Fort Taber / Fort Rodman
New Bedford, Massachusetts

Architectural / Structural Assessment & Feasibility Study for Universal Accessibility

Final Report

Prepared by

Bargmann Hendrie + Archetype, Inc.
Boston, Massachusetts

for

City of New Bedford, Massachusetts

September, 2013

[Note: this page deliberately left blank.]

Purpose of this Report

The City of New Bedford is the owner and steward of the Fort Taber / Fort Rodman military complex located on Clark's Point on the southern tip of the city. The City contracted with Bargmann, Hendrie + Archetype, Inc. to assess the current conditions of Fort Rodman and to prepare recommendations and priority Phase IV Construction Documents for the stabilization and preservation of the fort. This report is intended as a means for City staff to prioritize capital needs for this National Register District and eventually open the fort to the public.

Executive Summary

Fort Rodman was constructed between the years of 1857 and 1871 on Clark's Point in New Bedford, Massachusetts. The fort and the surrounding land have a long and important military history. The surrounding land is now a 47-acre public park owned and operated by the City of New Bedford. The fort is in need of stabilization of its granite and brick masonry walls, vaults, arches, columns, floors, terreplein, rooftop structures, and iron components. It is also necessary to keep the public safe during events and to enhance visitor's experience by providing universal accessibility and interpreted spaces. Recommendations in this report encompass structural stabilization, preservation of character-defining features, aesthetic improvements, building code compliances, public safety, accessibility, and interpreted learning experiences.

Research

Bargmann Hendrie + Archetype, in preparation for the building survey and conditions assessment work, reviewed existing documentation, with the intent of best understanding the existing construction and dates of alterations. Scans of original drawings and renovations were provided by the City of New Bedford.

The team spent some time researching in the Fort Taber/Fort Rodman Military Museum. They also conducted phone and in-person interviews with Ron Labelle, Commissioner for the City of New Bedford Department of Public Infrastructure, Bob Bromley, Curator at Fort Taber/ Fort Rodman Military Museum and Joseph Langlois, President of the Fort Taber/ Fort Rodman Historical Association.

Survey and Investigations

On-site survey and investigation work included two site visits from Bargmann Hendrie + Archetype (BH+A) and Structures North (SN), and one site visit from Kyle Zick Landscape Architecture (KZLA) and Building Engineering Resources (BER).

Conditions Assessments and Recommendations

The conditions assessment and recommendations has been organized by building component. The organization continues through to the cost estimates, priority recommendations, and cyclical maintenance matrix. The landscape, structural, and electrical/plumbing consultants all have stand-alone reports with conditions assessments and recommendations in the Appendix section of this report. Their recommendations have also been summarized in the body of BH+A's report.

Scope Matrix

Three scope matrixes were provided:

1. Treatment Recommendations and Cost Estimate – organizes scope items into Minimal, Basic, and Optimal treatment categories with associated costs.

2.Priority Treatment Recommendations – prioritizes scope items into Emergency (1-3 years), Short Term (3-5 years) and Long Term (more than 5 years) categories.
3.Cyclical Maintenance Recommendations – recommends maintenance after construction of scope items for Every year, Every 5 years, and Every 20 years with associated costs.

Condition Drawings

Existing drawings and site surveys were instrumental in documenting the current conditions in Fort Rodman. Condition drawings were developed by each disciple to better understand the scope of deterioration in the masonry walls, arches, vaults, metal work, and rooftop structures. The drawings complement the written description and condition assessment narrative and photographs.

Accessibility Options

Options were explored for horizontal and vertical circulation for visitors within the fort. The proposed solutions were designed to meet the requirements of American's with Disabilities Act (ADA) and the Massachusetts Architectural Access Board (MAAB). These options also explore the amount of public access within the fort and the need for the public to visit all areas and levels, or limit access for public safety.

Phase IV Construction Documents

A construction project is part of the scope of work in this contract, but will not be included in this assessment and feasibility study. A separate Phase IV Construction Documents Scope will be provided to the City, along with construction documents and specifications for a small-scale stabilization project.

The following consultants contributed to this study, including preparing reports and drawings:

Landscape Architects
Kyle Zick Landscape Architecture, Inc.
36 Bromfield Street, Suite 202
Boston, MA 02108

Structural Engineers
Structures North Engineers, Inc.
60 Washington Street, Suite 401
Salem, MA 01970

M/E/P/FP Engineers
Building Engineering Resources, Inc.
66 Main Street
North Easton, MA 02356

Masonry Consultant
Schnabel Conservation, L.L.C.
110 Kensington Avenue
Trenton, New Jersey 08618

Cost Estimating
D. G. Jones International, Inc.
3 Baldwin Green Common, Suite 202
Woburn MA 01801

Table of Contents

A. General Description and History

Fort Rodman is a two-tier, seven-sided granite fort constructed in 1857-1871 on Clark's Point in New Bedford, Massachusetts. The fort and the surrounding land have a long and important history, from the time of the Revolution to the present. Fort Rodman is located in the Fort Taber Park, a 47-acre public park owned and operated by the City of New Bedford, along with other batteries and a Military Museum. Clark's Point offers 270 degree views of Buzzards Bay, Clark's Cove, and the Elizabeth Islands. The Fort Taber/Fort Rodman military complex, including the fort and the five Endicott-period batteries are listed on the National Register of Historic Places as a Historic District.[1]

The intimidating walls of the fort are two stories high and outlined with coping stones at the roof. The five sided intimate interior has a unique composition of repetitive open casemate archways and rectangular window and door barracks openings. The barracks, or living quarters of the Officers are located on the first and second tiers at the northwest, entry elevation. The rest of the areas are dedicated to casemates where gun embrasures look out over the open waters and gun powder magazines that are tucked into the corners of the fort. There are four magazines at each tier and three on the roof. The earthen roof, referred to as a terreplein, is an interesting feature of the fort. There are there hidden magazine rooms under the mounds on the terreplein, and three structures on top of the terreplein – a lighthouse, a fire control tower, and a search light shed.

