the same problems and constraints that limited its functionality from the time the battery was constructed. Historical records document that water intrusion has been constant throughout the history of the building. The siting of the building, and the defects in construction resulting from the noncontinuous method of placing the concrete, make it both technically and feasibly impossible to seal the mining casemate against continued water infiltration. The restricted size and interior layout of the building, lack of openings, and absence of any services are fundamental limitations on reuse, without any apparent offsetting benefits or advantages.

1920 Mining Casemate

The 1920 Mining Casemate consists of a cavity- walled brick structure, built within a 2- foot-thick reinforced concrete wall. The interior building houses four main rooms: the Storage Battery Room, Engine Room, Observation Room, and Dormitory. A 2- foot- wide interstitial space separates the inner and outer structures on three sides.

The 1920 Mining Casemate is structurally stable, in that there are no significant signs of structural movement, cracking, or failure in the enclosing wall or roof system(s). The structure does not exhibit the advanced effects of (or potential for) ASR that has dramatically compromised the physical integrity of the earlier Battery Farnsworth installations constructed with Rosendale cement. However, the building does suffer from continuous, unchecked water infiltration. As an earth- sheltered structure, water enters the building(s) through all components of the building envelope in a manner similar to the 1901 Mining Casemate. The Operating Room, Dormitory Room, and toilet room flood with up to 2 feet of water after periods of rain. Lack of any functioning drainage or ventilation system ensures that standing water remains in the structure unless mechanical pumping is used to remove it. The high levels of moisture prevalent at all times within the structure resulted in complete failure of the wood floor system (probably within a few years of the final abandonment of the mining casemate in 1945). Interior finish surfaces remain damp at all times, and all ferrous metal components of the structure are subjected to continuing corrosion. There are stalactites hanging from the concrete ceiling in the interstitial space, and pronounced efflorescence in the tile ceiling and brick walls of the inner structure. Spalling of concrete on the inside face of the outer roof slab is further evidence of moisture intrusion, particularly at control joints in the concrete. This suggests the potential for corrosion of embedded reinforcing steel, although the masonry as a whole appears to have sufficient mass to constrain and/or withstand large- scale oxide jacking for the foreseeable future. Because the bulk of the building is earth- sheltered, freeze- thaw damage is not a principal mechanism of concrete deterioration.

The structure has the potential to continue in its existing condition for an indefinite, although not an unlimited, period without additional intervention. There is no practical means of absolutely preventing continued infiltration of water into the structure. Removal of the earth fill encasing the outer envelope to apply waterproofing to the building shell (approximately 2,500 square feet of earth- sheltered wall and roof surface), and install a subsurface drainage system, would require removal of more than 3,000 cubic yards of fill. This is further complicated by the fact that the condition of the outer roof slab should be considered unsuitable for loading with earth- moving equipment, due to the potentially compromised condition of the concrete and embedded reinforcing in the roof slab. Even a large- scale intervention of this type could be expected to result in only a reduction of the level of standing water, rather than complete remediation of the interior dampness problem. The saturated condition of the masonry envelope, and potential for continuing rising dampness through the floor of the casemate, in combination with the lack of building ventilation, virtually guarantee persistent high interior moisture levels.

One alternative for reducing the level of standing water in the 1920 Mining Casemate in installation of a sump pump to evacuate water from the building. While this is a reasonably low-cost option for eliminating standing water, it would require periodic maintenance and inspection, and do little to solve the main problems of high interior humidity and saturation of the building envelope. Similarly, introduction of forced mechanical ventilation into the interior spaces would serve only to reduce the problem, without removing the causes of corrosion of ferrous metal elements that pose the greatest source of damage to the building materials.

Stabilization to prevent structural failure is not mandated by any existing condition of structural movement, cracking, or failure. Any foreseeable worsening of the structural condition of the 1920 Mining Casemate to a point requiring structural intervention falls well outside the 10- 15 year lifespan of most structural- stabilization treatment programs. As discussed previously, the measures that would be required to substantially mitigate the continued infiltration of water into the interior of the structure go well beyond the commonly accepted understanding of "stabilization," due to the scale of the required intervention; they would fall into the category of "rehabilitation." Partial measures such as the installation of a geotextile "ground roof" on the earth berm above have a minimal probability of success, due to the movement of water through the earth fill on all sides of the building envelope. Internal solutions such as pumping standing water out of the building, and introducing forced mechanical ventilation, also have limited potential for either drying out the building envelope or substantially reducing the overall humidity levels within the structure. While the existing condition within the building cannot be described as being at equilibrium due to the continued conditions for corrosion of embedded ferrous reinforcement, the structure is at least protected from the worst effects of freeze- thaw damage of the outer concrete envelope by the earth fill. The wooden structural components of the interior, along with most interior fixtures and finishes, have already been irretrievably lost to the effects of moisture- induced decay. Therefore, there are no remaining features that can be effectively protected by conventional stabilization strategies. For this reason, after analysis of the existing conditions, a decision not to undertake stabilization measures can be supported as distinct from a policy of "benign neglect."

Should a decision to pursue the rehabilitation of the structure for a compatible reuse be reached, measures could be taken to attempt mitigation of water infiltration through the building envelope. These measures would include the means discussed previously, in combination with an internal dewatering and mechanical ventilation system, which would in any circumstance be required for occupation and use of the structure. In the absence of any active means to control water infiltration, no estimate can be given as to when failure of any key structural component could be expected to occur due to corrosion of embedded reinforcing or loss of integrity in the concrete envelope of the outer building shell. The lack of structural movement, cracking, or apparent deformation strongly suggests that the likelihood of such failures is extremely remote in the 10- 15 year period, which is the outer limit of typical stabilization programs.

Rehabilitation acknowledges the need to alter or add to a historic property to meet continuing or changing uses while retaining the property's historic character. The Secretary of Interior's *Standards for Treatment of Historic Properties* defines rehabilitation as "the act or process of making possible a compatible use for a property through repair, alterations, and additions while preserving those portions or features which convey its historical, cultural, or architectural values."[10] As stated in the definition, the treatment "rehabilitation" assumes that at least some repair or alteration of the historic building will be needed in order to provide for an efficient contemporary use; however, these repairs and alterations must not damage or destroy materials, features, or finishes that are important in defining the building's historic character.

Potential for rehabilitation of the 1920 Mining Casemate is constrained by the limitations of the site, the nature of the construction materials, and the size and layout of interior spaces, as well as the significant problems of internal environment and fabric condition. Minimum requirements for returning the structure to a usable condition are: controlling water intrusion; introducing building services (electric, water, HVAC); and replacing missing and damaged features such as the floor system. Rehabilitation costs cannot be reliably estimated without a building- use program and a detailed engineering assessment of the condition of the structural envelope. However, at a bare minimum, it is likely that measures to combat water intrusion could exceed $200,000, based on the amount of earth fill and the logistics of excavating the entire building envelope.

Restoration as a treatment to depict the structure at a particular period of time in its history, while removing evidence of other periods for interpretive purposes, is not considered an option due to the lack of any programmatic imperative to interpret the site at a specific period. It is, however, at least a theoretical possibility, contingent on a reuse scenario in which the World War II bombproof façade could be removed to expose the original 1920 wall face, to re-establish exterior window and doorway openings. This treatment option is subject to the use and cost constraints discussed under rehabilitation.

[10] Kay D. Weeks and Anne E. Grimmer, *The Secretary of the Interior's Standards for the Treatment of Historic Properties, with Guidelines for Preserving, Rehabilitating, and Reconstructing Historic Buildings* (U.S. Department of the Interior, National Park Service, Cultural Resource Stewardship and Partnerships, Heritage Preservation Services, Washington, D.C., 1995), p. 61.

1921 Power Plant

The Power Plant is a single- story rectangular structure built of reinforced Portland cement. The building measures 22 feet by 16 feet and is located directly behind and tight against the northwest wall of Battery Farnsworth. More than half of the earthen berm on the right side, behind the central traverse of Battery Farnsworth, was removed to make room for the new structure. The knee wall of the battery was retained and the plant constructed within its enclosure. The floor plan of the building consists of two rooms, an Engine Room and a Radiator Room. The Engine Room, the larger of the two, is located in the northeast end of the building.

The building is in the best condition by far of any of the extant structures at Fort Point. Its relatively good state of preservation is due to several factors. First, it is situated by design in the shelter of Battery Farnsworth, and for that reason escapes many of the environmental effects of exposure to the marine atmosphere. Second, it is constructed of reinforced Portland cement concrete, and is not highly subject to the destructive effects of ASR that have caused extensive damage to the earlier Fort Point structures. Finally, the building is freestanding and well ventilated, and therefore not affected by the water- intrusion problems that have plagued many of the other structures. In spite of lack of maintenance, and exposure to the elements associated with the loss of doors and windows, there are few interior remaining interior features or materials subject to damage. The building is essentially a concrete shell, without other features or services.

The principal area of deterioration in the building envelope is the condition of the exposed surface of the roof slab, which has sustained some surface loss of integrity to freeze- thaw action in the concrete. Sufficient spalling of the top layer of concrete has occurred to support the growth of vegetation.

There is relatively little that needs to be done to the structure to preserve it in a weather- resistant and structurally stable condition. There are no significant areas of structural loss or deterioration that threaten the long- term preservation of the structure in its existing condition. The preferred long- term treatment would be “repair in- kind,” using standard techniques of concrete patching in spalled areas. An interim treatment with a 10- 15 year life span is the installation of a ballasted EPDM roof membrane after removing vegetation and loose or spalled concrete. Secure, ventilated closure panels for window and doorway openings should be fabricated and installed to improve the weatherization of the structure, and secure it from unauthorized entry.

The building has a small footprint, with only approximately 350 sf of interior space. However, there are no known factors that would constrain potential rehabilitation if a suitable adaptive reuse can be identified.

Restoration as a treatment to depict the structure at a particular period of time in its history, while removing evidence of other periods for interpretive purposes, is not considered an option due to the lack of any programmatic imperative to interpret the site at a specific period.

1943 Observation Station

The 1943 Observation Station is a square, two- story, flat- roofed structure composed entirely of reinforced Portland cement concrete. The lower story rests on the Loading Platform of Gun Emplacement No. 1. The upper story extends 14 feet above the concrete parapet of the battery. The floor plan of the station consists of one room at each level, each measuring 12 feet square. The lower- level room served as the plotting room for the minefield fire control. The upper- level room was used as an observation point.

Both the Portland cement and aggregate used in the construction of the 1943 Observation Station are different from the cement and aggregate used in the construction of Battery Farnsworth and the 1901 Mining Casemate, and so lack their extreme susceptibility to the expansive effects of ASR.[11] Likewise, the concrete mixing and placement methods used in construction of the Observation Station generally resulted in better compaction. The Observation Station is in generally good condition, except for moderate areas of spalled concrete on exterior wall surfaces. The spalling typically occurs where the rebar appears to be embedded less than 3 inches below the concrete surface, or where pour lines in the concrete are poorly bonded, creating a route for water penetration. The fascia and soffit of the roof overhang show a similar pattern of minor concrete spalling and exposed rebar.

Concerns have been raised regarding the significant percentage of the weight of the concrete roof slab that is being carried on three steel pipe columns 2- $^{3}/_{8}$ inches in diameter at the north, east, and south corners, where the window opening is continuous. However, there is no evidence of structural movement or cracking that would indicate excessive loading (i.e., cracking or separation of the west corner wall at the level of the window openings).

In spite of the relatively sound condition of the Observation Station itself, the structure bears directly on the Loading Platform and scarp wall of Gun Emplacement No. 1, adjacent to one of the most critical areas of structural failure in Battery Farnsworth. In fact, the construction of the Observation Station, and the superimposition of the added structural load, has arguably played a role in the accelerated deteriorated of Gun Emplacement No. 1. Ultimately the fate of the Observation Station is dependent on that of Battery Farnsworth in general, and Gun Emplacement No. 1 in particular. Ensuring the ultimate preservation of the Observation Station would require a condition in which structural failure of the gun emplacement could be effectively prevented. With that consideration, it is difficult to recommend stabilization measures that treat the Observation Station as a completely independent structure. However, the main threat unrelated to the condition of Gun Emplacement No. 1 is the loss of concrete surfaces due to water infiltration, causing corrosion and oxide jacking of insufficiently covered rebar. This condition is not an imminent threat to the stability of the structure, but is a continuing process of deterioration affecting both historical integrity and long- term condition. Repairs could be made to the spalled areas by concrete patching after cleaning or removal of corroded ferrous metal. Alternatively, the exposed rebar could be treated with a brush- applied penetrating liquid corrosion inhibitor as an interim treatment to retard the corrosion process before it leads to additional spalling of the concrete surface.

[11] Gress, p. 12.

Conclusions

Part I of the HSR makes it clear that the structures at the Fort Point site possess a high degree of significance and architectural integrity. Part II demonstrates that the structures suffer from poor initial construction practices, a hostile environment, and the continuing effects of mechanisms of deterioration arising from the physical properties of the predominant construction materials.

Walbach Tower

Walbach Tower poses a high level of significance and substantial integrity of form as a ruin. Preservation and stabilization of the structure in its present state can be accomplished by:

- re- establishing continuous copings at exposed horizontal masonry wall surfaces;
- repointing extant masonry walls with compatible mortar; and
- installing ballasted geotextile matting to control vegetation growth and erosion.

Battery Farnsworth

Battery Farnsworth Gun Emplacements No. 1 and No. 2 are among the most visually defining features of the site, although they are also the most structurally threatened (particularly in the case of Gun Emplacement No. 1). Structural failure of the curved outer wall section of Gun Emplacement No. 1 is a significant threat. Potential treatment options range from relatively low- impact and reversible means of stabilization, to partial demolition and/or reconstruction of structurally compromised segments of the outer walls supporting the Loading Platforms.

Gun Emplacement No. 1 Treatment Options

- Stabilize with cribbing and shoring (15- 20 year option).
- Reconstruct “in- kind” failing support wall of Gun Emplacement No. 1.
- Partially demolish failing support wall and Gun Emplacement No. 1 Loading Platform slab.
- Install monitoring gauges to monitor structural movement over time.

Gun Emplacement No. 2 Treatment Options

- Stabilize with cribbing and shoring (15- 20 year option).
- Use jacks to bring displaced outer wall into plumb, and secure it to Loading Platform slab.

- Do nothing except install monitoring gauges to allow a comparative analysis between Gun Emplacement Nos. 1 and 2.

Battery Farnsworth General Treatment Options

- Remove vegetation and spalled/damaged concrete and debris.
- Treat damaged concrete surfaces and open cracks with lithium solution.
- Repair open cracks and damaged surfaces with cementitious patching material.
- Install EPDM or liquid applied roofing system on exposed horizontal surfaces.

1901 Mining Casemate

No major treatment is required to stabilize and preserve the structure beyond vegetation management and access control.

1920 Mining Casemate

No major treatment is required to stabilize and preserve the structure beyond vegetation management and access control.

1921 Power Plant

- Fabricate and install ventilated window and doorway closure panels.
- Replace deteriorated built- up tar- and- gravel roof with another tar- and- gravel system.

1943 Observation Station

- Treat exposed reinforcing steel with corrosion inhibiting primer/sealer.
- Fabricate and install ventilated window and doorway closure panels.

Fort Point Site (General)

- Install security fencing and lighting.
- Install ballasted geotextile matting around perimeter of structures to control vegetation growth and erosion.
- Establish annual maintenance and inspection program.

Preservation Maintenance Plan

The preservation and stabilization treatments recommended for the Fort Point structures are intended to stabilize the portions of the buildings subject to impending structural failure, slow the irreversible processes of deterioration inherent in ASR- affected concrete, and address other mechanisms of moisture intrusion and resulting damage where feasible. Through stabilization and preservation treatments, it is possible to bring the structures into a condition in which they can be maintained for the foreseeable future without major loss of architectural integrity. However, the long- term preservation of the site is contingent on developing an effective program of periodic inspections, and routine and cyclic maintenance.

Annual or biannual inspections by a facility maintenance specialist and historical architect or engineer should concentrate on identifying any new condition requiring treatment or structural intervention, and on evaluating the continuing effectiveness of prior treatments. Some preservation treatments, such as patching and grouting cracks in the concrete slabs, will have a significant failure rate over time, as the concrete continues to move in response to the expansive forces of ASR. These types of treatment will require periodic renewal to be effective in reducing water intrusion. Periodic inspections will help in determining maintenance cycles and managing treatment costs by making repairs before larger- scale problems develop.