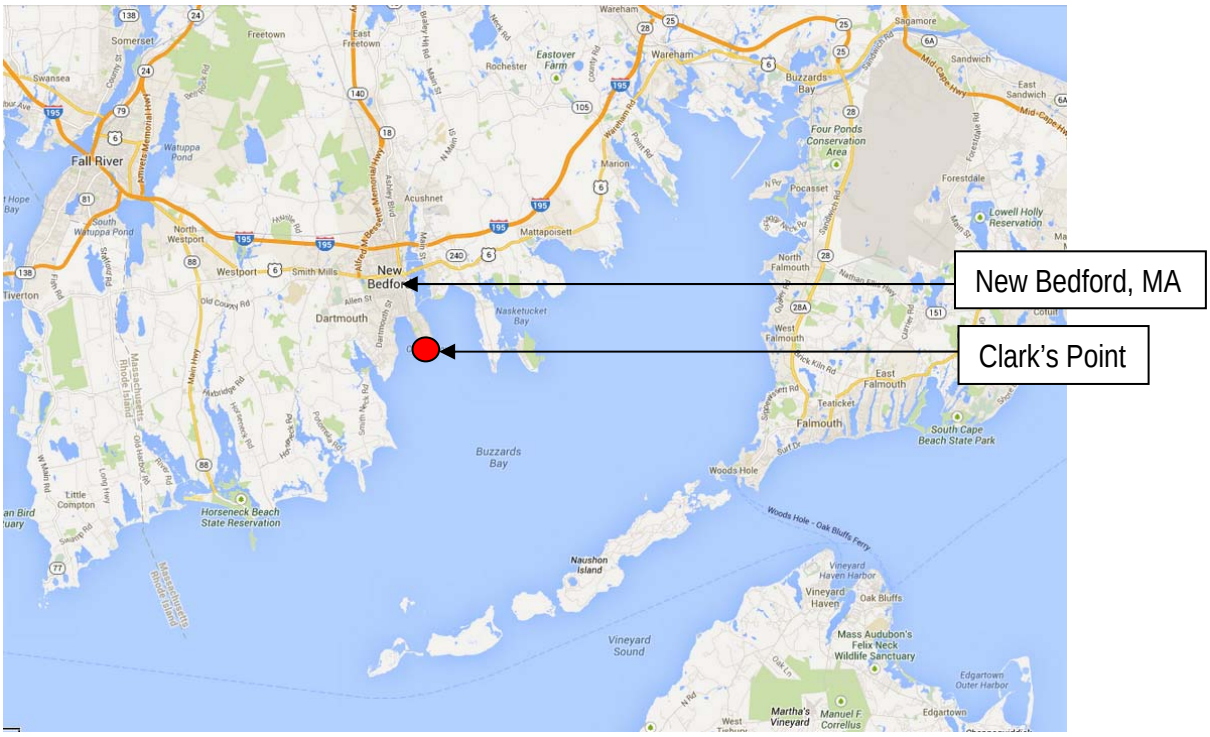


Figure 1. Map of Buzzards Bay area, New Bedford, MA and the Elizabeth Islands. (www.google.com.)

[1] "City of New Bedford Official Website." City of New Bedford Official Website, http://www.newbedford-ma.gov/Tourism/Attractions/FortTaberPark.html

Figure 2. Clark's Point at the southern tip of New Bedford.


Figure 3. Arial view of Ford Rodman.

Figure 4. The main entrance is on the northwest elevation of the fort.

Figure 5. Inside the parade grounds.

Historical Summary

In the 1840's a plan was set out for the construction of a military fort at Clark's Point in New Bedford that would link the northeast coastal defense systems. The land was purchased in 1857 and construction of a granite, three-tiered, seven-sided fort began. Granite was shipped from Fall River, Massachusetts and Sullivan, Maine. This fort is now known as Fort Rodman.

The outbreak of the Civil War in 1861 halted the construction and left Clark's Point venerable for attack. Mayor Isaac C. Taber and the New Bedford City Council commissioned a temporary earthworks fort just north of the granite fort under construction. On May 11, 1861, the earthworks fort was complete and named Fort Taber after the City's Mayor. Fort Taber was in commission for two years as the stone fort continued construction under the supervision of Captain Henry Martyn Robert. By 1863, the Fort Taber earth works was dismantled and the canons were moved and installed in the new stone fort. The exact location of Fort Taber is outlined in the grass opposite the entrance to Fort Rodman. The light at the Clarks' Point Lighthouse, built in 1804, was moved to the top of the fort in 1869 because the two tiered walls now blocked some views to the light. With the end of the Civil War "The Fort at Clark's Point" stopped construction in 1871 and the third tier was never completed. In 1898, the military complex at Clark's Point was officially named Fort Rodman in honor of Lt. Col. William Logan Rodman, although locals still call it Fort Taber.[2]

During the time after the Spanish American War (1898) and during World War I (1917-1920), many improvements were made to Fort Rodman and the surrounding military complex. In 1899, a bomb-proof mine storage room was constructed in the north corner of the fort. Mines were carried from the fort to the pier in the New Bedford harbor by a system of underground rails. A two-story concrete and brick fire control tower was built on the terreplein, as well as a wooden structure to house a 60" diameter search light for signaling. This structure was later replaced with the more permanent brick and concrete building with iron rails.[3] Between 1899 and 1902, the Barton, Walcott, Craig and Cross batteries were constructed of reinforced concrete. In the 1920's, Battery Milliken was built with all the advancements of new technology and chemical warfare.[4]

Fort Rodman was an active military base leading up to World War II (1941-1995). The National Guard Coastal Artillery regiments were activated and stationed at Fort Rodman in the 1940's. The fort was also protecting the strategic waterway through the Cape Cod Canal.[5]

After WWII, the military base was decommissioned and the Rodman guns and large artillery was removed. The military complex became a reserve base in the 1960's and 1970's for the Marine Corps, Coast Guard, Army and Navy. A sewage treatment plant was built to the east of Fort Rodman in 1968 and can be seen in Figure 11. The last reserve unit left the base in approximately 1990 and the modern military structures were demolished to make way for a larger sewer treatment plant built in 1996.[6]

The City of New Bedford purchased the Fort Rodman complex in the 1970's and developed it into Fort Taber Park in the late 1990's for recreational and educational purposes. Events in the fort such as living

[2] "History of the Fort." Fort Rodman Historical Association, Inc. http://forttaber.org/history-of-the-fort/
[3] Bob Bromley, Curator at Fort Taber/ Fort Rodman Military Museum. Phone interview. 12 Aug 2013.
[4] "History of the Fort."
[5] Bob Bromley
[6] Bob Bromley

history programs, war and historical reenactments on the grounds around the fort, as well as the Military Museum displays, has kept the history alive and visitors coming back to this site for many years.[7]

Figure 6. Image of Fort Taber, 1906. (D'Entremont, Jeremy. "Clark's Point Lighthouse, New Bedford, Massachusetts." Clark's Point Lighthouse, New Bedford, Massachusetts. Blandchard, Young & Co, http://lighthouse.cc/clarkspoint.)

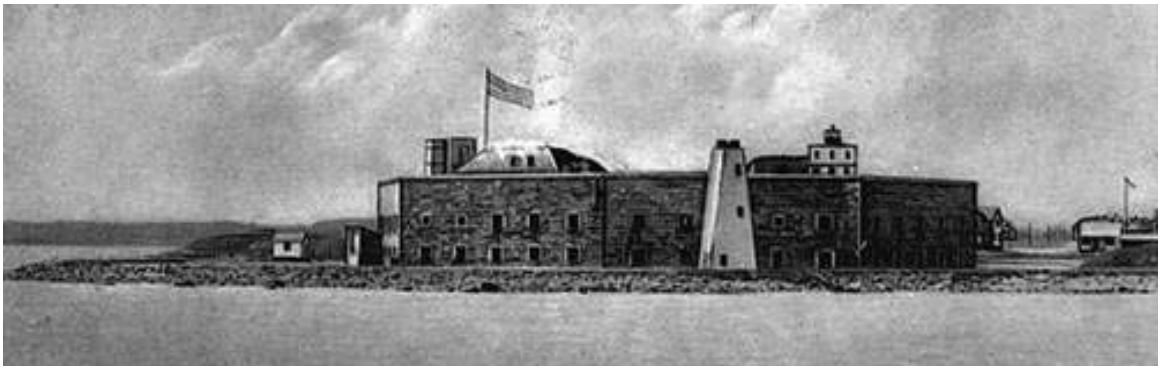


Figure 7. Image of Fort Taber, date unknown. (D'Enteremont, "Clark's Point Lighthouse, New Bedford, Massachusetts.")

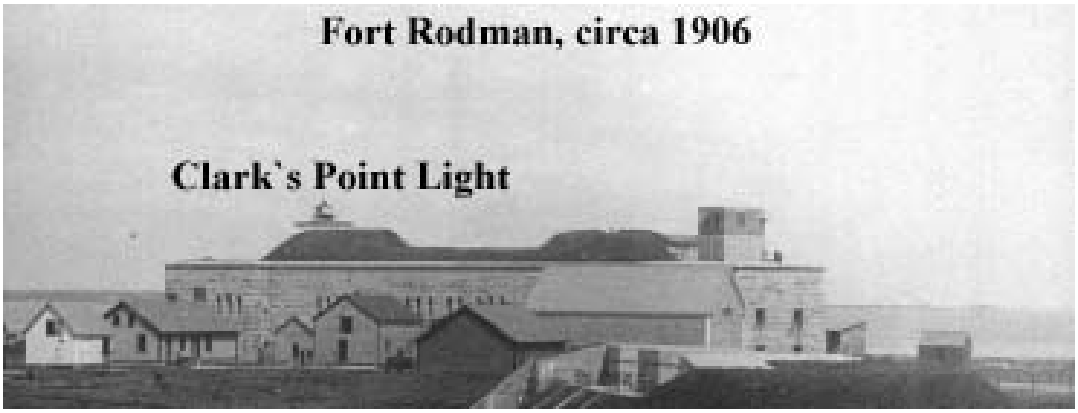


Figure 8. View of other military structures on the base in 1906. (Debbie Dolphin. Clark's Point Light Station. New England Lighthouse wallpapers. http://home.comcast.net/~debee2/mass/ClarksPoint.html)

[7] "History of the Fort."

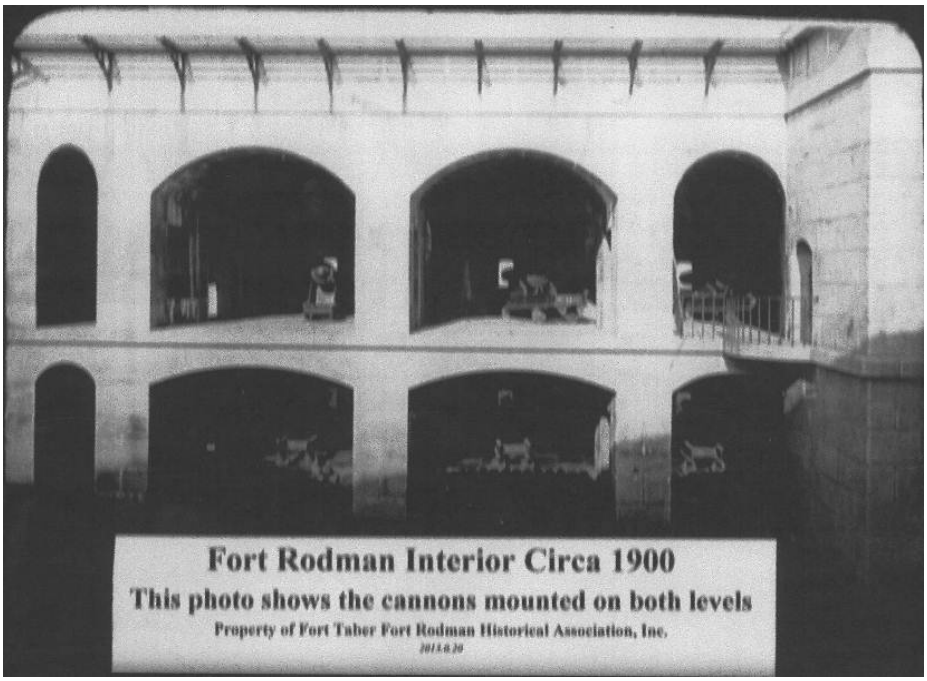


Figure 9. Fort Rodman interior of casemates with cannons mounted on both tiers. (Fort Taber / Fort Rodman Historical Association, Inc. "Fort Taber / Fort Rodman Historical Association." Fort Taber Fort Rodman Historical Association Inc. New Bedford Internet, http://forttaber.org/)

Figure 10. Interior of parade ground. Note original guard rails on second and terreplein levels, wood roof on stair tower, and wood shed in parade ground. Date unknown. (Fort Taber / Fort Rodman Historical Association, Inc.)