Routine maintenance activities will consist primarily of vegetation control and maintaining security fences, site lighting, etc. Cyclic maintenance will involve periodic repair of the structures, including repair of cracks, roof systems, and building enclosure panels. Shoring and cribbing will need to be inspected and adjusted periodically, and deteriorated shoring members repaired or replaced.

Annual costs for preservation maintenance are recurring costs not covered in the preservation/ stabilization treatment recommendations. Projected annual figures are as follows:

Annual routine maintenance costs	Vegetation control, minor repairs, maintain security fencing and lighting (personnel, tools, and materials)	$12,000
Annual inspection costs	40 hours x $150/hr	$6,000
2- year cyclic maintenance costs		$25,000
5- year cyclic maintenance costs		$50,000
10- year cyclic maintenance costs		125,000
	Annual preservation maintenance total pro- rated over a 10- year period	$39,700

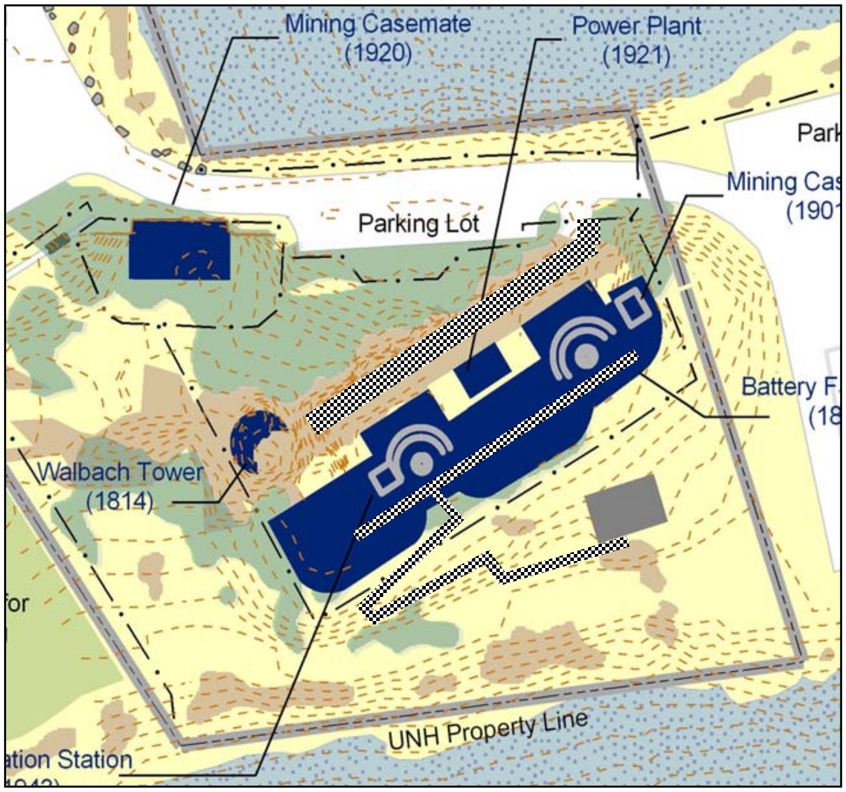


Figure 3. Schematic plan of walkways for visitor access.

SECTION 2.

TREATMENT COST SUMMARY

TREATMENT COST SUMMARY
Fort Point, New Castle, New Hampshire

1901 Mining Casemate

Treatment Type: Preservation Maintenance

Feature Name	Priority	Treatment Description	Quantity	Unit Cost	Total Cost
GENERAL	High	Construct covered opening at the entry portal	1 LS	$500.00	$500.00
GENERAL	High	Construct barricade around casemate floor opening	1 LS	$75.00	$75.00
		Total High Priority Preservation Maintenance Treatment Costs:			**$575.00**

Total Net Preservation Maintenance Treatment Costs: $575.00

Total Net Cost: 1901 Mining Casemate $575.00

TREATMENT COST SUMMARY

Fort Point, New Castle, New Hampshire

Battery Farnsworth - Gun Emplacement #1

Treatment Type: Preservation

Feature Name	Priority	Treatment Description	Quantity	Unit Cost	Total Cost
GENERAL	Medium	Concrete treatment and repairs	1,200 SF	$45.00	$54,000.00
		Total Medium Priority Preservation Treatment Costs:			**$54,000.00**

Total Net Preservation Treatment Costs: $54,000.00

Treatment Type: Restoration

Feature Name	Priority	Treatment Description	Quantity	Unit Cost	Total Cost
GENERAL	Low	Jacking and pinning curved wall sections	2 LS	$50,381.00	$100,762.00
		Total Low Priority Restoration Treatment Costs:			**$100,762.00**

Total Net Restoration Treatment Costs: $100,762.00

Treatment Type: Stabilization

Feature Name	Priority	Treatment Description	Quantity	Unit Cost	Total Cost
GENERAL	Critical	Install raking shores at exterior wall face	8 Ea	$7,500.00	$60,000.00

TREATMENT COST SUMMARY
Fort Point, New Castle, New Hampshire

Battery Farnsworth - Gun Emplacement #1

Treatment Type: Stabilization

Feature Name	Priority	Treatment Description	Quantity	Unit Cost	Total Cost
		Total Critical Priority Stabilization Treatment Costs:			**$60,000.00**
GENERAL	High	Relieve outward movement of gun platform	55 LF	$120.00	$6,600.00
		Total High Priority Stabilization Treatment Costs:			**$6,600.00**

Total Net Stabilization Treatment Costs: $66,600.00

Total Net Cost: Battery Farnsworth - Gun Emplacement #1 $221,362.00

TREATMENT COST SUMMARY

Fort Point, New Castle, New Hampshire

Battery Farnsworth - Gun Emplacement #2

Treatment Type: Preservation

Feature Name	Priority	Treatment Description	Quantity	Unit Cost	Total Cost
GENERAL	Medium	Concrete treatment and repairs	1,000 SF	$45.00	$45,000.00
		Total Medium Priority Preservation Treatment Costs:			**$45,000.00**

Total Net Preservation Treatment Costs: $45,000.00

Treatment Type: Restoration

Feature Name	Priority	Treatment Description	Quantity	Unit Cost	Total Cost
GENERAL	Low	Jacking and pinning curved wall sections	2 Ea	$50,381.00	$100,762.00
		Total Low Priority Restoration Treatment Costs:			**$100,762.00**

Total Net Restoration Treatment Costs: $100,762.00

Treatment Type: Stabilization

Feature Name	Priority	Treatment Description	Quantity	Unit Cost	Total Cost
GENERAL	High	Relieve outward movement of gun platform	55 LF	$120.00	$6,600.00

TREATMENT COST SUMMARY

Fort Point, New Castle, New Hampshire

Battery Farnsworth - Gun Emplacement #2

Treatment Type: Stabilization

Feature Name	Priority	Treatment Description	Quantity	Unit Cost	Total Cost
GENERAL	High	Install raking shores at exterior wall face	8 Ea	$7,500.00	$60,000.00
		Total High Priority Stabilization Treatment Costs:			**$66,600.00**

Total Net Stabilization Treatment Costs: $66,600.00

Total Net Cost: Battery Farnsworth - Gun Emplacement #2 $212,362.00

TREATMENT COST SUMMARY

Fort Point, New Castle, New Hampshire

Landscape

Treatment Type: Preservation Maintenance

Feature Name	Priority	Treatment Description	Quantity	Unit Cost	Total Cost
General	Medium	Install fencing and security lighting	1 LS	$15,000.00	$15,000.00

Total Medium Priority Preservation Maintenance Treatment Costs: $15,000.00

Total Net Preservation Maintenance Treatment Costs: $15,000.00

Treatment Type: Stabilization

Feature Name	Priority	Treatment Description	Quantity	Unit Cost	Total Cost
General	High	Install ballasted geotextile matting	7,500 SY	$5.50	$41,250.00

Total High Priority Stabilization Treatment Costs: $41,250.00

Total Net Stabilization Treatment Costs: $41,250.00

Total Net Cost: Landscape $56,250.00

TREATMENT COST SUMMARY
Fort Point, New Castle, New Hampshire

Observation Station (1943)

Treatment Type: Stabilization

Feature Name	Priority	Treatment Description	Quantity	Unit Cost	Total Cost
GENERAL	Medium	Treat exposed rebar with corrosion inhibitor	50 SF	$23.50	$1,175.00
		Total Medium Priority Stabilization Treatment Costs:			**$1,175.00**

Total Net Stabilization Treatment Costs: $1,175.00

Total Net Cost: Observation Station (1943) **$1,175.00**

TREATMENT COST SUMMARY
Fort Point, New Castle, New Hampshire

Power Plant (1921)

Treatment Type: Stabilization

Feature Name	Priority	Treatment Description	Quantity	Unit Cost	Total Cost
GNERAL	Medium	Fabricate window and door closure panels	86 SF	$18.36	$1,578.96
GNERAL	Medium	Install EPDM membrane roof system	432 SF	$16.38	$7,076.16
		Total Medium Priority Stabilization Treatment Costs:			**$8,655.12**

Total Net Stabilization Treatment Costs: $8,655.12

Total Net Cost: Power Plant (1921) $8,655.12

TREATMENT COST SUMMARY

Fort Point, New Castle, New Hampshire

Walbach Tower

Treatment Type: Stabilization

Feature Name	Priority	Treatment Description	Quantity		Unit Cost	Total Cost
GNERAL	High	Reset copings	350	LF	$45.00	$15,750.00
GNERAL	High	Repoint exterior masonry	800	SF	$45.00	$36,000.00
GNERAL	High	Salvage and stockpile fallen brick and stone	120	Hr	$40.00	$4,800.00
GNERAL	High	Install ballasted geotextile matting	4,500	SY	$5.50	$24,750.00

Total High Priority Stabilization Treatment Costs: $81,300.00

Total Net Stabilization Treatment Costs: $81,300.00

Total Net Cost: Walbach Tower $81,300.00

TREATMENT COST SUMMARY
Fort Point, New Castle, New Hampshire

Total Net Construction Cost:	$581,679.12
General Conditions (15% Net):	$87,251.87
Design Costs (10% Net):	$58,167.91
Construction Contingency (15% Net):	$87,251.87
Total Treatment Cost for all Structures:	$814,350.77

SECTION 3.

TREATMENT RECOMMENDATIONS AND COST ESTIMATES

1901 Mining Casemate

Preservation Maintenance

Priority: High

Construct Covered Opening at the Entry Portal

Construct a framed cover extending from the top of the projected roof slab to the outer edge of the flank walls, using corrugated metal or other durable, low- maintenance surface material on plywood or OSB sheathing. Slope roof surface to drain away from the structure. Provide secure enclosure at the sides and a lockable gated entry. Side enclosure and gate to be constructed of open metal bars or grid to maintain some ventilation to interior.

Quantity	Unit Cost	Treatment Cost
1 LS	$500.00	$500.00
CSI Division 1 – General Requirements		

Construct Barricade around Casemate Floor Opening

Construct a waist- height railing around the floor opening (2 feet 8 inches by 4 feet 2 inches) to the Cable Gallery.

Quantity	Unit Cost	Treatment Cost
1 LS	$75.00	$75.00
CSI Division 1 – General Requirements		

Total Net Treatment Cost: $575.00

Battery Farnsworth – Gun Emplacement No. 1

Preservation

Priority: Medium

Concrete Treatment and Repairs

Remove loose, spalled, and damaged concrete on parapets and horizontal surfaces. Rake cracks and treat with lithium solution. Patch surface cracks with compatible cementitious patching compounds.

Quantity	Unit Cost	Treatment Cost
1200 SF	$45.00	$54,000.00
CSI Division 3 – Concrete		

Battery Farnsworth – Gun Emplacement No. 1

Restoration

Priority: Low

Jacking and Pinning Curved Wall Sections

The curved wall sections affected by the overturning forces generated by expansion of the loading platform slab above them could be jacked back into plumb following execution of the relieving cut, where the overturning wall is hinged on the expanding floor slab above. Each wall section contains approximately 36,288 cf concrete at 1441bs/cf = 18.1 tons. Using hydraulic jacks at the foot of each of the racking shores (RS Means Section 01590- 600- 5500), opposed by jacking points inside the curved corridor to prevent sudden settlement of the wall section, the wall could be re- plumbed, using a grillage of curved steel girders sandwiched on the inside and outside face of the wall, combined with vertical and raking shores to insure that the wall remains intact.

Cost Components:

Concrete core drilling for attachment of grillage	$1,200
Jacks	$2,112
Curved girders	$2,736 @ $2.00/lb
4 raking shores	$30,000
4 additional vertical shores	$924
Misc wood sheeting and shoring	$1,775
Stainless steel rod and epoxy grout to pin plumbed wall to floor slab	$11,634

Total = $50, 381 each wall section

Quantity	Unit Cost	Treatment Cost
2 LS	$50,381.00	$100,762.00
CSI Division 4 – Masonry		

Construction costs based on RS Means 2003 Building Construction Cost Data and January 2005
Structures Manual, Florida Department of Transportation Structures Design Office <http://www.dot.state.fl.us/structures/StructuresManual/ Current Release/FDOTBridgeManua1.htm#DesignGuidelines/SDG_9 .2-CosCEstimatin_Process.htm>

Battery Farnsworth – Gun Emplacement No. 1

Stabilization

Priority: Critical

Install Raking Shores at Exterior Wall Face

Fabricate and install engineered steel raking shores to prevent overturning of the displaced curved wall sections, approximately 3- 4 feet on center, on the exterior of the Guard Room and Shot Room walls. Install concrete anchor blocks to secure the foot of the raking shores. Anchor and grout the vertical shore to the wall surface. Provide raking shores near the top and mid-point of the wall.

Quantity	Unit Cost	Treatment Cost
8 Ea	$7,500.00	$60,000.00
CSI Division 2 - Sitework		

Construction costs based on RS Means 2003 Building Construction Cost Data, unit prices for structural steel sections (based on approximate lineal feet), bolted connection plates, drilling and anchoring vertical shores, equipment rental, excavating ledge, and placing concrete anchor blocks, with allowance for complexity of layout and execution (150% of new construction).

Priority: High

Relieve Outward Movement of Gun Platform

Saw cut the upper edge of the interior face of the curved Battery wall, where the wall and roof slab join. The purpose of the saw cut is to relieve the lateral force from the expansion of the roof slab above, to prevent the overturning of the wall, as the roof slab continues to move as a result of ASR. The relieving cut should be no thicker than necessary to free the hinge point of the upper wall edge. In order to prevent destabilizing the wall, raking shores should be installed prior to cutting the relieving joint.

Quantity	Unit Cost	Treatment Cost
55 LF	$120.00	$6,600.00
CSI Division 4 – Masonry		

Estimate source: RS Means 2003 Repair and Remodeling Cost Data, Section 02200- 760- 0800.

Total Net Treatment Cost: $221,362.00

Battery Farnsworth –
Gun Emplacement No. 2

Preservation

Priority: Medium

Concrete Treatment and Repairs

Remove loose, spalled, and damaged concrete on parapets and horizontal surfaces. Rake cracks and treat with lithium solution. Patch surface cracks with compatible cementitious patching compounds.

Quantity	Unit Cost	Treatment Cost
1,000 SF	$45.00	$45,000.00
CSI Division 3 – Concrete		

Battery Farnsworth –
Gun Emplacement No. 2

Restoration

Priority: Low

Jacking and Pinning Curved Wall Sections

The curved wall sections affected by the overturning forces generated by expansion of the loading platform slab above, could be jacked back into plumb following execution of the relieving cut, where the overturning wall is hinged on the expanding floor slab above. Each wall section contains approximately 36,288 cf concrete at 1441bs/cf = 18.1 tons. Using hydraulic jacks at the foot of each of the racking shores (RS Means Section 01590- 600- 5500), opposed by jacking points inside the curved corridor to prevent sudden settlement of the wall section, the wall could be re- plumbed, using a grillage of curved steel girders sandwiched on the inside and outside face of the wall, combined with vertical and raking shores to insure that the wall remains intact.

Cost components:

Concrete core drilling for attachment of grillage	$1,200
Jacks	$2,112
Curved girders	$2,736 @ $2.00/lb
4 raking shores	$30,000
4 additional vertical shores	$924
Misc wood sheeting and shoring	$1,775
Stainless steel rod and epoxy grout to pin plumbed wall to floor slab	$11,634
Total =	$50, 381 each wall section

Quantity	Unit Cost	Treatment Cost
2 Ea	$50,381.00	$100,762.00
CSI Division 4 – Masonry		

Construction costs based on RS Means 2003 Building Construction Cost Data and January 2005 Structures Manual, Florida Department of Transportation Structures Design Office <http://www.dot.state.fl.us/structures/StructuresManual/ Current Release/FDOTBridge Manual.htm#DesignGuidelines/SDG_9 .2-CosCEstimatin_Process.htm>

Battery Farnsworth –
Gun Emplacement No. 2

Stabilization

Priority: High

Relieve Outward Movement of Gun Platform

Saw cut the upper edge of the interior face of the curved battery wall, where the wall and roof slab join. The purpose of the saw cut is to relieve the lateral force from the expansion of the roof slab above, to prevent the overturning of the wall, as the roof slab continues to move as a result of ASR. The relieving cut should be no thicker than necessary to free the hinge point of the upper wall edge. In order to prevent destabilizing the wall, raking shores should be installed prior to cutting the relieving joint.