Figure 11. Clark's point, 1974. Note sewer treatment plant behind fort and military buildings throughout the site. (Begel, Judith. "Historical Analysis Municipal Wastewater Treatment, Clarks Cove, New Bedford MA." US EPA, United States Environmental Protection Agency. USA GOV, http://www.epa.gov/region1/superfund/sites/newbedford/25743.pdf.)

Figure 12. Fort Taber Park site map, 2013. ("City of New Bedford Official Website." City of New Bedford Official Website, http://www.newbedford-ma.gov)

Figure 13. Civil War reenactment. (Silvia, Mike. "New Bedford Guide | Your Guide to New Bedford and South Coast, MA." New Bedford Guide. http://www.newbedfordguide.com)

B. Conditions Assessment and Recommendations

Note: For purposes of this report, the entrance to the fort is on the northwest elevation.

1. Roof and Terreplein (also see SN Structural Conditions Report and KZLA Site Narrative)

The terreplein, a once sculpted and maintained lawn and gun emplacement deck (Figure 17), is now overgrown with vegetation. Existing drawings of the fort show earth fill on top of a brick base. Between the brick layer and top of the brick ceiling vaults could be a layer of cinder concrete; indicated by a stipple pattern on the existing section (Figure 18). It is unknown if the gun emplacements were ever finished, but the existing drawings indicate that the foundations for the platforms were completed. The emplacements were designed for 10" or 8" Rodman guns, or 300lb, 200lb, or 100lb Parrott Guns. One section of the terreplein was excavated to reveal a concrete platform, a rusted pipe, and brick back-up for the stone parapet wall (Figure 20).

Magazines are located under earthen mounds on the terreplein; one on the northwest corner, one on the southwest corner, and one on the south. An existing section of the magazine shows that they are constructed of brick, encased in cinder concrete and covered with earth and grass (Figure 19). Accessed from the roof, a doorway leads down a short flight of stairs and around an "L" shaped hallway to reach the 15 feet long by 13 feet wide magazine. At the retaining wall around the southern magazine, the coping stones are bowed outward due to soil loads on the magazine structure. Spalled and cracked stones were found near the entrance to the magazine.

Brick ruins of chimneys from the barracks fireplaces are located at the terreplein. Most of the ruins are hard to see and access because of the thick vegetation. The top of brick flues from the casemates can also be found along the terreplein. These flues vented smoke from the Rodman guns in the casemates on the first and second tiers.

There is a system of 35 roof drains that collect rain water from the terreplein and drain it to downspouts located inside the masonry walls (See Figure 16). The earth on the terreplein is sloped toward the drains for suitable drainage down to channels below the parade grounds and possibly discharged out to sea. In recent years, this system has failed and allowed an excess of water to build up on the terreplein and pour into the vaults below.

A few interesting structures sit on top of the fort roof. A wooden light keeper's shack was built on top of the north stairwell and the light from the nearby lighthouse was moved to the roof of the shack. A brick search light shed with a concrete roof and floor slab is located at the south corner of the roof. A narrow iron railway starts in the building and extends along the west section of the roof, but is partially covered by vegetation. The 60" diameter search and signal light used to run along this rail. A 2-story concrete and brick fire control tower is located on the southeast corner.

The well-groomed turf, seen in Figure 17, is too much maintenance than the City can handle. The steep slopes and unprotected edges of the roof add to the maintenance problem. Grass, trees, and shrubs are growing throughout the terreplein. Invasive species and poison ivy have also taken root. Roots from all of the vegetation cause deterioration of masonry by causing cracks in mortar and masonry and provide avenues for water infiltration.

Recommendations:

Extensive water is seeping through the terreplein and draining down to the masonry ceiling vaults, walls, and arches below. To prevent further water deterioration, it is recommended to remove the earth fill above the casemates and barracks and stockpile suitable material for reinstallation. Introducing a waterproof membrane roofing system and flashings could prevent the water from further deteriorating the masonry below.

Remove soil from the south magazine wall and re-set and/or anchor the stones to the wall below. Spalled and cracked stones should be replaced or dutchman-repaired. Repointing exposed copings, parapets, and retaining walls is recommended.

The earth grade should be restored to the 1906 profile and appearance. Vegetation should be cleared from the terreplein. Cut stems of invasive plant species and woody vegetation and apply an herbicide to kill the roots of the plants. Provide geogrid soil reinforcement layers and/or a long-term erosion control blanket to retain and structure the new fill, especially on the steep slopes of the magazine roofs. Reseed the terreplein with a no-mow fescue turf mix to keep maintenance to a minimum.

Existing roof drains should be located, documented, and re-established down through the piers and walls to below-grade channels and existing drain pipes exiting the fort.

Locate and document the existing chimney ruins. They should be reconstructed based on physical evidence, construction drawings, and old photographs.

Figure 14. View of north terreplein and lighthouse.

Figure 15. View of south terreplein, concrete bunker, brick head house, and magazine retaining wall.