Quantity	Unit Cost	Treatment Cost
55 LF	$120.00	$6,600.00
CSI Division 4 – Masonry		

Estimate source: RS Means 2003 Repair and Remodeling Cost Data, Section 02200-760- 0800.

Install Raking Shores at Exterior Wall Face

Fabricate and install engineered steel raking shores to prevent overturning of the displaced curved wall sections, approximately 3- 4 feet on center, on the exterior of the Guard Room and Shot Room walls. Install concrete anchor blocks to secure the foot of the raking shores. Anchor and grout the vertical shore to the wall surface. Provide raking shores near the top and mid - point of the wall.

Quantity	Unit Cost	Treatment Cost
8 Ea	$7,500.00	$60,000.00
CSI Division 2 – Sitework		

Construction costs based on RS Means 2003 Building Construction Cost Data, unit prices for structural steel sections (based on approximate lineal feet), bolted connection plates, drilling and anchoring vertical shores, equipment rental, excavating ledge, and placing concrete anchor blocks, with allowance for complexity of layout and execution (150% of new construction).

Total Net Treatment Cost: $212,362.00

1943 Observation Station

Stabilization

Priority: Medium

Treat Exposed Rebar With Corrosion Inhibitor

Brush- apply water- borne corrosion inhibitor at areas of exposed rebar and embedded ferrous metal on exterior wall and roof surfaces.

Quantity	Unit Cost	Treatment Cost
50 SF	$23.50	$1,175.00
CSI Division 4 – Masonry		

Estimate based on RS Means 2003 Repair and Remodeling Cost Data, 24th annual edition, Section 03930- Concrete Rehabilitation, p.80.
Concrete Corrosion Inhibitors Association. Email: info@corrosioninhibitors.org. Phone: 30 340- 7368. Website: http://www.corrosioninhibitors.org

Total Net Treatment Cost: $1,175.00

1921 Power Plant

Stabilization

Priority: Medium

Fabricate Window and Doorway Closure Panels

Fabricate and install secure ventilated window and door closure panels.

Quantity	Unit Cost	Treatment Cost
86 SF	$18.36	$1,578.96
CSI Division 8 – Doors and Windows		

Sharon C. Park, AIA, *Preservation Brief No. 31: Mothballing Historic Buildings* (Washington, DC: U.S. Department of the Interior, National Park Service, Preservation Assistance Division, 1993) <http://www.cr.nps.gov/hps/tps/briefs/brief31.htm>

Install EPDM Membrane Roof System

Clean existing roof surface to remove vegetation and loose concrete. Apply ballasted single- ply membrane roof system.

Quantity	Unit Cost	Treatment Cost
432 SF	$16.38	$7,076.16
CSI Division 7 – Thermal and Moisture Protection		

Total Net Treatment Cost: $8,655.12

Walbach Tower

Stabilization

Priority: High

Install Ballasted Geotextile Matting

Install ballasted geotextile matting to control vegetation growth, control erosion, and promote drainage away from the structure.

Quantity	Unit Cost	Treatment Cost
4500SY	$5.50	$24,750.00
CSI Division 2 - Sitework		

Estimate source: RS Means 2003, Building Construction Cost Data, Section – 02700.

Salvage and Stockpile Fallen Brick and Stone

Salvage and stockpile fallen brick at grade from both inside and outside the structure; clean, sort, and stockpile for reuse. Salvage and stockpile building stone at grade that is clearly disassociated from the wall. Photographically record the location of major building stones showing evidence of being worked square or for a particular use (i.e., arches, columns, etc) in relationship to the structure prior to salvage, and indelibly number the stone on a nonface surface to a correspond with a numbered key map of the structure layout.

Quantity	Unit Cost	Treatment Cost
120 Hr	$40.00	$4,800.00
CSI Division 2 - Sitework		

Repoint Exterior Masonry

Repoint extant brick and stone masonry using a high- lime mortar compatible in hardness, color, and physical properties with the existing.

Quantity	Unit Cost	Treatment Cost
800 SF	$45.00	$36,000.00
CSI Division 4 - Masonry		

"Preparation and Use of Lime Mortars: An Introduction to the Principles of Using Lime Mortars," Historic Scotland, Edinburgh, Scotland, 1998.

R.C. Mack and J.P. Spewick, *Preservation Brief #2, Repointing Mortar Joints in Historic Brick Buildings* (Washington, DC: U.S. Department of the Interior, National Park Service, 1998.

Reset Copings

Reestablish continuous copings at exposed horizontal masonry wall surfaces using sound salvaged brick, replacement brick to match the existing in color, size, and physical properties, or salvaged stone as required to match adjacent historic work.

Quantity	Unit Cost	Treatment Cost
350 LF	$45.00	$15,750.00
CSI Division 4 - Masonry		

Total Net Treatment Cost: $81,300.00

Landscape

Preservation Maintenance

Priority: Medium

Install Fencing and Security Lighting

Upgrade/repair existing site fencing and install security lighting to minimize unauthorized sit access.

Quantity	Unit Cost	Treatment Cost
1 LS	$15,000.00	$15,000.00
CSI Division 2 – Sitework		

Stabilization

Priority: High

Install Ballasted Geotextile Matting

Install ballasted geotextile matting around structure perimeters to control vegetation growth, control erosion, and promote drainage away from the structures.

Quantity	Unit Cost	Treatment Cost
7500 SY	$5.50	$41,250.00
CSI Division 2 – Sitework		

Estimate source: RS Means 2003, Building Construction Cost Data, Section- 02700.

Total Net Treatment Cost: $56,250.00

SECTION 4.

EXISTING CONDITIONS SURVEY AND ASSESSMENT

Editor's Note:

This section was created by excerpting the text contained in the Access database program created for this project: "Feature Inventory." The order in which the subject structures are treated, and the order in which the features comprising each structure appear, was dictated primarily by the operation of the database. In addition, the authors decided to address Battery Farnsworth's Gun Emplacement No. 2 before Gun Emplacement No. 1, because of the former's greater condition issues. Thus, the order of structures and features may seem disorganized when viewed from a purely narrative perspective. However, since the database is the focus of this section, it was decided to maintain the order generated by the database.

Occasionally the narratives about specific structures and features will be seen to lack certain entries, particularly "Description." This is primarily due to the fact that the "missing" information is already covered in other entries, particularly "Condition."

1901 MINING CASEMATE

Entry Portal

View of entry portal of 1901 Mining Casemate, looking east

Feature Description:

The entry portal wing walls are battered at 9- ½ :12, retaining the earth berm on either side. The left (northeast) wing wall is 32" thick, and the right (southwest) wing wall is 35" thick. The wing walls show form marks of horizontal, vertical- sawn boards 6" wide. As seen throughout the structure, the concrete was placed in irregular lifts of approximately 12" to 24". The exposed top face of the wing walls was finished with an applied concrete surface coat approximately 3" thick. The portal opening is 3'- 6" x 7'- 0" high, and the wing walls extend from the entrance at grade, approximately 9'- 6" into the earth berm. A poured concrete floor slab extends to the outer ends of the wing walls, and continues through the length of the corridor and cable gallery without changes in level. The poured concrete roof is 7'- 6" wide, bearing 24" on each flanking wing wall. This indicates that the thickness of the corridor walls is also 24". The roof slab is 32" thick, with approximately 4'- 0" of the upper surface exposed, before entering the berm. The upper 6" of the front face of the roof slab is battered at approximately 45 degrees. The underside of the roof slab at the corridor opening has a steel angle lintel 5'- 0" long, with a 5" vertical leg and 3" horizontal leg.

Feature Condition

The concrete top surface of the wing walls are delaminating, with losses, from the pour below. Hammer testing for soundness reveled areas of delamination amounting to approximately 50% of the total surface area. There are thick calcium carbonate crust deposits on the interior faces of the wing walls and outer face of the roof slab. Biological growth is present on the interior faces of the wing walls, particularly in conjunction with cracks that transmit moisture and support formation of calcium carbonate crusts. Continuous horizontal cracking is evident at the upper front face of the roof slab, with substantial vegetation growth. The steel lintel and ceiling reinforcing bars are corroded and exhibiting oxide jacking. They are allowing moisture entry into the roof slab and walls. There is a wide crack at the wall ceiling/juncture on both sides of the corridor, although it is particularly pronounced on the northeast side.

Concrete Coping

Description: Hammer testing for soundness reveled areas of delamination amounting to approximately 50% of the total surface area.

Deficiencies: spalling
surface delamination
cracking at dissimilar material interfaces

Fascia of Lintel Above Entrance

Description: MD: minor, except at lowest part
SP: 6" x 24" in center

Deficiencies: cracking at dissimilar material interfaces
spalling
horizontal cracking (typically at cold joints)
spiderweb cracking

Casemate Entry Corridor


View from entry portal, looking down the length of the corridor

Feature Description

The entry corridor is approximately 38' long, and runs northwest to southeast from the entrance portal at grade level into the berm adjacent to Gun Emplacement No. 2. The corridor is 3'- 6" wide x 7"- 0" high, except at the end opposite the mining casemate doorway, where it widens to 4'- 6" to accommodate the swing of the door at the casemate entrance. There is also a shallow alcove 3" deep x 4'- 9" long at both sides of the corridor immediately within the entrance portal. There are two flat steel plates 3" wide spanning the width of the corridor ceiling in the entrance alcove, 8" and 10" in from the front and rear ends of the alcove. Along with the steel lintel, these are the only evidence of concrete reinforcement. The floors, walls, and ceiling are poured concrete, showing form marks of horizontal, rough- sawn lumber 6" wide. The concrete is placed in irregular lifts of 12" to 24" with joint lines clearly marking the pours. The southeast end wall of the corridor has a cypress nailer 2 x 6 (actual) x 45" formed into the wall, 7" below the ceiling line. Half- inch round wooden dowels are drilled into the southwest corridor wall on approximately 32" centers, 3" below the ceiling line, to serve as nailers for mounting electrical conduit. Two bronze, pintle- type hinge fittings measuring 2 x 1½" with 1- ¼ " eyes are let into the concrete wall on the northeast side of the entrance portal, and into the southeast end wall of the corridor at the entrance to the mining casemate, to carry the large cypress doors. The remains of a broken- off hasp or latch fitting are visible on the southwest wall of the entrance portal.

Feature Condition

The pattern of horizontal cracking in the corridor is similar and related to the pattern of cracking in the mining casemate, with the highest crack in the casemate presenting on the northeast corridor wall as a crack 60"- 64" above the floor. The middle crack in the casemate presents on the southwest wall of the corridor approximately 52" above the corridor floor. There is particularly active moisture penetration in the middle of the length of the crack in the southwest wall. Biological growth appears on both walls, as a symptom of damp conditions. Standing water is present in the east end of the corridor.

Casemate and Cable Gallery

Feature Description

The mining casemate is 16' square. The entrance is on the northeast side 2"- 0" in from the northwest wall of the room. The opening is 3'- 5" x 7'- 0". The room is barrel- vaulted along the northwest- southeast axis. The spring of the vault is 2'- 1" above the floor. There is a 4'- 0" alcove on the northeast wall where the wall face continues vertically past the spring line of the vault and intersects the projected line of the ceiling at the highest point of the vault. There is a bevel at the top of the alcove. The bottom of the bevel is 9'- 1" above the floor. A cypress nailer measuring 2 x 6 (actual dimension) is formed into the wall and continues horizontally around the room at 5"to 5- ½" above the floor. On the south wall the nailer is penetrated by two three-quarter- inch galvanized conduits 46" from the west wall. On the same wall, there is a pair of badly corroded galvanized conduits approximately 1- ½" in diameter, 7'- 0" from the west wall and 4'- 6" above the floor. Walls and ceiling are concrete poured in irregular lifts of 12" to 24". Horizontal, rough- sawn, wood form boards were used. Vertical wall forms used 6" boards, and the radius of the barrel vault was formed with 2- 3/4" boards. There is a ventilation shaft 10" in diameter in the southeast end of the ceiling at the high point of the vault. The ventilation shaft is 12'- 10" long. The upper 2'- 0" of the shaft is lined with a cast- iron pipe. The shaft appears to have been formed with a cardboard tube.

The opening for the cable gallery measures 4'- 2" x 2'- 8". It is 4'- 8" from the southeast wall and 5'- 11" from the northeast wall. The opening was formed with a lip to accept a 1- ¼ " thick cover. The pit is approximately 5'- 0" deep, although the actual depth is difficult to determine due to water, debris, and sediment accumulation. The barrel- vaulted tunnel runs from the northwest edge of the pit. The top of the vault is 20" from the finished floor surface. The vault spring line is 3'- 0" from the floor surface. There is a roughly chiseled hole approximately 14" in diameter along the northeast wall. The hole is only a few inches deep. The purpose is unknown.

The extant finish in the mining casemate and throughout the interior appears to be whitewash, based on the characteristic body and matte surface appearance, and the evident application with a thick coarse brush. Another indicator is that the finish is worn but well adhered in all areas, without cracking or peeling.

Feature Condition

There are three horizontal masonry cracks that circle the room at varying heights. The highest one averages 8'- 7" above the floor. It starts in the north corner and continues around all four sides of the casemate. There is a quarter- inch crack 5'- 0" above the floor. It originates in the southeast wall of the corridor and travels around the doorway jamb before angling upward to intersect the pocket for the northwest wall nailer. A similar crack at a similar height appears on the northwest wall, and travels into the southwest wall of the corridor. The smallest crack is 4-6" above the floor, also beginning on the southeast corridor wall. This crack traverses all sides of the chamber, dropping in elevation on the northwest wall. The cracks appear to be associated with the lift lines from the original placement of the concrete.

Moisture is evident throughout the chamber. The remaining cypress nailers are saturated throughout. There is evidence of active moisture penetration through the cracks. There is moisture or standing water on the floor at all areas where the walls intersect the floor. In the south quadrant of the vault near the apex is a crack approximately 24" long, with tan crust and heavy deposition of minerals that conform to the appearance of ASR.

The concrete floor of the chamber is in sound condition, with minimal cracking.

Doors

View of casemate, looking west and showing salvaged doors

Feature Description

There are two cypress doors that came from locations within the 1901 Mining Casemate. Both doors are 3'- 8" wide, and both were originally 7 '- 0" high. One door was cut down to 6'- 5" in length and a plywood panel scabbed onto the front face. The doors are constructed of 4" x ½ " tongue- and- groove boards, applied vertically on the interior face and diagonally on the exterior face. The doors are assembled with clenched cut nails. The pairs of strap hinges no longer exist on either door, but the mortise pockets reveals that they were approximately 26" in length (with pintle), round- nosed, and 2'- 5/8" high. They were secured with 4- ½" diameter bolts.

1943 OBSERVATION STATION (INTERIOR)

Plotting Room

Feature Description

The room is 12'- 0"x12'- 0", with 13" thick reinforced concrete walls. The ceiling height is 10'- 8". The walls of the Observation Station are poured directly on the concrete floor of the loading platform of Gun Emplacement No. 1, with the south and east walls of the Gun Emplacement making up the base of the Observation Station walls to a height of 6'- 8". A small cast- in- place concrete sill was placed at the doorway opening on the west wall of the Plotting Room.

The room has two small wood sash windows on the north wall. The concrete openings for the windows bevel out on the interior. The wood frame is 13"x24" with three fixed lights. They are in- swing casements. The windows are 4'- 3" above the floor. The wood door on the west elevation is 32"x6'- 8" in a wood frame. The door was originally a five- panel, rail and stile door. The door swings out on the right hand side. There is a 3'- 6" x 5'- 7" door to the hoistway on the south wall. The hoistway door is in the south wall of the loading platform of Gun Emplacement No. 1. The steel lintel above the hoistway door is 57" long, with a 5" vertical leg, and a 3" horizontal leg. The wooden ship's ladder to the Observation Room is 2'- 7" and begins 2'- 9" to the south of the doorway in the southwest corner of the room. There is a 3" electrical outlet box between the windows on the north wall, and a 7" electrical panel box on the west wall next to the upper left hand corner of the door. There are two 3" diameter holes in the ceiling for cables in the middle of the south wall. In the south end of the west wall there are two more cutouts in the wall, both 3" across, one square, and one circular. The round one is filled with corroded metal. Both go through the wall to the building exterior.

The interior finish in both rooms consists at least two fragmentary coatings. The first is a thin light- colored cementitious, skim coat about 1/16" thick. On top there are gray and blue coats of a conventional paint.

Feature Condition

There are three parallel horizontal cracks in the east scarp wall face, which are continuous along the face of the battery scarp wall. One is 6'- 0" above the floor, one is 4'- 5". The highest crack propagates into the north wall, following the smallest section of concrete wall to the lower corner of the window frame. There is substantial water penetration along the east and south walls, particularly the south wall, at the level 6'- 8" above the floor where the concrete walls of the Observation Station were poured on top of the existing gun emplacement scarp walls. This water penetration is evident in thick calcium carbonate buildup on the south wall, and corrosion of the lintel above the hoistway door.

There is exposed rebar in the ceiling along the east and west walls. Approximately 25 square feet of rebar and damaged concrete is exposed.

Observation Room

Feature Description

The ceiling height in the observation room is 7'- 0", and like the room below, the dimensions are 12'- 0"x12'- 0". There is a continuous narrow band of windows at eye level, covering approximately the eastern half of the south wall, all of the east and north walls, and approximately half of the west wall. The windows are 4'- 4" above the floor. The single- light, top- hinged, out- swinging wood casement. The window sashes are set in continuous wood sills and heads, cast integrally with the concrete wall. Steel pipe columns, approximately 2" in diameter support the corners of the wall. The casement windows butted up flush with each other at the corners. The concrete wall makes a beveled transition from the wood window frames to the interior wall surface. There is an octagonal concrete instrument base, 3'- 3"x3'- 3" by approximately 8", tall close to the middle of the room. There are three instrument mounting bolts in the top surface of the concrete base. In the southeast quadrant of the room there is a 10" diameter cast iron instrument pedestal, filled with concrete, 4' high.

There is a lined flue in the west corner of the south wall, 9" in from the wall, into the exterior chimney. There is an electrical panel box, 7" wide x 19", 7" below the window of on the south wall. The floor opening for the ship's ladder is 3'- 3" x 4'- 2". The opening is edged with a mitered wood frame, constructed of 4"x4" (nominal) lumber, flush to the floor, and a wooden door attached to the north side, that swings up. There is an iron pipe railing on the north (3'- 6" in length) and east side (1'- 3") of the ladder opening.

The interior finish in both rooms consists at least two fragmentary coatings. The first is a thin, light- colored, cementitious skim coat about one- sixteenth of an inch thick. On top there are gray and blue coats of a conventional paint.

The floor slab dividing the Observation and Plotting Room is 6" thick concrete.

Feature Condition

There is relatively little exposed rebar, cracking or surface spalling in the Observation Room. There is a small area of damaged floor slab in the northeast corner, and several small isolated areas of exposed rebar along the northern end of the east wall.

Although not currently showing overt signs of structural settlement or cracking, one area of potential concern is that a significant percentage of the weight of the roof slab is being carried on three steel pipe columns 2- 3/8" in diameter at the northwest, northeast, and southwest corners, where the window openings are continuous around all four sides of the building.

BATTERY FARNSWORTH –
GUN EMPLACEMENT NO. 2

Exterior Walls

Feature Condition

"Façade" Between Gun Loading Platforms and Above Long Corridor Entrance

Description:	HC: esp. in section w/ removed berm and w/o cementitious skin LC/ DC: coping *SC *MD: 50% DC: at northeast end, along commander's post and along southwest side of removed berm
Deficiencies:	mineral deposits horizontal cracking (typically at cold joints) cracking at dissimilar material interfaces spiderweb cracking

Fascia of Loading Platform Floor/ Roof Slab

Description: *SM: about half as much as No. 1
SP: 50% cornice
(SC/ MD)

Deficiencies: structural movement/deformation
large- scale structural cracking (more than 1" wide)
spalling
horizontal cracking (typically at cold joints)

Northwest Section of Curved Wall Below Roof Slab (Exterior of Guard Room)

Description:	MD: 50%
Deficiencies:	horizontal cracking (typically at cold joints) structural movement/deformation mineral deposits spiderweb cracking

North Section of Curved Wall Below Roof Slab (Exterior of Battery Room)

Description: MD: 20%

Deficiencies: horizontal cracking (typically at cold joints)
spiderweb cracking
mineral deposits
vertical cracking

West Section of Curved Wall Below Roof Slab (Exterior of Guard and Shot Rooms)

Description: *SC
MD: 90%

Deficiencies: structural movement/deformation
horizontal cracking (typically at cold joints)
diagonal cracking
spiderweb cracking

Southwest Section of Curved Wall Below Roof Slab (Exterior of Shot Room)

Description:	*SC MD: 80% (HC)
Deficiencies:	spiderweb cracking mineral deposits horizontal cracking (typically at cold joints)

Shot Room

Feature Description

The Shot Room consists of a semicircular corridor and a straight corridor along its southwest end. The ceiling height is 8'- 0". The curved section of corridor is 7'- 0" wide, with an overall length of 23'- 7". The straight corridor is 9' - 10" wide x 30"- 7" in overall length.

The Shot Room is separated from the Guard Room on the north by a section of wall 3'- 0" wide x 1'- 0" thick extending from the inner section of curved wall. There is an exterior doorway in the outer curved wall 3'- 0" wide. The straight corridor is open to the area containing the Hoistway.

The floor and walls are unreinforced poured concrete. The ceiling is reinforced with radial steel tee- sections, 3" wide on the bottom leg, spaced 18" on center at the inner diameter and 24" on center at the outer. In the straight part of the corridor the tee- sections run perpendicular to the long axis (except at the southeast end of the corridor, where they run parallel for approximately 4'- 0") and are spaced approximately 22" apart.

A 2 x 6 cypress nailer is formed into the wall on the inner section of curved corridor wall. The bottom of the nailer is 7'- 0" above the floor. The nailer continues onto the southeast wall of the straight corridor, and extends about 7'- 0" into the wall before dropping at a 60- degree angle, ending approximately 1'- 0" from the south corner near the hoistway.

Feature Condition

Southeast Wall of Straight Corridor

Description:	*DC: one large SD: in wood nailer and along cracks
Deficiencies:	diagonal cracking horizontal cracking (typically at cold joints) surface dampness microbiological growth

Floor

Description: MD: stalagmite "nubs"

Deficiencies: standing water
mineral deposits

Curved Back Wall Opposite Entrance

Interior of Shot Room, looking north; curved back wall is in foreground at right

Description: *MG: heavy, pronounced patches
MD: esp. along bottom and in center
SD: bottom 1'

Deficiencies: horizontal cracking (typically at cold joints)
microbiological growth
structural movement/deformation
mineral deposits

Stub Wall (Shared With Guard Room)


View of Shot Room stub wall from Guard Room

Description:	HC *SM: upper third *MD: 50%; thick
Deficiencies:	horizontal cracking (typically at cold joints) structural movement/deformation mineral deposits

Front Curved Wall (Shared With Guard Room)

Description: *DC/ LC: down middle
MD: 70%

Deficiencies: structural movement/deformation
diagonal cracking
large- scale structural cracking (more than 1" wide)
horizontal cracking (typically at cold joints)

Southwest Wall of Straight Corridor

Description: VC: @ outer edge
(SC/ MD)
*SD/ MG: small but discrete/ very wet areas

Deficiencies: horizontal cracking (typically at cold joints)
vertical cracking
diagonal cracking
surface dampness

Curved Entrance Wall

Interior of Shot Room, looking north; curved entrance wall is in foreground at left

Description:	(SM) SW/ MD: minor, except at southwest edge and at southwest return of wall (northeast of straight corridor entrance)
Deficiencies:	horizontal cracking (typically at cold joints) diagonal cracking structural movement/deformation standing water

Guard Room

Feature Description

The Guard Room is north of the Shot Room and south of the Battery Room, being the center room in the semicircular corridor below the Loading Platform. It has two entrances on the exterior wall, both 4'- 0" wide. Cypress doors slid on overhead tracks at each of these openings. Each track was fixed to six of the ceiling reinforcing bars surrounding the doorway. An entrance to both the Battery Room and Shot Room is on the north and south ends of the corridor. The lineal run of the interior curved wall section is 18'- 8". The corridor is 7'- 0" wide with an 8'- 0" ceiling, similar to the Shot Room.

At the north end is a wall 3'- 0" wide x 12" thick perpendicular to the inner wall section, and a wall 1'- 0" wide perpendicular to the outer wall section, creating a doorway 3'- 0" wide opening into the Battery Room.

Feature Condition

Curved Back Wall Opposite Entrances

Description:	*SD: @bottom of biological growth *MG: 20%, some very thick *MD: 60%; very heavy *SC
Deficiencies:	horizontal cracking (typically at cold joints) spiderweb cracking mineral deposits microbiological growth

Floor


View of Guard Room interior looking southwest; note standing water

Description:	MD: stalagmite "nubs" *SW: 50%
Deficiencies:	standing water mineral deposits

Northeast Stub Wall (Shared With Battery Room)

Description: MD: very heavy at bottom

Deficiencies: horizontal cracking (typically at cold joints)
spiderweb cracking
mineral deposits
microbiological growth

Curved Entrance Wall

Interior of Shot Room, looking north into Guard Room; curved entrance wall is in background behind the people at right

Description: *HC/ VC/ DC: big stepped HC through middle; VC's at one- third wall intervals
*SM: tilted forward
MD: 50%, esp. at bottom
(SC)

Deficiencies: structural movement/deformation
vertical cracking
diagonal cracking
horizontal cracking (typically at cold joints)

Storage Battery Room

Feature Description

The Storage Battery Room is at the north end of the semicircular corridor below the Loading Platform. It has only one entrance, at its south end, from the Guard Room. The interior curved section of wall is 9'- 7" long. The back wall is 3'- 4" long. The north wall is straight and 7'- 4" long. The outer section of curved wall is 6'- 1" long. The cypress nailer continues from the back wall onto the east and northeast walls, ending 27" from the intersection of the northeast wall with the front (northwest) wall.

Feature Condition

Curved Back Wall

Description:	*HC MD SD/ MG: along bottom
Deficiencies:	horizontal cracking (typically at cold joints) mineral deposits surface deposits microbiological growth

Floor

Description:	(MD): stalagmite "nubs" *SW: 70%
Deficiencies:	mineral deposits standing water

East (Straight) Wall

Description:	*HC *DC *LC: at juncture w/ northeast wall *SM

Deficiencies: large- scale structural cracking (more than 1" wide)
structural movement/deformation
horizontal cracking (typically at cold joints)
diagonal cracking

Northeast (Straight) Wall

Description: *HC
*LC: at junction with north wall
SC
MD

Deficiencies: large- scale structural cracking (more than 1" wide)
horizontal cracking (typically at cold joints)
spiderweb cracking
mineral deposits

Curved Front Wall

Description: *HC
SC

Deficiencies: horizontal cracking (typically at cold joints)
spiderweb cracking

Curved Corridor Ceiling

Feature Description

The concrete of the interior ceilings is poured flush against the bottom flange of cast- in steel I-beams, which mostly have 3" flanges. The I- beams are placed radially along the circular corridor rooms. At the corridor corners and at other structural junctions, the flanges are 4" wide. The I- beams are placed at about 12" intervals across the corridor. The boards of the formwork were laid perpendicular to the direction of the I- beams.

Feature Condition

The ceiling of the curved corridor, which is the underside of the Loading Platform above, is cracked and shows the severe structural displacement outward discussed in the “Feature Condition” section of the Loading Platform. There is evidence of severe moisture infiltration on all ceiling surfaces. The steel I- beams are all corroded to varying degrees. Where there are wood “beams” (nailers) cast into the ceiling, they are saturated with water. Many areas have clusters or rows of small stalactites.

Manual Winch Alcove

Manual Winch Alcove is at far right of photo

Feature Description

The Manual Winch Alcove is a small room measuring 5'- 0" x 9'- 0", with an 8'- 0" ceiling. It is located southeast of the Hoistway and down the stair from the Shot Room.

Feature Condition

Deficiencies: horizontal cracking (typically at cold joints)
diagonal cracking
mineral deposits: 60% southwest wall; thick
microbiological growth: esp. southeast wall
standing water

Hoistway

Feature Description

The bottom of the Hoistway consists of a well 1'- 0" below the level of the floor slab. The shaft is 23'- 0" deep from the bottom of the well to the ceiling of the hoistway. The shaft is 5'- 0" x 3'-6", with a 16"x18" niche at the east corner extending into the Manual Winch Alcove. At the top of the shaft, in the east and west corners, are two 13" square steel plates, each with a pair of ferrous pulleys. One of the pulleys on the west plate is missing. There is a pair of U- beams in the center of both the northwest and southeast walls, directly across from one another.

Feature Condition

Deficiencies:	horizontal cracking (typically at cold joints)
	standing water
	spiderweb cracking
	mineral deposits: heavy on ceiling

Relocating Room

Feature Description

This room lies west of the stair. It measures 7'- 0" x 8'- 0", and is entered through a 3'- 0" wide doorway on the southeast side. The northeast wall of the Relocating Room is approximately 5'- 0" thick. The southwest and southeast walls are approximately 2'- 0" thick.

Feature Condition

Deficiencies: horizontal cracking (typically at cold joints)
diagonal cracking
spalling: 4" x 12" on southwest wall

Shell Room

Feature Description

The Shell Room is 20'- 0" long x 8'- 0" wide. It is entered through a doorway 4'- 6" wide in a 4'- 0" thick wall. The ceiling height is 8'- 0". Three ventilating shafts were crudely cut into the northwest wall adjacent to the Powder Magazine; two are on the southwest side, one at the top of the wall and one at the bottom, and one is at the top of the wall near the northeast end. The northwest wall between the Shell Room and the Powder Room is approximately 5'- 0" thick.

The concrete of the ceiling is poured flush against the bottom flange of cast- in steel I- beams, which mostly have 3" wide flanges. At structural junctions, the flanges are 4" wide. The I- beams are placed at about 12" intervals across the width of the room. The boards of the formwork were laid perpendicular to the direction of the I- beams. The ceiling also features a cast- in wood “beam” running lengthwise, perpendicular to the I- beams.

Feature Condition

Ceiling

Deficiencies: oxide jacking
surface dampness
mineral deposits

Floor

Description: SW

Deficiencies: standing water

Walls

Description:	HC/ DC: two on southeast wall become one on southwest wall, continuing on northwest wall MD: in areas along crack, esp. northwest wall. "Cascades" at ceiling beams on southwest wall
Deficiencies:	horizontal cracking (typically at cold joints) diagonal cracking mineral deposits

Powder Magazine

Powder Magazine, facing northeast

Powder Magazine, facing west

Feature Description

This space measures 11'- 0" x 20'- 0". Like the Shell Room, it is entered at the northeast end through a 4'- 6" doorway in the 4'- 0" thick northeast wall. One ventilating shaft is cut through the exterior wall, which is 5'- 6" thick.

The concrete of the ceiling is poured flush against the bottom flange of cast- in steel I- beams, which mostly have 3" wide flanges. At structural junctions, the flanges are 4" wide. The I-beams are placed at about 12" intervals across the width of the room. The boards of the formwork were laid perpendicular to the direction of the I- beams.

Feature Condition

Ceiling

Deficiencies: oxide jacking
surface dampness
mineral deposits

Floor


Powder Magazine, facing west

Deficiencies: standing water

Northeast and Southeast Walls

Deficiencies:	horizontal cracking (typically at cold joints) diagonal cracking mineral deposits surface dampness

Southwest and Northwest Walls

Description:	SD: 70%
Deficiencies:	horizontal cracking (typically at cold joints) mineral deposits surface dampness

Entry Corridor

Feature Description

The Shell Room, Powder Magazine, Relocating Room, and Hoistway are served by a corridor 48'- 0" long x 6'- 0" wide, entered from a bermed portal on the northwest side. The corridor runs northwest/southeast, and takes a right turn to the northeast near its southeast end, where it increases to 9'- 0" in width. The corridor has reinforcing tee bars 3" wide perpendicular to the long axis at approximately 22"on center.