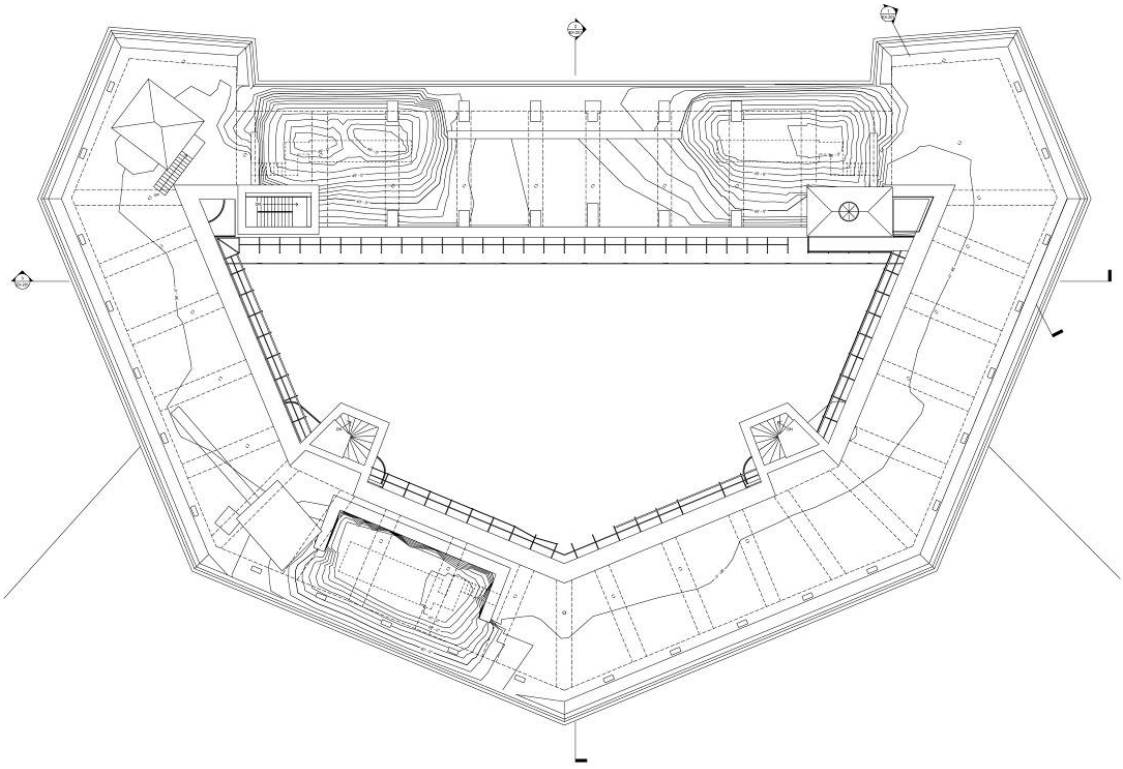


Figure 16. Roof plan (BH+A)

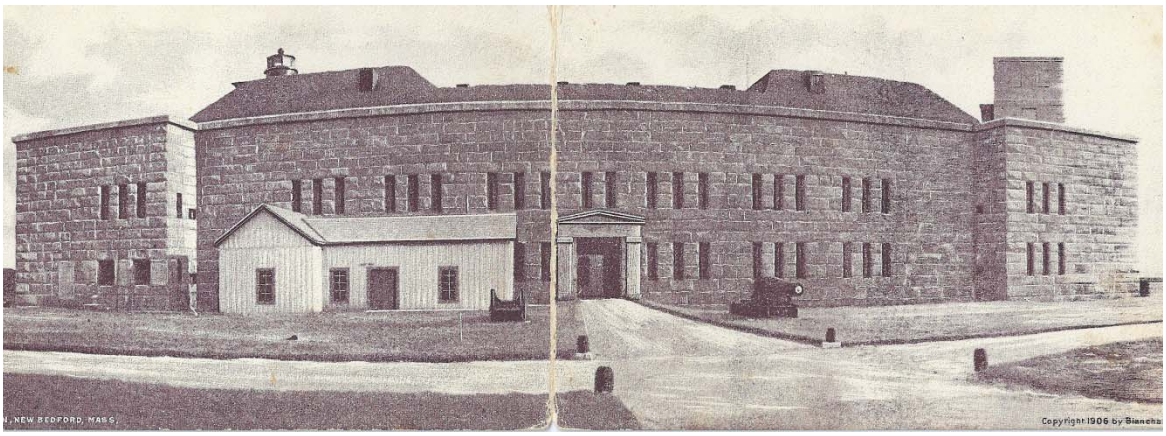


Figure 17. Image of Fort Taber, 1906. (D'Enteremont, "Clark's Point Lighthouse, New Bedford, Massachusetts.")

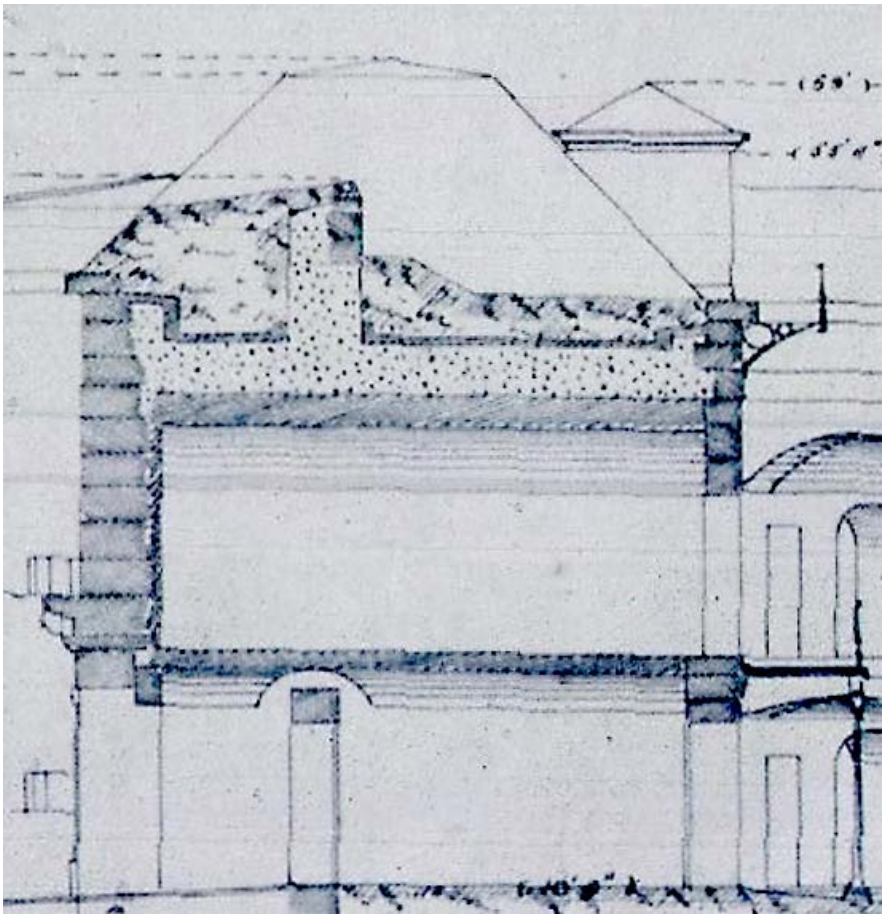


Figure 18. Section of fort walls from original drawings. Note layer of brick and cinder concrete below earthen terreplein.