Feature Condition

Ceiling

Deficiencies: oxide jacking
surface dampness
mineral deposits

Southeast (End) Wall of Corridor

End wall of corridor, facing east

Description:	HC MD: isolated but thick SC *MG: heavy, algal SD
Deficiencies:	horizontal cracking (typically at cold joints) mineral deposits spiderweb cracking microbiological growth

Fascia Above Entrance

Fascia above entrance to Entry Corridor, facing south

Deficiencies: cracking at dissimilar material interfaces
horizontal cracking (typically at cold joints)

Floor

Deficiencies: standing water
mineral deposits

Main Walls

Deficiencies: diagonal cracking
horizontal cracking (typically at cold joints)
microbiological growth
mineral deposits

Northeast Wing Wall (Entrance)

Description: MD: 30%
*SP: 4 sf at coping

Deficiencies: horizontal cracking (typically at cold joints)
diagonal cracking
spiderweb cracking
mineral deposits

Southwest Wing Wall (Entrance) and Return, Surrounding Power Plant

Description: *LC/ SP: S face 2' x 5'

Deficiencies: horizontal cracking (typically at cold joints)
large- scale structural cracking (more than 1" wide)
spalling
cracking at dissimilar material interfaces

Northeast Wall (Facing Shell Room Entrance)

Deficiencies: horizontal cracking (typically at cold joints)
mineral deposits

Wall Between Southeast End of Corridor and Manual Winch Alcove

Deficiencies: spiderweb cracking
mineral deposits
surface dampness

Wall Between Shell and Powder Room Entrances

Description: HC
SC
MD: 50%
MG: dark
SD

Deficiencies: horizontal cracking (typically at cold joints)
spiderweb cracking
mineral deposits
microbiological growth

Loading Platform Stair

Loading Platform stair, facing southwest

Feature Description

The Loading Platform is reached from the northwest scarp at grade level by means of a corridor and stairway. The corridor is 15'- 0" long from northwest to southeast, and 5'- 10" wide. The corridor is bridged for a length of 9'- 1" by the Loading Platform above. The concrete roof slab is 39" deep at that point. The corridor floor is concrete. The concrete walls were formed with rough- sawn horizontal boards. The corridor ceiling has the typical 3" steel "tee"- section reinforcing bars running perpendicular to the corridor walls approximately 22" on center. After passing under the slab, the Loading Platform wall height is 11'- 4", and the height of the Rosendale cement layer is 7'- 5" above grade. The ceiling is 8'- 0" high. The corridor makes a slightly greater than right- angle turn at the southeast end, and a series of 12 steps of 8- ½" risers and 9- ½" treads leads to the Loading Platform. The stair is 3'- 10" wide. The stair and corridor end are open above.

Feature Condition

Floor of Entry Corridor

Deficiencies: standing water

Inner Fascia of Bridge

Description: *HC
SC
MD
IC: at top surface

Deficiencies: horizontal cracking (typically at cold joints)
spiderweb cracking
mineral deposits
cracking at dissimilar material interfaces

Northeast Wall of Corridor Leading to Stair


Upper northwest end of northeast wall of corridor leading to Loading Platform stair. Top of bridge at lower right.

Description:	*MD: very heavy along bottom four pours *SP: along coping, esp. 6' x 3' area at southeast, and at northwest corner
Deficiencies:	horizontal cracking (typically at cold joints) diagonal cracking structural movement/deformation mineral deposits

Southwest Wall of Corridor Leading to Stair

Deficiencies: diagonal cracking
spalling
spiderweb cracking
mineral deposits

Treads and Risers

Description: SP

Deficiencies: spalling

Wall Southeast of Stair

Deficiencies: horizontal cracking (typically at cold joints)
spiderweb cracking
mineral deposits
cracking at dissimilar material interfaces

Wall Northwest of Stair

Description: *SP: 4' x 4' at southwest end

Deficiencies: horizontal cracking (typically at cold joints)
spalling
spiderweb cracking
mineral deposits

Loading Platform


Loading Platform, facing south


Rear wall of Loading Platform, facing northeast

Feature Description

The Loading Platform is a semicircular open deck 13'- 0" wide from the outer edge to a series of three steps down to the gun mount area. The overall width of the Loading Platform is 61'- 8". The outer area of the platform was raised to facilitate loading the gun. The three steps down to the gun mount have 7- ½" risers and 7- ½" treads. The lower section of the Loading Platform is 24'- 2" from the top stair to the farthest point on the rear (northwest) wall. The rear wall is 8'- 0" high at the highest level of the Loading Platform. The rear wall has five angled segments, with the two longest sections (15"- 2", 15'- 5") forming a shallow "V" at the gun mount. The southernmost two segments (11'- 0", 7'- 2") form an inward- facing "V" . The 15'- 0" northeast and southwest walls of the Loading Platform are perpendicular to the northwest face of the traverse.

The rear wall of the Loading Platform has three large iron rings 2" in diameter. The rings are 10" in diameter and fixed with steel eyebolts 6" in diameter cast into the concrete wall. The rings were used to assist in moving the gun, and are set 6'- 0" above the platform floor. The lower level of the lower platform floor has alternating groups of three and four bolts in alternating triangular and rectangular configuration. The bolts are a third of an inch in diameter by 4" high. Each bolt is associated with a 4"x 4" steel plate, flush with the concrete floor slab.

Feature Condition

Platform Surface (Slab)

Description: *LC: along curved line of top step; two radial cracks extending from step outward
*SM: radially outward. Loading Platform detached from part of structure with steps and counterweight well

Deficiencies: large- scale structural cracking (more than 1" wide)
structural movement/deformation
spiderweb cracking
vegetation growth

Northwest (Rear) Wall, Below Apron

Description: *SP: top center, 1' x 2'
*LC: middle of coping

Deficiencies: horizontal cracking (typically at cold joints)
diagonal cracking
spalling
large- scale structural cracking (more than 1" wide)

Southwest Wall, Below Apron

Description: *SP: 2' x 3' at northwest corner, next to Battery Commander's observation post

Deficiencies: spalling
horizontal cracking (typically at cold joints)
spiderweb cracking
mineral deposits

Semicircular Steps

Description: *LC: along curved line of top step

Deficiencies: spalling
vegetation growth
large- scale structural cracking (more than 1" wide)

Gun Mount and Counterweight Well

Feature Description

The gun mount is a circular stepped platform located in the center of the Loading Platform. The gun mount is 6'- 2" in diameter, with a single 7- ½" step encircling the mount. The gun mount's top surface joins the west wall with a splayed extension of the circular slab 20" wide. The counterweight well is a circular pit 4'- 2" in diameter at the center of the gun mount. The depth of the pit could not be established due to the amount of dirt infill. However, the presence of a tree 6" in diameter growing in the pit suggests a substantial depth.

There are 16 evenly space bolts around the top surface of the gun mount. They are 22" on center and spaced 11" on center from the outside face of the gun mount ring. The bolts are 1- 3/4" in diameter, and they project 4" above the surface of the concrete slab. There is a flat 4" x 4" steel plate associated with each bolt. The bolts were used to secure the gun carriage.

Feature Condition

Deficiencies: vegetation growth
soil or sediment deposits

Battery Commander's Observation Post

Battery Commander's Observation Post, looking south; taken from loading platform

Feature Description

The Battery Commander's Observation Post is an elevated niche in the northwest wall of the battery at the west corner of Gun Emplacement No. 2.

Feature Condition

Description: IC
SC
*SP
MD

BATTERY FARNSWORTH – GUN EMPLACEMENT NO. 1

Exterior Walls

Feature Description

The exterior walls of Gun Emplacement No. 1 are comprised of the exterior portions of the curved corridor rooms (described in the sections devoted to each of these rooms); the "façade" below the apron and behind the Power Plant; and the low wall surrounding the Power Plant. The outline of the berm that was removed to build the Power Plant in 1920- 21 can be seen where the "façade" is missing its cement skin and the aggregate is exposed. At the bottom of this wall are large rocks that were evidently placed in the forms prior to pouring the concrete. This method of construction can also be seen in the low wall surrounding the Power Plant, which originally surrounded the berm. The low wall was poured into a form consisting of formwork on the front and earth on the back; the back surface, which was not intended to be seen, is very rough, without a consistent cement skin.

Feature Condition

"Façade" Wall Below Apron and Behind the Power Plant

Description: *SP: along DC (12 sf)
*MD: 60%; heavy
MG: black wash

Deficiencies: vertical cracking
diagonal cracking
spalling
horizontal cracking (typically at cold joints)

Fascia of Loading Platform Floor/ Roof Slab

Description: *SP: almost 100% of coping

Deficiencies: horizontal cracking (typically at cold joints)
large- scale structural cracking (more than 1" wide)
structural movement/deformation
spiderweb cracking

Northwest Section of Wall Below Roof Slab (Exterior of Guard Room)

Deficiencies: horizontal cracking (typically at cold joints)
spiderweb cracking
mineral deposits
structural movement/deformation

North Section of Curved Wall Below Roof Slab (Exterior of Battery Room)

Deficiencies: vertical cracking
spiderweb cracking
mineral deposits

West Section of Curved Wall Below Roof Slab
(Exterior of Guard and Shot Rooms)

Deficiencies: horizontal cracking (typically at cold joints)
vertical cracking
spiderweb cracking
structural movement/deformation

Southwest Section of Curved Wall Below Roof Slab
(Exterior of Shot Room)

Description: HC
VC
SC
MD: 40%
MG: black, lichen

Deficiencies: horizontal cracking (typically at cold joints)
vertical cracking
spiderweb cracking
mineral deposits

Shot Room

Shot room interior, facing north; note standing water along rear wall

Shot Room, facing north: front curved wall (shared with Guard Room)

Feature Description

The Shot Room consists of a semicircular corridor and a straight corridor adjoining it to the south. The ceiling height is 8'- 0". The curved section of corridor is 7'- 0" wide, with an overall length of 23'- 7". The straight corridor is 9' - 10" wide x 30"- 7" in overall length.

The Shot Room is separated from the Guard Room on the north by a section of wall 3'- 0" wide x 1'- 0" thick extending from the inner section of curved wall. There is an exterior doorway in the outer curved wall 3'- 0" wide. The straight corridor is open to the area containing the Hoistway.

The floor and walls are unreinforced poured concrete. The ceiling is reinforced with radial steel tee- sections, 3" wide on the bottom leg, spaced 18" on center at the inner diameter and 24" on center at the outer. In the straight part of the corridor the tee- sections run perpendicular to the long axis (except at the southeast end of the corridor, where they run parallel for approximately 4'- 0") and are spaced approximately 22" apart.

A 2 x 6 cypress nailer is formed into the wall on the inner section of curved corridor wall. The bottom of the nailer is 7'- 0" above the floor. The nailer continues onto the southeast wall of the straight corridor, and extends about 7'- 0" into the wall before dropping at a 60- degree angle, ending approximately 1'- 0" from the south corner near the Hoistway.

Feature Condition

Southeast Wall of Straight Corridor

Deficiencies:	horizontal cracking (typically at cold joints)
	diagonal cracking
	surface dampness
	microbiological growth

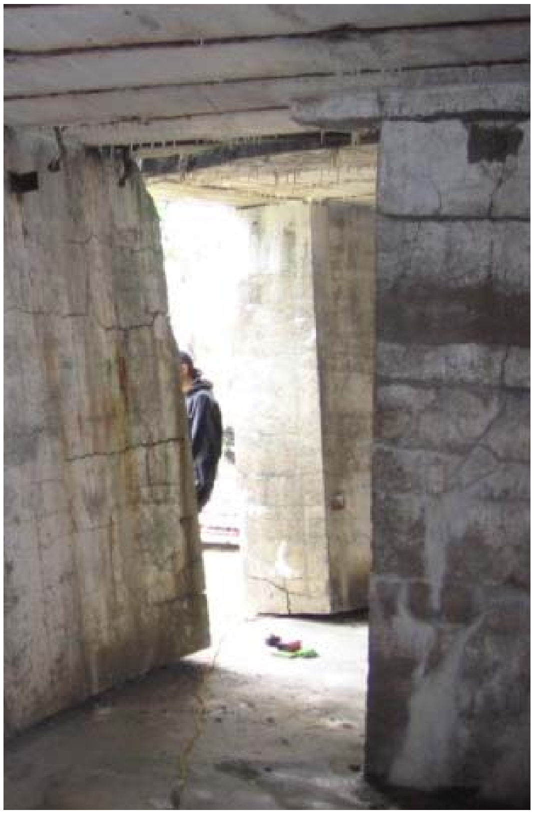
Floor

Deficiencies:	mineral deposits
	standing water

Curved Back Wall Opposite Entrance

Deficiencies:	horizontal cracking (typically at cold joints)
	surface dampness
	mineral deposits
	microbiological growth

Stub Wall (Shared With Guard Room)



Shot Room, facing north: stub wall shared with Guard Room (at right of photo)

Deficiencies: horizontal cracking (typically at cold joints)
diagonal cracking
spiderweb cracking
mineral deposits

Front Curved Wall (Shared With Guard Room)

Description: HC
*LC: down center
*SM: tilted out
SC: 50%; large- scale
(MD)
MG: black, lichen

Deficiencies: horizontal cracking (typically at cold joints)
large- scale structural cracking (more than 1" wide)
structural movement/deformation
spiderweb cracking

Southwest Wall of Straight Corridor

Description:	MD: 10% on main wall section; 30% at wall return (north of Straight Corridor entrance) SP: 1' x 4' loss SD: sm. Area where wall jogs out (1 sf)
Deficiencies:	horizontal cracking (typically at cold joints) vertical cracking spiderweb cracking mineral deposits

Curved Entrance Wall

Deficiencies:	horizontal cracking (typically at cold joints) spiderweb cracking mineral deposits microbiological growth

Guard Room

Guard Room interior, facing south: curved back wall opposite entrances

Feature Description

The Guard Room is north of the Shot Room and south of the Battery Room, being the center room in the semicircular corridor below the Loading Platform. It has two entrances on the exterior wall, both 4'- 0" wide. Cypress doors slid on overhead tracks at each of these openings. Each track was fixed to six of the ceiling reinforcing bars surrounding the doorway. An entrance into both the Battery Room and Shot Room is on the north and south ends of the corridor. The lineal run of the interior curved wall section is 18'- 8". The corridor is 7'- 0" wide with a ceiling 8'- 0" high, similar to the Shot Room.

At the north end there is a wall 3'- 0" x 12" thick perpendicular to the inner wall section, and a wall 1'- 0" wide perpendicular to the outer wall section, creating a doorway 3'- 0" wide opening into the Battery Room.

Feature Condition

Curved Back Wall Opposite Entrances

Deficiencies:	horizontal cracking (typically at cold joints) standing water mineral deposits microbiological growth

Floor

Deficiencies:	mineral deposits standing water

Northeast Stub Wall (Shared With Battery Room)

Deficiencies:	vertical cracking

Curved Entrance Wall

Deficiencies:	diagonal cracking structural movement/deformation mineral deposits

Storage Battery Room

Feature Description

The Storage Battery Room is at the north end of the semicircular corridor below the Loading Platform. It has only one entrance, at its south end, from the Guard Room. The interior curved section of wall is 9'- 7" long. The back wall is 3'- 4" long. The north wall is straight and 7'- 4" long. The outer section of curved wall is 6'- 1" long. The cypress nailer continues from the back wall onto the east and northeast walls, ending 27" from the intersection of the northeast wall with the front (northwest) wall.

Feature Condition

Curved Back Wall

Description: *LC: vertical, at juncture with east wall

Deficiencies: horizontal cracking (typically at cold joints)
diagonal cracking
large- scale structural cracking (more than 1" wide)
spiderweb cracking

Floor

Deficiencies: standing water
mineral deposits

Northeast (Straight) Wall

Description: *LC: vertical (diagonal at bottom) at juncture with front curved wall

Deficiencies: diagonal cracking
horizontal cracking (typically at cold joints)
large- scale structural cracking (more than 1" wide)
spiderweb cracking

East (Straight) Wall

Description: HC
SC
*LC: vertical, at juncture with back curved wall

Deficiencies: horizontal cracking (typically at cold joints)
spiderweb cracking
large- scale structural cracking (more than 1" wide)

Curved Front Wall

Description: *LC: vertical (diagonal at bottom) at juncture with north wall

Deficiencies: horizontal cracking (typically at cold joints)
large- scale structural cracking (more than 1" wide)
spiderweb cracking
microbiological growth

Curved Corridor Ceiling

Left: Curved ceiling of Shot Room and Guard Room. Photo taken from Hoistway, facing north.

Below: Detail of ceiling of Shot Room, facing north


Radial I- beams and wood nailers in ceiling

Feature Description

The concrete of the interior ceilings is poured flush against the bottom flange of cast- in steel I-beams, which mostly have 3" flanges. The I- beams are placed radially along the circular corridor rooms. At the corridor corners and at other structural junctions, the flanges are 4" wide. The I- beams are placed at about 12" intervals across the corridor. The boards of the formwork were laid perpendicular to the direction of the I- beams.

Feature Condition

There is evidence of severe moisture infiltration on all ceiling surfaces. The steel I- beams are all corroded to varying degrees. Where there are wood “beams” (nailers) cast into the ceiling, they are saturated with water. Many areas have clusters or rows of small stalactites.

Manual Winch Alcove

Manual Winch Alcove, looking east

Feature Description

The Manual Winch Alcove is a small room measuring 5'- 0" x 9'- 0", with an 8'- 0" ceiling. It is located southeast of the Hoistway and down the stair from the Shot Room.

Feature Condition

Description: MG: southeast wall; algal
HC
DC: northeast wall
SC
MD: 70%; heavy
SD, SW: floor
MD: heavy on ceiling (in front of Hoistway)

Hoistway

Hoistway and stair, looking northeast. The bottom of the Hoistway is to the right of the stair

Feature Description

The bottom of the hoistway consists of a well 1'- 0" below the level of the floor slab. The shaft is 23'- 0" deep from the bottom of the well to the ceiling of the Hoistway. The shaft is 5'- 0" x 3'- 6", with a 16" x 18" niche at the east corner extending into the Manual Winch Alcove.

Feature Condition

There is some horizontal cracking, but relative to many of the other features the Hoistway appears to be in good condition.

Relocating Room

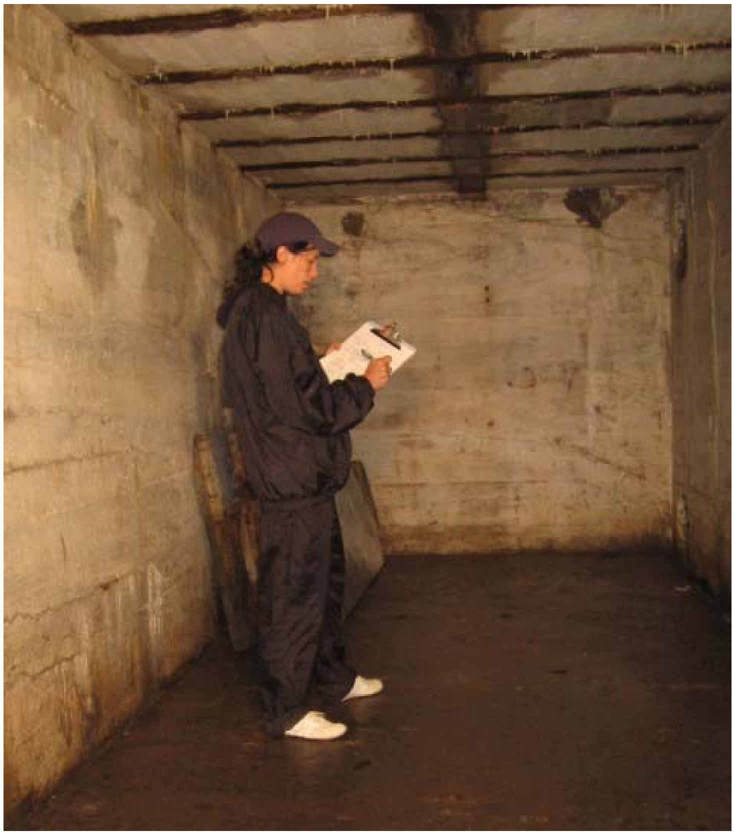
Feature Description

This room lies west of the stair. It measures 7'- 0" x 8'- 0", and is entered through a 3'- 0" wide doorway on the southeast side. The northeast wall of the Relocating Room is approximately 5'-0" thick. The southwest and southeast walls are approximately 2'- 0" thick. There is a wood "beam" cast into the ceiling that begins at east of the entrance, continues along the northeast wall, and stops short of the west corner of the room.

Feature Condition

Description:	HC: northeast and southeast walls
	*DC: southeast, northeast, esp. northwest
	SC: minor on southeast
	MD: 10%; thin
	SW: floor

Shell Room



Shell Room, looking southwest

Shell Room, southeast and southwest walls


Shell Room, southeast wall and doorjamb, looking east

Feature Description

The Shell Room is 20'- 0" long x 8'- 0" wide. It is entered through a doorway 4'- 6" wide in a 4'- 0" thick wall. The ceiling height is 8'- 0". Three ventilating shafts were crudely cut into the northwest wall adjacent to the Powder Magazine; two are on the southwest side, one at the top of the wall and one at the bottom, and one is at the top of the wall near the northeast end. The northwest wall between the Shell Room and the Powder Room is approximately 5'- 0" thick.

The concrete of the ceiling is poured flush against the bottom flange of cast- in steel I- beams, which mostly have 3" wide flanges. At structural junctions, the flanges are 4" wide. The I- beams are placed at about 12" intervals across the width of the room. The boards of the formwork were laid perpendicular to the direction of the I- beams. The ceiling also features a cast- in wood “beam” running lengthwise, perpendicular to the I- beams.

Feature Condition

Description:	(DC) (SC) MD: 40- 50%; heavy on southwest and northwest walls SW, MD: floor
Deficiencies:	There is evidence of severe moisture infiltration on all ceiling surfaces. The steel I- beams are all corroded to varying degrees. Where there are wood “beams” (nailers) cast into the ceiling, they are saturated with water. Many areas have clusters or rows of small stalactites.

Powder Magazine

Powder Magazine, looking west

Powder Magazine, looking south

Feature Description

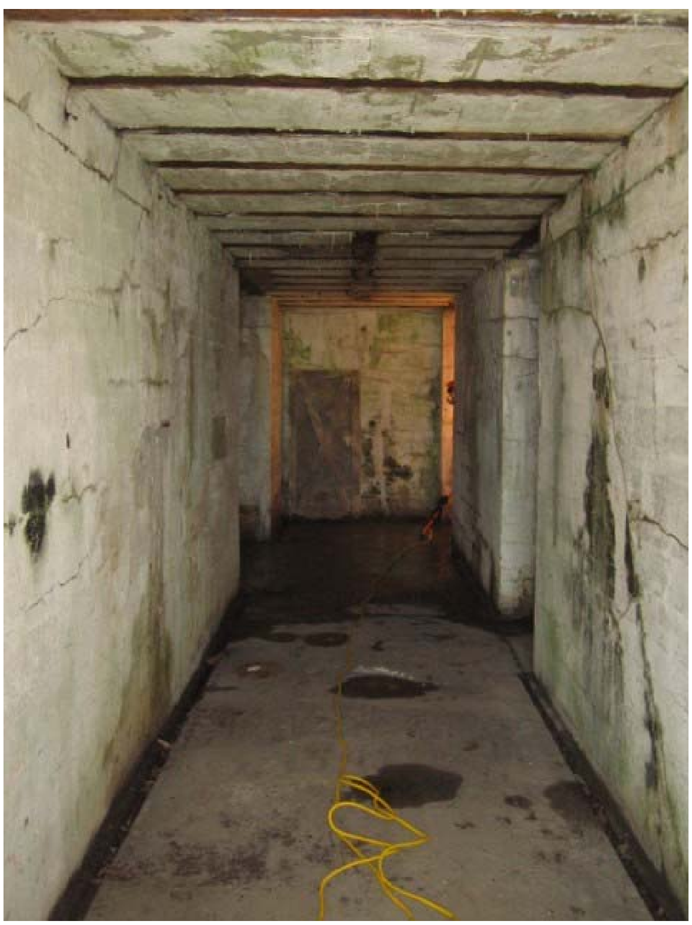
This space measures 11'- 0" x 20'- 0". Like the Shell Room, it is entered at the northeast end through a 4'- 6" doorway in the 4'- 0" thick northeast wall. One ventilating shaft is cut through the exterior wall, which is 5'- 6" thick.

The concrete of the ceiling is poured flush against the bottom flange of cast- in steel I- beams, which mostly have 3" wide flanges. At structural junctions, the flanges are 4" wide. The I-beams are placed at about 12" intervals across the width of the room. The boards of the formwork were laid perpendicular to the direction of the I- beams.

Feature Condition

Description:	SD: all walls (HC) (SC) DC: northwest wall *MD: southeast wall 80%, northwest wall 40%, both very heavy; MD: northwest wall 50%, southwest wall 10% SW, MD: floor
Deficiencies:	There is evidence of severe moisture infiltration on all ceiling surfaces. The steel I- beams are all corroded to varying degrees. Where there are wood “beams” (nailers) cast into the ceiling, they are saturated with water. Many areas have clusters or rows of small stalactites.

Entry Corridor



Feature Description

The Shell Room, Powder Magazine, Relocating Room, and Hoistway are served by a corridor 48'- 0" long x 6'- 0" wide entered from a bermed portal on the northwest side. The corridor runs northwest/southeast, and takes a right turn to the northeast near its southeast end, where it increases to 9'- 0" in width. The corridor has reinforcing tee bars 3" wide perpendicular to the long axis at approximately 22"on center.

Feature Condition

Southeast (End) Wall of Corridor

Deficiencies: surface dampness
microbiological growth
surface dampness

Fascia Above Entrance

Deficiencies: horizontal cracking (typically at cold joints)

Floor

Deficiencies: standing water
surface dampness

Northeast Wing Wall (Entrance)

Deficiencies: horizontal cracking (typically at cold joints)
surface dampness
mineral deposits
diagonal cracking

Southwest Wing Wall (Entrance)

Deficiencies: vegetation growth

Northeast Wall

Deficiencies: horizontal cracking (typically at cold joints)
diagonal cracking
microbiological growth

Southwest Wall

Description: (HC)
(MG)

Deficiencies: horizontal cracking (typically at cold joints)
microbiological growth
diagonal cracking

Wall Sections Facing Shell Room Entrance and Around Its West Corner

Deficiencies: horizontal cracking (typically at cold joints)
standing water
mineral deposits

Wall Between Shell and Powder Room Entrances

Deficiencies: horizontal cracking (typically at cold joints)
spiderweb cracking
mineral deposits

Loading Platform Stair

Feature Description

The Loading Platform is reached from the northwest scarp at grade level by means of a corridor and stairway. The corridor is 15'- 0" long from northwest to southeast, and 5'- 10" wide. The corridor is bridged for a length of 9'- 1" by the Loading Platform above. The concrete roof slab is 39" deep at that point. The corridor floor is concrete. The concrete walls were formed with rough- sawn horizontal boards. The corridor ceiling has the typical 3" steel "I"- section reinforcing bars running perpendicular to the corridor walls approximately 22" on center. After passing under the slab, the Loading Platform wall height is 11'- 4", and the height of the Rosendale cement layer is 7'- 5" above grade. The ceiling is 8'- 0" high. The corridor makes a slightly greater than right- angle turn at the southeast end, and a series of 12 steps of 8- ½" risers and 9- ½" treads leads to the Loading Platform. The stair is 3'- 10" wide. The stair and corridor end are open above.

Feature Condition

Wall Northwest of Stair

Deficiencies: horizontal cracking (typically at cold joints)
large- scale structural cracking (more than 1" wide)
vertical cracking
spiderweb cracking

Northeast Wall of Corridor Leading to Stair

Description: **SP: in association with cracks, and at coping.
Large areas in east corner and below bridge

Deficiencies: horizontal cracking (typically at cold joints)
diagonal cracking
spiderweb cracking
mineral deposits

Southwest Wall of Corridor Leading to Stair

Description: *DC
SP: along DC

Deficiencies: diagonal cracking
horizontal cracking (typically at cold joints)
spiderweb cracking
mineral deposits

Treads and Risers

Description: SC
SP

Deficiencies: spiderweb cracking
spalling

Loading Platform

Feature Description

The Loading Platform is a semicircular open deck 13'- 0" wide from the outer edge to a series of three steps down to the gun mount area. The overall width of the Loading Platform is 61'- 8". The outer area of the platform was raised to facilitate loading the gun. The three steps down to the gun mount have 7- ½" risers and 7- ½" treads. The lower section of the Loading Platform is 24'- 2" from the top stair to the farthest point on the rear (northwest) wall. The rear wall is 8'- 0" high at the highest level of the Loading Platform. The rear wall has five angled segments, with the two longest sections (15"- 2", 15'- 5") forming a shallow “V” at the gun mount. The southernmost two segments (11'- 0", 7'- 2") form an inward- facing “V” . The 15'- 0" north and south walls of the Loading Platform are perpendicular to the northwest face of the traverse.

The rear wall of the Loading Platform has three large iron rings 2" diameter. The rings are 10" in diameter and fixed with steel eyebolts 6" in diameter cast into the concrete wall. The rings were used to assist in moving the gun, and are set 6'- 0" above the platform floor. The lower level of the lower platform floor has alternating groups of three and four bolts in alternating triangular and rectangular configuration. The bolts are a third of an inch in diameter x 4" high. Each bolt is associated with a 4"x 4" steel plate, flush with the concrete floor slab.

Feature Condition

The semicircular exterior of Gun Emplacement No. 1 – consisting of the slab of the Loading Platform and the exterior wall of the battery, and the Guard and Shot Rooms below it – is severely deflected outward. The platform slab is restrained on the north, south, and east directions by the rest of the massive structure, and so has moved westward in an outward radial direction. There is secondary movement southward, resulting in the southwest displacement of the slab/ceiling of the three semicircular rooms. The back wall of the three rooms has remained in place, along with the stub walls that are part of it. The exact amount and direction of the Loading Platform slab movement away from the back wall and stub walls can be seen in the ceiling of the three rooms that retain indicators of the slab's original placement, including the upper part of the stub walls.

There is 2 ½ - inch lateral displacement in the ceiling slab at the northeast end of the Battery Room, but no forward (radial) movement. The rear stub wall at the Battery Room is shifted 6 inches laterally. At the opposite end (the southwest end of the Battery Room), there is no deflection because of the weight of the Observation Station above bearing down. The forward displacement increases along the length of the Guard Room and Shot Room to the maximum point of displacement near the center – the south rear stub wall of the Guard Room – where the slab has moved 14 inches away from its original position on the back wall. There is no lateral displacement at this section. There is more deflection – more of a "bulge" forward in the back-wall pour scar on the ceiling – along the back wall of the Guard Room than along the back wall of the Shot Room.

The outward movement of the Loading Platform slab has pushed the segments of the exterior wall below it forward; it has also rotated the middle two segments forward at their top edges. The exterior wall segments at the northeast and southwest ends (the outside walls of the Battery Room and Shot Room, respectively) remain plumb; they are not rotated forward like the middle two segments are. The southwest end of the northeast segment is displaced 5 inches forward, and the northeast end of the southwest segment is displaced 4 inches forward. At the point of maximum slab displacement, the exterior wall segment across from this point (the wall outside of the Guard and Shot Rooms) is 14 inches horizontal from plumb. This section has also moved forward 2 inches. There is a 3- inch opening between the top edge of the rotated wall and the slab above.

There are two large cracks through the slab thickness where the portion of the slab has detached from the rest of the structure and moved forward. These occur radially from the semicircular steps out to the exterior edge. One, near the northeast end of the slab, is 4 ½ inches wide and traverses the ceiling of the Battery Room. The other, near the southwest end of the slab, crosses the Shot Room ceiling in front of the Observation Station. The movement of the slab, and the resulting structural displacement, is largely within the area circumscribed by these cracks, the semicircular steps, and the exterior edge of this part of the structure.

On the top of the Loading Platform are several large cracks in addition to the ones described previously. One runs along the top semicircular step, one runs radially through the middle, and a third begins close to the middle crack and moves laterally to the northeast corner of the exterior semicircular wall.

Platform Surface (Slab)

Deficiencies: large- scale structural cracking (more than 1" wide)
structural movement/deformation
spiderweb cracking
spalling

Northwest (Rear) Wall, Below Apron

Description: SP: at coping, along northeast side of shallow “V” and along part of southwest side of “V”

Deficiencies: horizontal cracking (typically at cold joints)
spiderweb cracking
mineral deposits
cracking at dissimilar material interfaces

Semicircular Steps

Deficiencies: horizontal cracking (typically at cold joints)
vegetation growth
spalling
spiderweb cracking

Gun Mount and Counterweight Well

Feature Description

The gun mount is a circular stepped platform located in the center of the Loading Platform. The gun mount is 6'- 2" in diameter, with a single 7- ½" step encircling the mount. The gun mount's top surface joins the northwest wall with a splayed extension of the circular slab 20" wide. The counterweight well is a circular pit 4'- 2" in diameter at the center of the gun mount. The depth of the pit could not be established due to the amount of dirt infill. However, the presence of a tree 6" in diameter growing in the pit of Gun Emplacement No. 2 suggests a substantial depth.