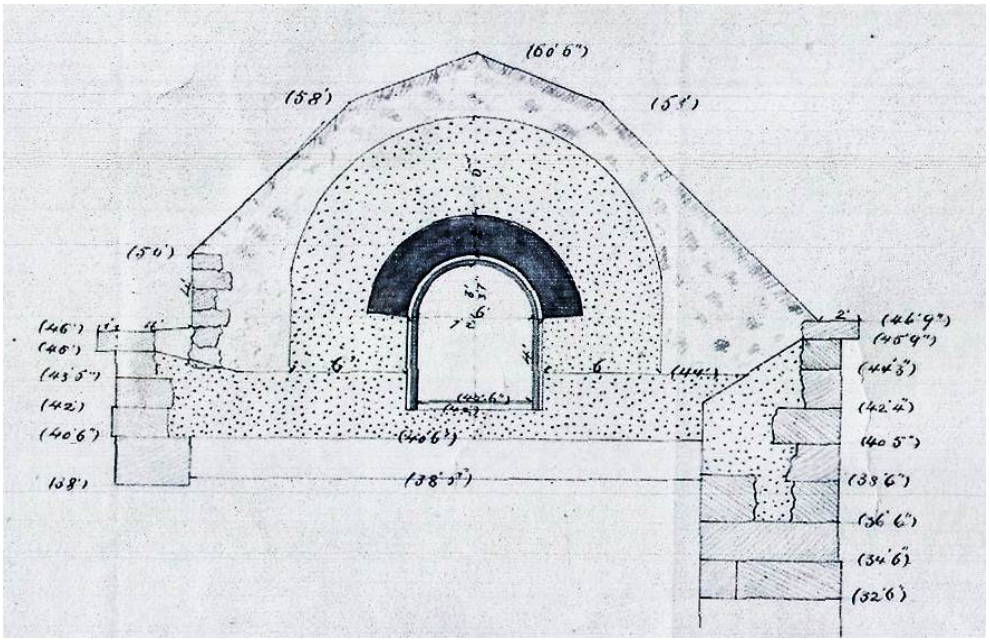


Figure 19. Section of magazine from original drawings. Note cinder concrete, retaining walls, and earthen terreplein construction.


Figure 20. Excavated area of roof reveals concrete foundation for gun emplacements.

2. Exterior Masonry Walls (also see SN Structural Conditions Report)

The exterior rough-cut granite block walls are about 36'-0" tall and about 7'-6" thick. A granite pediment and pilasters mark the main and only entrance on the northwest elevation. Most of the mortar joints at the exterior walls have eroded and some granite blocks have cracked. Algae growth can be found on the north and northwest elevations along with vegetation growth in the mortar joints. The rusted iron trim embrasure openings have caused staining on large areas of the masonry directly under the openings. Efflorescence is also visible on the exterior elevations due to water infiltration.

Open mortar joints were found at the connection of the exterior granite walls and the brick vaulted ceilings at the 1st and 2nd tiers. This could be due to outward pressures on the exterior wall from the soil on the terreplein, and/or lengthening of the exterior walls due to rusting embrasures. Expansion of the rusting metal embrasures have caused movement and cracking in the granite stones and mortar joints. Movement in the exterior walls was also noted in the widening mortar joints at the cornice stones. There is so outward bowing and lifting of the cornice stones at multiple walls.

Recommendations:

Cut and repoint mortar joints on all elevations. Reset dislocated stones and repair cracks in stones with an epoxy injection to prevent water infiltration. Repoint via grout injecting open mortar joints between the exterior wall and the brick vaulted ceilings. Bowing cornice stones should be anchored to the stone walls below. Lead weather caps could be installed at sky-facing joints to prevent water infiltration and mortar deterioration.

Lateral soil loads on the exterior walls can be reduced by installing geogrid soil reinforcement layers. Treat rusting embrasure ironwork to prevent further cracking of granite stones and mortar joints. Treat rust stains with a chemical cleaner. Algae and efflorescence should be removed from stone surfaces and vegetation should be removed from mortar joints.

Figure 21. South elevation of exterior walls.

Figure 22. Northwest elevation of exterior walls. Note concrete-filled door and window openings.

3. Interior Granite and Brick Masonry Piers and Walls (also see SN Structural Conditions Report)

The parade elevations were constructed with more refined and smooth-cut granite blocks than the exterior. The casemate elevations are composed of granite arches and piers with two solid stair towers that jut out into the parade ground. The arches on the first tier are shallower than the arches on the second tier. The barracks elevation has door and window openings but functional doors and windows have been removed. A two story gallery on the barracks elevation has iron columns and a stone slab deck (Figure24). Original intricate railings on the 2nd tier gallery seen in Figure 10 have been removed. In 2001, a graffiti removal project was commissioned to remove massive amounts of graffiti on the walls throughout the fort.[8]

There are rust stains running down the parade elevations from the iron brackets at the roof galleries. Efflorescence is present on the parade elevations and interior stone and granite masonry walls. Most of the mortar joints at the barracks parade granite walls have eroded. On the southwestern end of the barracks parade walls, widening and open mortar joints around the doorways to the barracks indicate potential movement in the granite stones. There are also eroded mortar joints along the piers of the casemate parade elevations.

The interior walls of the casemates are about 4'-0" thick and constructed of solid granite. A large doorway and arched opening are a repetitive feature in almost every interior wall. Cracked granite lintels were found over the doorways at the casemates. The interior walls of the barracks were built of brick and have an arched opening, a rectangular fireplace and an arched fireplace in almost every wall. The barracks also have a one-wythe interior furring brick wall that was most likely built to keep moisture out of the finished room. Spalled brick are located at ceiling vaults, arched openings, and upper wall surfaces due to extensive moisture in the masonry. The surface brick of the east magazine on the 2nd tier is buckling.