There are 16 evenly space bolts around the top surface of the gun mount. They are 22" on center and spaced 11" on center from the outside face of the gun mount ring. The bolts are 1-3/4" in diameter, and they project 4" above the surface of the concrete slab. There is a flat 4" x 4" steel plate associated with each bolt. The bolts were used to secure the gun carriage.

Feature Condition

Description: SP
(HC)
(VC)

Battery Commander's Observation Post

Battery Commander's Observation Post

Feature Description

The Battery Commander's Observation Post is an elevated niche in the northwest wall of the battery at the west corner of Gun Emplacement No. 1.

Feature Condition

Description: *SC
MD (in assoc. w/ SC)
SP
*IC (at coping)

WALBACH TOWER

Feature Description

The Walbach Tower today exists as a ruin of the original two story circular masonry structure, set into the rocky outcropping on which it stands. The southwest part of the exterior is the best preserved, with remains extending from the foundation to the upper level. A comparison of the ruin's upper profile as it stands today to photographs of the ruin in the early twentieth century (date?) suggests that there has been relatively little loss in the profile since that time.

Although the exact original configuration of the tower is uncertain, historical sources suggest that the tower had three vaulted casemates, each with an embrasure in its back wall, and a powder magazine on its lower level. One source (Lawry) mentions 4 casemates, but it is likely that this larger number includes the powder magazine, also vaulted but on a lower level and with no embrasure in the back. This lower, barrel vaulted room, presumably the powder magazine, is the only interior space that visibly survives intact. Comparison with historical photographs, however, suggest that significant portions of the casemates (with vaults of similar radius) may be preserved, but are filled with backfill and rubble and are overgrown. The springing of one of these upper vaults can be discerned on what would have been the upper level.

The outer wall is built on a stone foundation, and consist of inner and exterior layers of brick construction (each four wythes thick) that enclose a core of rubble masonry construction of equal thickness. The walls are approximately 4 feet thick. An embrasure from the tower interior pierces the walls.
There is not a consistent brick bonding pattern; header courses are separated from one another by varying numbers of stretcher courses. Headers are scattered throughout courses that consist primarily of stretchers, and vice versa. The stone foundation and rubble core are the same type of schist- like, stratified stone that makes up the outcropping on which the tower stands. The embrasure sills, quoins, and lintel; the doorway threshold; and the central gun- mount column are cut granite. Remains of a whitewashed finish can be discerned on the tower's exterior.

The lower vaulted chamber, presumably the powder magazine, is 8' 7" deep from the front opening to the back wall and is divided into two rooms by a wall that extends up to the vault. The back room is 5' deep. The rooms have a whitewashed finish. The height of the rooms is about 6' 6" from the threshold to the top of the vault. The granite threshold rests on bricks and is about 12" above the current floor level, which consists of brick, stone, and dirt fill and is not original. This floor level is about 3' 6" below the vault springline. Below the springline of the vault, the back wall is stone, the west wall is brick for four courses and stone below, and the east wall is brick for five courses with stone below. The brick partition wall is 13" and four wythes thick. There is a 4' x 2' flat- arched doorway to the left. The outer two wythes of the partition wall step back at the doorway arch to form a two- wythe inner arch. The dooway has a granite threshold as wide as the wall. There is a 9" x 10" window to the right of the doorway that steps back on the reverse side to a dimension of 12" x 17".

The front opening of the casemate is filled with large radiused stones, 11" thick; these are undoubtedly the remains of the thick ashlar pillar that supported the wood gun platform and the roof of the interior (Lawry p. 14).

Feature Condition

As described in the "Feature Description" section, Walbach Tower is a ruin, or a fragmentary structure in an advanced state of deterioration. Historical photographs from the early 20th century (date?), however, show that the structure has been a ruin for most of its existence. It is probable that the tower was never even completed as intended. The above- grade masonry remains are in unstable condition. The mortar bonding the brick and stone courses and wythes is failing, causing the fragmentary wall to "unravel" as the masonry units at the edges fall off or become dislodged, exposing the units behind them to the same fate. Water can penetrate at all faces of the walls, including directly into their interior from above. This uncontrolled, omnidirectional moisture infiltration is hastening the deterioration of the mortar and wall structure.

The situation of the tower walls partially within the rock outcropping, as well as the infill of the above grade casemates, results in differential drainage conditions that further encourage moisture movement through the walls, draining from the filled/buried side of wall to the other side: the interior of the powder magazine, and the exterior wall of the upper casemates.) There is ample evidence of moisture infiltration in these areas. The brick of the exterior is porous and worn, with mortar deterioration. The bricks and mortar of the interior vault are also deteriorating, with numerous cracks through both bricks and mortar and open joints. The west side of the vault is damp, and there id thick biological growth.

Vegetation growth is rampant all over the structure.

POWER PLANT (1921)

Engine Room

Feature Description

The Engine Room is the larger of the two rooms in the Power Plant. Its interior measurements are 16' 6" x 14' 5". It has reinforced concrete walls that were poured into 7" board forms. Its rebar is ridged. All walls are 9" - 9 ½" thick except for the back (southeast) wall, which is 12" thick. There is a 6" chimney hole on the back wall, 12" from the south corner. The room is entered through a doorway (3' 11" wide) on the west elevation. The doorway has a wood jamb that held an inward- swinging wooden door. There is a window (31" x 38", wood casing that would have held double- hung wood sash) to each side of the doorway.

The reinforced concrete floor has cast- in- place features that supported the machinery. There are two platforms measuring 4'10" x 2' 2" in the front center of the room, each of which held a gas motor. The iron bolts that held the motors to the bases remain. A 10" trench (3- ½" deep, with a 1" lip) runs along the northwest side of the bases (with smaller trench sections running from the bases to the trench) to the radiator bases in the Radiator Room. The trench is 3- ½" wide, with a 1" lip that accommodated a half- inch thick steel plate cover: a section of the cover remains in the channel along the northwest wall. There is a 6' 8" x 2' 6" cable pit in the middle of the back wall.

A doorway (with a wood jamb) in the northwest side of the southwest wall leads into the Radiator Room. A 6' 2" iron track above the door indicates that it used to have a sliding door.

The terra- cotta tile ceiling (laid in running bond) is 8' above the floor.

On all walls there is a painted “wainscot” 3' 2" from the floor. The original colors appear to have been blue- gray for the wainscot and ocher for the upper walls.

Feature Condition

The Power Plant is in good condition relative to most of the other structures. Because the rebar of the walls is not too close to the concrete surface, there is relatively little of the spalling that sometimes plagues reinforced concrete buildings of this vintage. There is a white carbonate "wash" along the upper part of the S wall at the ceiling juncture.

The ceiling has been carelessly repointed with Portland cement. There are patches of white efflorescence along the W (front) side, with associated delamination and spalling of the terra-cotta tiles. This area of water damage corresponds to the spalled cornice on the exterior.

The doors and window sashes are missing. There is a diagonal crack above the E corner of the doorway leading to the Radiator Room.

The painted finishes are flaking and fragmentary. There is graffiti and scrachiti on the walls.

Radiator Room

Feature Description

The Radiator Room is the smaller of the two rooms in the Power Plant, located to the southwest of the Engine Room. Its interior measurements are 16' 6" x 8'. It has reinforced concrete walls that were poured into 7" board forms. Its rebar is ridged. All walls are 9" - 9 ½" thick except for the back (southeast) wall, which is 12" thick. The room is entered from the Engine Room by a doorway at the northwest end of the northeast wall. There is also a doorway at the northwest elevation with a sliding wooden door (five single panels, 7' x 40") on a 2- ½" iron track that runs the length of the interior northwest wall. The southwest wall has two window openings, 3' 2" x 4'- 9" , that have three- panel sliding wood shutters that hang on a track on the wall interior. The track (similar to that on the northwest wall) runs along the southwest wall, stopping 16" from the southeast wall.

The reinforced concrete floor has two cast- in- place platforms measuring 5' 9" x 3' 2" behind each window opening (6- ½" thick), each of which held a radiator with a blower. Some of the iron bolts (and a pipe opening) in the bases remain. The 10" trench (cast in place, 3- ½" deep, with a 1" lip) that originates in the Engine Room runs along the northeast side of the bases. A narrower branch of this trench runs between the radiator platforms to an opening in the wall, where its opening flares out.

The terra- cotta tile ceiling (laid in running bond) is 8' above the floor.

On all walls there is a painted “wainscot” 3' 2" from the floor. The original colors appear to have been blue- grey for the wainscot and ocher for the upper walls.

Feature Condition

The Power Plant is in good condition relative to most of the other structures. Because the rebar of the walls is not too close to the concrete surface, there is relatively little of the spalling that sometimes plagues reinforced concrete buildings of this vintage.

The sliding shutters are in need of repair, and the sliding door and track on the northwest wall are also broken.

Exterior and Roof

Feature Description

The exterior walls have reinforced concrete walls that were poured into 7" board forms. Its rebar is ridged. No exterior finish is apparent.

The roof of the Power Plant has a very slight pitch with an 8" overhang on all sides.

The window and doorway openings on the northwest elevation have cast- in- place “lintels” 7" wide x 1"deep, extending 4" beyond the openings in both directions. The two windows on the northwest elevation have cast- in- place sills, 39" long x 4 ½" high, extending out 1" from the wall. The window openings on the southwest elevation have no lintels, but cast- in- place sills similar to those on the northwest elevation.

Feature Condition

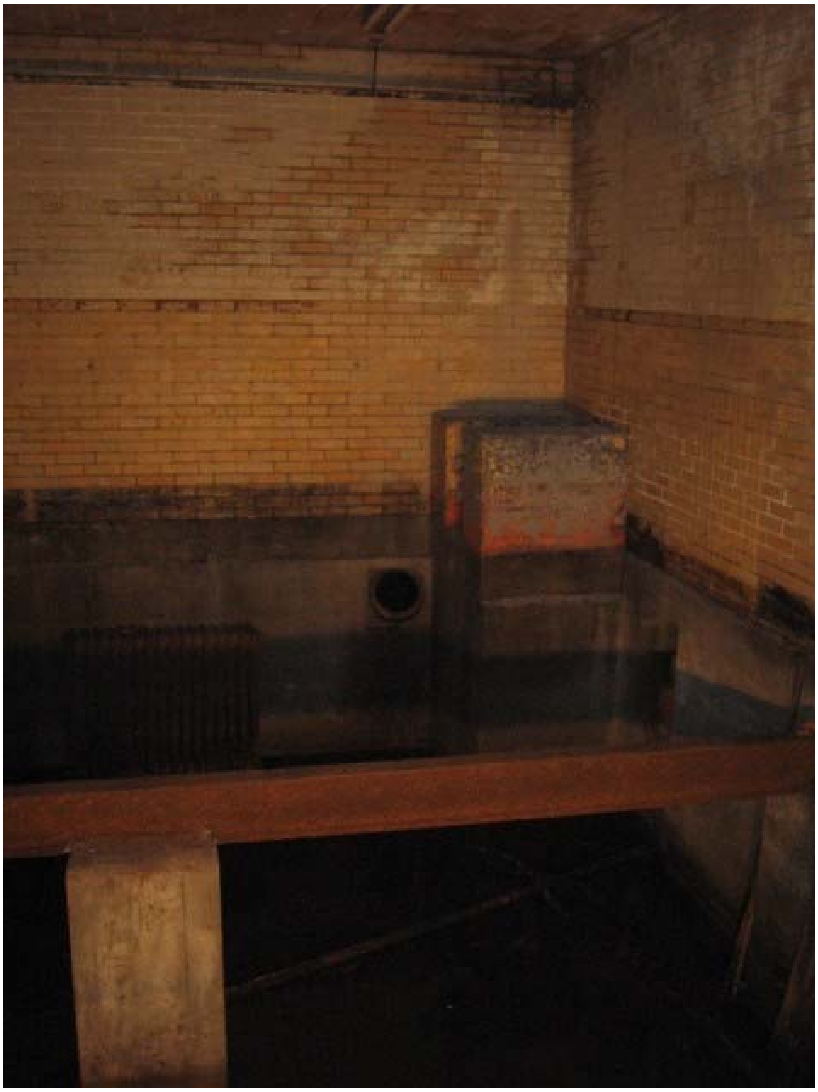
The Power Plant is in good condition relative to the rest of Battery Farnsworth.

The roof has considerable soil deposition and vegetation growth.

The roof overhang is spalled along the northwest (front) elevation both on the northeast half and at the southwest corner. There is exposed rebar in the middle 9- 12" of the slab. On the lintel of the northeast window on the northwest elevation there is a 3" x 12" spall. The cornice is spalled at the northeast end of the southeast (rear) elevation, beneath the tree.

There is green biological growth on the southeast elevation, and red and yellow lichen growth on the northeast elevation where it is shaded by the berm. There is also some lichen growth on the northwest elevation. The northwest elevation has the carbonate “washing” seen on the interior between the roof overhang and the lintels on the Engine Room façade, particularly around the northeast window.

1920 MINING CASEMATE



Feature Description

The 1920 Mining Casemate consists of a cavity- walled brick structure on concrete foundation walls, built within 2' thick reinforced concrete walls. The exterior dimensions of the concrete structure are 29' x 61' 8". The exterior dimensions of the brick structure are 23' x 53' 8". There is a 2' airspace between the structures on all sides except for the north, where the concrete wall was poured directly against the brick wall at the east end and is 3- ½" from the brick at the west end.

The height from the floor to ceiling of the outer concrete structure is 11' 6". The brick structure has a 12" thick concrete slab roof with a 3" overhang. There is a 2' 2" airspace between the concrete ceiling and the roof of the brick structure. The floor- to- ceiling height within the brick structure is 8' 6".

The inner structure has 8- ½" thick cavity walls consisting of two wythes of running- bond buff brick that are joined at intervals with bricks that are not tied in to the rest of the wall. Its length is divided into four main rooms, from east to west: the Storage Battery Room (7' 8" wide), the Engine Room (11' 9" wide), the Operating Room (16' wide), and the Dormitory (9' 3"). All of these rooms are 21' 6" deep, the depth of the brick structure from the front to the back wall. Between the Engine and Operating Rooms is a "core" extending the depth of the structure consisting of (from north to south) a toilet room and two closets.

The Storage Battery Room, Engine Room, and closets had painted concrete floors. The Engine Room has two cast- in- place equipment bases measuring 3' 5" x 2' 5" in the center. The Operating Room, toilet room, and Dormitory had wood floors that are now missing. The joists of the Operating Room floor were supported by two 3- ½" ledges cast into the concrete foundation on the east and west (6" below the brick- concrete interface), and by a steel I- beam supported on a concrete pillar running the width of the room about 8' (a little under halfway) from the back wall. There is a 2' x 2' cast- in- place concrete equipment base in the southwest corner with a joist ledge at floor level on the west edge. The joists of the bathroom and dorm room floors were supported on ledges cast into the concrete foundation of the north and south walls (also 3- ½" deep and 6" below the brick- concrete interface).

The ceilings consist of terra- cotta tiles laid in a grid pattern, and appear similar to those in the Power Plant.

The Storage Battery and Engine Rooms each have a 3' 0" x 4' 8" concrete- filled window opening centered on their north wall. The Operating Room has two of these patched openings, located at each side of its north entrance. The Dormitory window patch, also centered on the north wall, is 5'10" x 4' 9".

There is a double doorway at the north wall of the Engine Room, with doors having two by four lights over two panels. This was the original entrance to the brick structure, as well as a doorway on the north wall of the Operating Room. Within the structure, doorways with wood doors lead from the Engine Room into the Storage Battery Room and toilet room, from the toilet room into the Operating Room, and from the Operating Room into the Dormitory. These doors are all near the north ends of the walls in which they sit. The Engine Room also has a doorway to the north closet, and the Operating Room has a doorway to the south closet. The

Dormitory has a doorway towards the south end of its west wall that opens into the corridor (air space) between the brick and concrete walls. All interior doors are five- panel wood doors.

The exterior is formed on the sides by wing walls that are part of the 1920 concrete structure that function as retaining walls for the berm over the casemate. These are 16' 8" at their highest and extend in both directions for about 27', sloping down to the ground level. The front façade is part of an addition from 1943. The concrete was poured into forms consisting of large sheets of plywood. The addition is built 7' 6" from the original façade, 8' from the wing walls) and is the about the same length as that of the original concrete structure, stepped slightly to the west. Its walls are 2' thick. The front elevation is entered through a doorway at the east end of the façade. The ceiling height of the interior is 8' 10". The length of the addition is divided into a 29' corridor with access to the Engine Room (as well as a tank pit and buried oil tank) and a doorway at its west end, which leads into a small 9' room that opens into the Operating Room. The westernmost room in the corridor, 14' 9" long, is walled off from the others and is accessible from the west airway/corridor, and from the outside through a doorway in its west wall that has been narrowed since its construction.