[8] Bob Bromley.

Recommendations:

Remove inappropriate concrete patches at the brick walls and infill with brick. Dismantle or reconstruct brick furring walls at quarters for aesthetic or historical reasons. Remove vegetation from mortar joints and algae from granite. Remove graffiti and treat rust stains with a chemical cleaner. Remove efflorescence from masonry surfaces. Dismantle and reconstruct all shifted masonry at buckled walls. Pin-repair cracked granite lintels over doorways and use an epoxy injection at cracks in the granite. Epoxy-inject cracked granite stones and cut and repoint all granite and brick masonry. Removed and replace spalled brick where the masonry is to be reconstructed or repaired. Only remove the most damaged spalled brick where no other masonry repairs are needed.


Figure 23. Interior parade walls at casemates.


Figure 24. Interior parade walls at barracks.

Figure 25. Living quarter brick structural walls and furring walls with graffiti, efflorescence and mineral deposits.

4. Brick Masonry Arches and Vaulted Ceilings (also see SN Structural Conditions Report)

The ceilings in all of the casemates and barracks are structural brick barrel vaults. Water infiltration has caused the vaults to elongate and create large cracks in the masonry. Masonry cracking occurs when water is absorbed in the brick and then undergoes freezing and thawing cycles. Generally, these cracks run transversally across each vault between the granite support walls. A few of the arch spans at the vault ceilings have shifted laterally. The vault cracking is minor on the 2nd-teir casemate vaults but more significant on the 1st-tier casemate vaults. The amount of cracks at the vaults in the barracks is relatively equal between the 1st and 2nd-tier vaults.

Some of the bricks at the vaults and arches have spalled and dropped from the ceiling (Figure 26). The interior granite casemate walls and barracks walls have brick archways that are badly deteriorated. Large sections of these arches have jacked out of place and spalled and crumbled the brick (Figure 28). The arches have cracked, slipped and widened. The mortar joints in the arches and vaults on both tiers have eroded. Wood support columns have been placed under most of the casemate arches to provide some temporary stabilization. The deterioration in the arches and vaults are compromising the structure of the fort as well as creating a safety hazard to visitors.

Recommendations:

If only minor work is to be completed in the first phase of construction, adjust, repair or supplement temporary wood column shoring, as well as install plywood forms at the loose brick masonry with in the vaults and arched openings to protect the public from falling debris. At failed facings of arches between casemates, remove and stockpile loose face brick to prevent falling debris.

Efflorescence should be washed or brushed off the masonry to create a "clean slate" for observing patterns of subsequent moisture infiltration over time.

Approximately 1/3 of the brick arches will need to be significantly repaired and partially reconstructed, while most of them will require resetting portions of the missing brick. Once the brick back-up walls are exposed, additional reconstruction may be required. Dismantle and partially reconstruct select brick vaults and injection-grout all cracks at arches and vaults. Repoint all brick masonry. At vaults where surrounding brick is stable, cracks should be jet cleaned, pointed, and injected with a compatible grout. Once arches are stable, it will be possible to remove all wood support columns.

Figure 26. Brick arch at interior granite wall. Note large crack in vault, missing brick at arch, efflorescence, and wood support column as a typical condition throughout the fort.

Figure 27. Large portions of the brick in the arches have been displaced and fallen to the ground.

Figure 28. The outer wythe of brick has jacked out of place due to water infiltration and expansion of the brick in the arches and ceiling vaults.

5. Bluestone Floor Surfaces

The 1st and 2nd-tier casemate floors are made of bluestone pavers set into grout. For the most part, these stones are in good condition. Some of the floor surfaces are covered in debris and it is difficult to see the condition of the stone. Some stones have collapsed over drainage channels at the 1st-tier floor (Figure 30). Some stones have shattered or disintegrated and now pose tripping hazards (Figure 31). Green algae has formed on the stones that do not get sunlight during the day.

The condition of the iron tracks for the Rodman guns vary from casemate to casemate. Some tracks are almost completely intact while others have been removed or are barely visible due to deterioration.

Recommendations:

At bluestone slabs that have caved-in or collapsed over drainage channels, provide new, removable bluestone slabs to match originals. Remove vegetation and biological growth throughout. Remove shattered and disintegrated stones and other paving deemed a tripping hazard and replace with salvaged and/or new bluestone slabs. Stabilize and epoxy-repair delaminated and cracked pavers otherwise in fair to good condition.

Figure 29. Bluestone walking surfaces and iron canon tracks at 1st-tier.

Figure 30. Collapse of bluestone over drainage channel.

Figure 31. Shattered bluestone slabs at 1st-tier.

6. Other Walking Surfaces

The 1st-tier barracks have compacted dirt floors that are anywhere from 4" to 9" below the stone door threshold. During later renovation into a "power plant," the southwest barracks has a poured concrete floor and four raised concrete pads. The 2nd-tier barracks floors are interesting because they expose the top of the 1st-tier barrel vault ceiling. Concrete with large stone aggregate fills in the uneven floor at the interior walls and low points of the vault (Figure 32).

The 1st-tier magazine floors are depressed about 1'-6" and have stepped concrete around the perimeter walls (Figure 33). The 2nd-tier floors are dirt with remnants of wood framing members and wood floor boards. The boards are now deteriorated, but the southwest magazine floor is a good representation of what the floor used to look like (Figure 34).

Recommendations:

At the 1st and 2nd-tier magazines and 1st-tier barracks with depressed or sunken floor levels, document existing conditions, remove debris and provide new compacted fill at floor. Align finish grade with existing door thresholds and walking surfaces to make accessible. At the 2nd-tier barracks, provide a wood boardwalk over a portion of the existing floor but leave a portion of the floor exposed to show the top of the brick vault and concrete construction. See Accessibility Option A for proposed area of boardwalk.

Figure 32. Top of barrel vault on 2nd-tier floor of barracks.

Figure 33. Depressed floor in southwest magazine room on 1st-tier.

Figure 34. Wood framing and floor boards in southwest magazine on 2nd tier.