The façade has a 3" x 12" "belt course" cast into the concrete that runs its length, 10' 10" from the ground.

There are four concrete chimney structures that emerge through the top of the berm containing the casemate. Each of these has three or four cast- iron chimney pipes cast into its concrete, with a concrete slab cap that is held over the lower part by pieces of exposed rebar at each of the corners. The chimney pipes emit from the back (south) wall of the concrete enclosure.

Feature Condition

The Mining Casemate is structurally stable but has drastic moisture problems in every part of the structure. The Operating Room, Dormitory, and toilet room (all with missing wood floors) flood with up to 2' of water after heavy rains. Other surfaces are damp, and all remaining metal elements in the structure are corroded. There are stalactites hanging from the concrete ceiling in the interstitial space, and mortar efflorescence in the tile ceiling and brick walls of the inner structure.

1943 OBSERVATION STATION (EXTERIOR)

Feature Description

The concrete walls of the Observation Station were poured directly on the concrete floor slab of the loading platform of Gun Emplacement No. 1. The exterior walls are 13" thick, poured in lifts of approximately 3' in 3' form boards. Circular Portland cement patches on the southwest and southeast elevations reveal the location of bolt holes for the concrete forms. There are a total of eight lifts to the top of the roof slab. Half- inch steel rebar is used in the construction. Due to corrosion, it cannot be determined if the rebar is smooth or deformed; however, it appears to be smooth, and in locations where the rebar is showing, it is within 1" of the surface of the concrete. The concrete contains an angular black aggregate. The surface is relatively heterogeneous, with areas of differing textures and surface smoothness. There are remnants of ochre paint on exterior surfaces, notably the underside of the roof overhang and doorway hood, and inside the door jamb. Wood trim appears to have been a deep blue. There are also small remains of ochre paint in the pores of the exterior concrete surface. The south and east parapet walls of the gun emplacement form the base of the southwest and southeast walls of the Observation Station to a height of 6'- 8". The exterior of the Observation Station is a square box, 19'- 0" high from the floor of the Loading Platform to the concrete- slab roof cover. There are two small window openings in the north elevation of the first- floor Plotting Room. The single entrance doorway on the northwest elevation is protected by a cast- in- place concrete hood, 6'- 0" long and projecting 1'- 8". It slopes from 12" thick at the wall surface to 4" thick at the outer edge.

The roof overhang exists only above the windows in the Observation Room. It has a similar profile to the doorway hood, projecting 18" and diminishing in thickness from 12" at the wall surface to 4" at the outer edge, with a formed drip detail. The bottom of the roof overhang is 17'- 2" above the floor of the Loading Platform. Hinged iron strap attachments hang from the overhang to secure the casement window sashes in an open position. There is one piece of hardware per window sash.

A concrete chimney on the northwest end of the southwest wall measures 14" x 20" wide. The top of the chimney is stepped back on an approximately 45- degree slope to a small square top. The chimney height is 12'- 10" from the top of the concrete to the bottom of the set- back. The roof slab also has a 45- degree angle at the top surface.

Feature Condition

General

The weight of the Observation Station, superimposed on the Loading Platform floor and scarp walls has resulted in differential loading and movement in the Loading Platform slab. This movement is evidenced by a 3" wide crack of undetermined depth separating the outer platform slab from the portion supporting the Observation Station. In addition, the level of the slab supporting the Observation Station is 2" lower that the remainder of the Loading Platform slab.

There is about 4 sf of exposed rebar along the lower left side of the northwest wall, northeast of the doorway opening. There is another substantial area of exposed rebar on the northwest wall above the doorway hood, totaling 15 sf. There are incipient spalls adjacent to the already exposed rebar. On the north wall there is an area of exposed rebar along a pour line, 11'- 0" above the Loading Platform floor. This area is approximately 7'- 0" long x 6"- 8" wide.

Roof

The roof overhang fascia is failing in several areas totaling approximately 8 lf, due to the thin section of the overhang, poorly consolidated aggregates in the concrete mix, and placement of rebar too close to the surface of the concrete. The roof soffit shows a number of areas of spalling concrete and exposed rebar, totaling 10 sf. The beveled edge of the top of the roof slab has approximately 4 sf of spalled or poorly consolidated concrete. The west corner of the chimney base shows cracking and spalling possibly related to differential settlement. This damage appears to be of fairly recent origin.

SECTION 5.

INSTALLATION AND USE OF THE CONDITION ASSESSMENT DATABASE

INTRODUCTION

Overview

Existing conditions were documented as a feature inventory, using a Microsoft Access 2002 database developed for this project. The following categories of information are included for each feature as appropriate: existing appearance, historical evolution, conditions assessment, treatment recommendations, cost estimates, and references. The condition assessment program consists of two linked databases – **UNH Data.mdb** and **UNH Front End.mdb**. The Front End contains the user interface, data entry, and report forms. UNH Data consists of the tables containing the data as shown below.

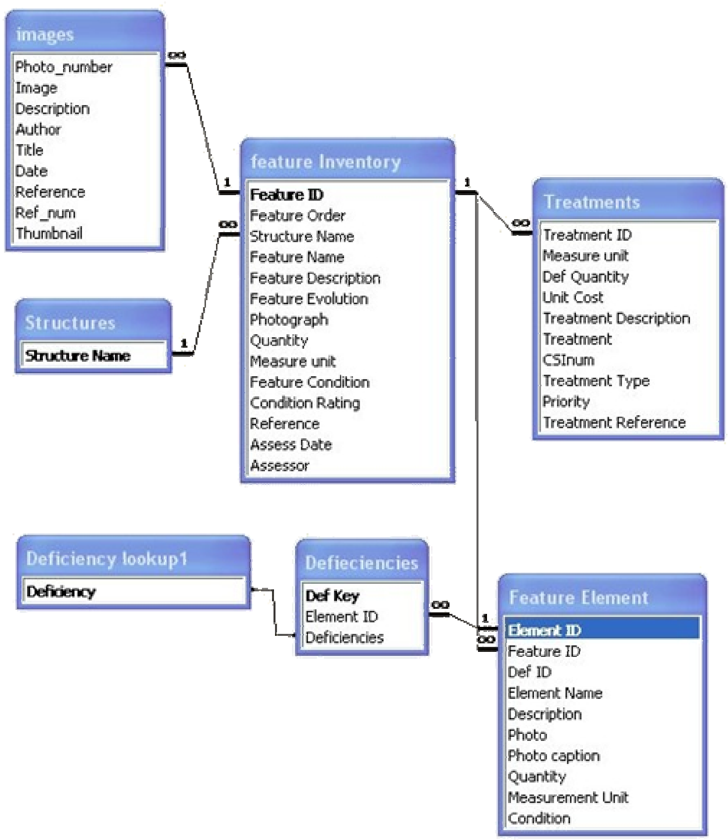
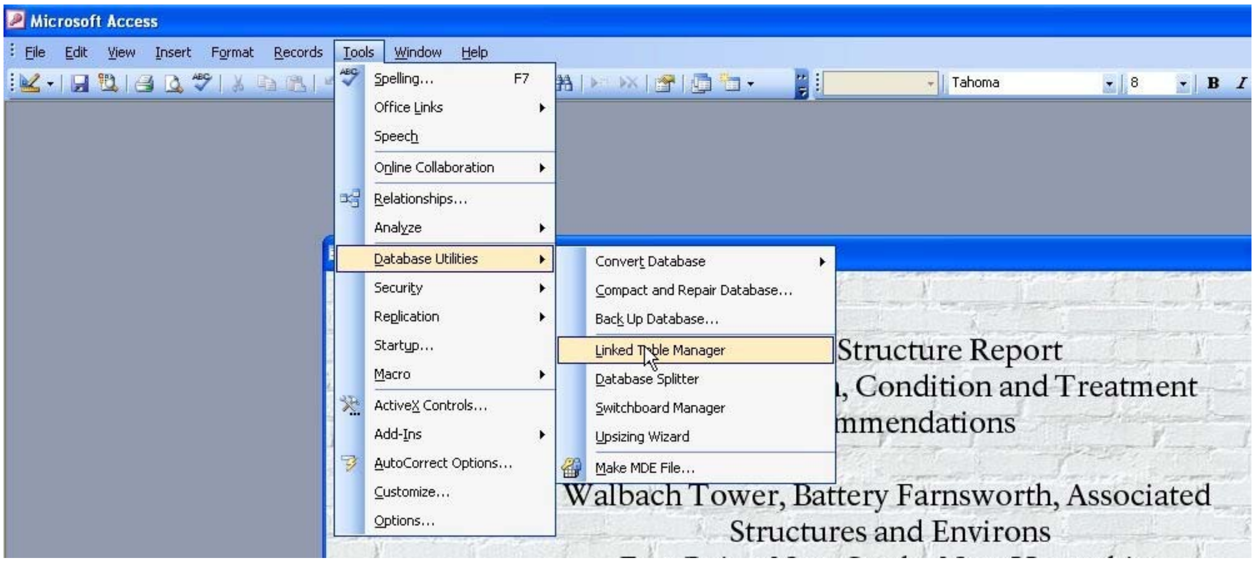


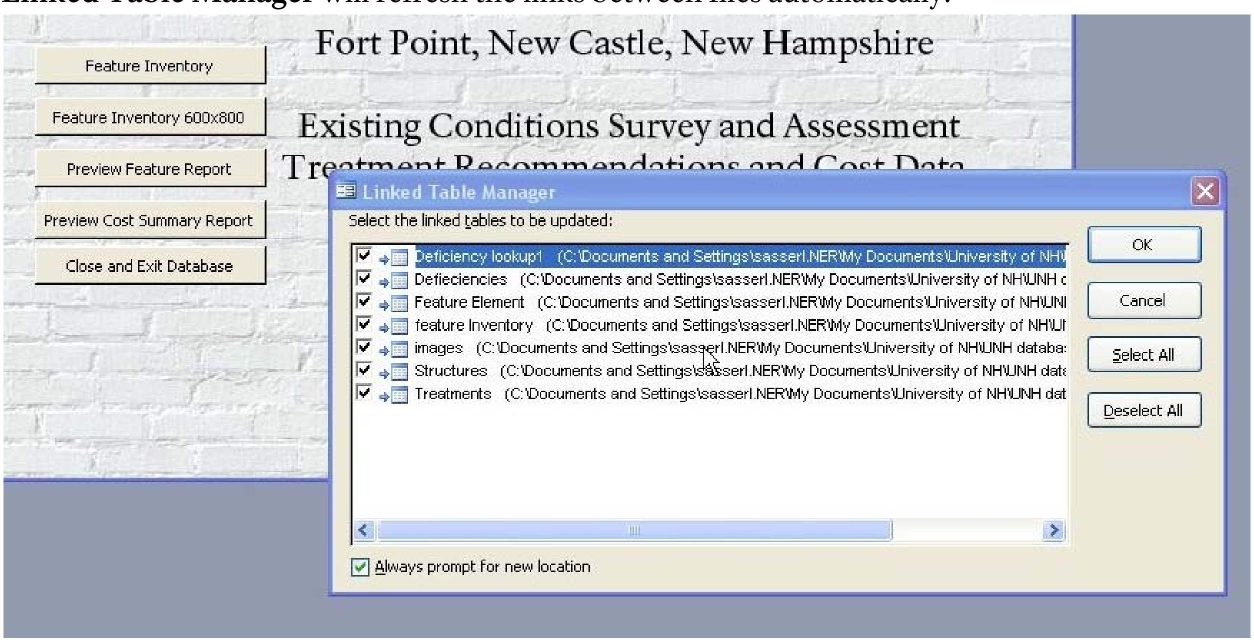
Figure 1. UNH Data.mdb tables and relational structure.

Installing the Database

Copy the **UNH Data.mdb** and **UNH Front End.mdb** files to a directory on a local or networked hard drive. Double- click on the **UNH Front End.mdb** file to open the menu screen. Associate the link file in the new directory structure by selecting **Database Utilities** and **Linked Table Manager** from the **Tools Menu**.

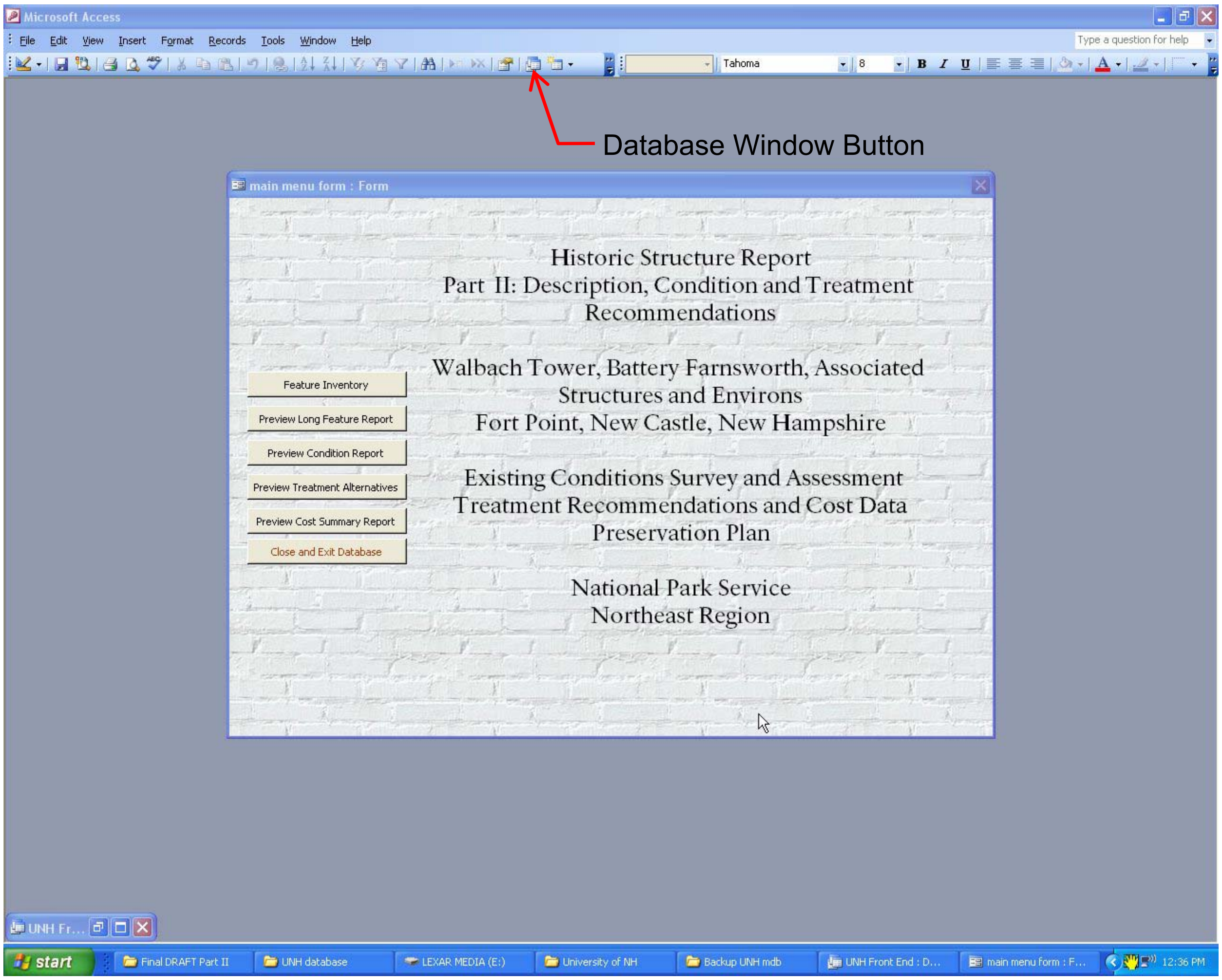


Choose **Select All** and **Always prompt for new location** in the **Linked Table Manager** pop up box. Enter **OK**, and select the new location of the file **UNH Data.mdb** at the prompt. The **Linked Table Manager** will refresh the links between files automatically.



Using the Database

Use the screen menu to view or edit the Feature Inventory, view or print reports, and exit the database. Additional functions can be accessed by clicking the database window button on the tool bar at the top of the screen.



Using the Feature Inventory

The **Feature Inventory** screen contains tabbed sections for viewing and editing graphic images, description and condition information, and treatment recommendations.