7. Cast Iron Columns and Capitals (also see SN Structural Conditions Report)

Directly after exiting the sally port and entering the interior of the fort, soldiers would have been protected by a covered gallery running the whole length of the northwest parade elevation. The two-tier gallery is located off of the living barracks and provided a walkway between the casemates and the barracks. The existing cast iron fluted columns are in fair to poor condition. Most of the acanthus leaves are missing and the columns and soffits are rusted. The first column directly to the south of the sally port has cracked and shifted. There is rust exfoliation on most of the iron beam soffits near the center of their span between the columns.

Recommendations:

Remove rust in situ and apply a zinc-rich primer to all ironwork. Repair and reinforce or replace the cracked column south of the sally port. Restore the acanthus leaf features by casting replicas in aluminum or fiberglass and finish the restored assembly with an appropriate primer and finish coats.

Figure 35. Gallery with cast iron columns.

Figure 36. Column capital with acanthus leaves still intact.

Figure 37. Column base is slightly covered with existing gravel walkway.

8. Upper Galleries

The upper roof galleries are a character defining feature of this fort. The cast-iron brackets, the iron railings, and iron supports are in poor condition, but are very interesting features that should be retained. All but one bracket remains, but the structural integrity is unknown. Most of the original railings were knocked down by vandals, but some sections still exist. Originally, a wood platform ran around the whole interior perimeter of the fort. It is unknown if iron railings were located at all perimeter sections. Historical photographs from the early 1900's (Figure 9 & 10) only show guardrails at the northwest section. There are existing guardrail sections at the north and south parade elevations. Further research should be conducted to determine when these additional railings were added. A small section of deteriorated wood boards can still be found on the north section. The gallery also provides access to the lighthouse, as well as the top of the metal north and southwest stair towers.

Recommendations:

Remove the deteriorated wood plank decking at upper gallery. Remove rust from the metal components in situ and apply zinc-rich primer and apply 2-3 epoxy finish coats to metalwork. Remove one intact bracket for documentation and replication and reinstall original bracket. Replicate a bracket and install it at the missing location on east corner. Repair the support rails throughout the gallery. Analyze the structural capacity of the gallery to carry loads. Reconstruct the wood gallery decking and guardrails at the north section and lighthouse entrance as a basic scope and reconstruct the wood gallery decking and guardrails throughout as an optimal scope.

Figure 38. Cast iron brackets, support rails, and guardrails at roof galleries.

Figure 39. Existing guard rails and wood decking at lighthouse.

9. Cast- and Wrought-Iron Railing Assemblies

Simple yet elegant railings follow the curved 2nd tier walkways at the circular granite stair halls and at either end of the 2nd-tier gallery walkways. The railing assembly at the north side of east stair hall has been removed, and balusters from the south side of the east stair hall are missing (Figure 40).

Recommendations:
Measure and document the existing railing assemblies currently stored on the 1st-tier. Remove rust in situ and apply a zinc-rich primer and 2-3 epoxy finish coats. Restore the cast-iron posts by casting replicas in aluminum or fiberglass and fabricating wrought-iron guardrails to match originals. Finish restored assembly of old and new components with appropriate primer and epoxy finish coats.


Figure 40. Existing railing assembly at circular granite stair tower.


Figure 41. Existing railing assemblies at 2nd-tier gallery and magazine entrance.

10. Cast- and Wrought-Iron Stair Assemblies

The north and southwest two-tier stair towers house iron stairs to access the 1st and 2nd tier, terreplein, and lighthouse. The stairs are rusted but in fair condition. The iron risers seen in Figure 42 have a diamond grate pattern. The handrails are too low and the risers are too steep to meet the current building code. The stair to get to the lighthouse floor is so steep it could be considered a ladder (Figure 43). A proposed accessibility scheme requires the removal of the southwest stair to make way for a LU/LA elevator.

Recommendations:

Document and remove the southwest stair at the time of installation of a LU/LA elevator. Salvage the southwest stair for spare parts to restore the north stair. Remove rust in situ and apply zinc-rich primer and 2-3 epoxy finish coats throughout. Restore the north stair assemblies (stair treads/risers, stringers, balusters, handrails) by casting replica components in aluminum or fiberglass or reusing components from the southwest stair.

Figure 42. North stair at roof level.

Figure 43. Ladder to lighthouse shack above north stair.

11. Barracks/ Living Quarters

The barracks or living quarters of the Officers are located on the northwest section of the fort, on both the 1st and 2nd-tiers. The lower rank soldiers would have slept outside of the fort in tents. Eventually, a base system was set up and separate barracks were constructed.[9]

The rooms had a door, two windows, and two fireplaces (Figure 44). There are no known historical photographs of the interior of these rooms. The Fort Taber/Fort Rodman Military Museum has interior barracks photographs from other forts around the time of the Spanish American War (1898). These can be compared to Fort Rodman for similar finishes. One photograph has wood beadboard walls painted a dark grey on the bottom half and white on the top half. The window trim was very plain and simple. It is also thought that the rooms were never fully completed because of the abrupt halt in construction in 1871.[10]

On the original plans, the veneer brick is not shown. The walls on the plans are shown at 3'-8" thick and in the field, the arched opening walls were measured at that exact dimension. With the gap between the wall and the dimension of a wythe of brick on either side, the current walls with the furring brick are measured at 4'-10" thick. The furring walls could have been a later addition, or just not drawn on the plans. More research is needed to come to a conclusion. In the 1980's, vandals dismantled the brick walls and stole the brick for salvage materials.[11] The condition of these walls differ from room to room, but the majority of them have been partially removed (Figure 45).

The southwest 1st-tier barracks is different than the others and is known as the "engine room" or "power plant." In the time around World War I (1914-1920), this room was an engine room that held diesel fuel in tanks that was distributed to the fire control tower and the search light shed. The room also housed an electrical generator that distributed electricity to the equipment. The finishes in the room are most-likely from this time period.[12]

The "power plant" room has a brick furring wall with an open doorway, a wood partition wall and a concrete floor with 4 raised concrete pads. The beadboard on the ceilings and partition wall are tongue-and-groove boards with two beads per board; the ceiling boards are wider than the wall boards. The ceiling boards are attached to wood furring joists that span across the barracks and sit on top of the brick furring walls. Transite ceiling panels attached to the wood beadboard ceiling may contain asbestos (Figure 46 & 47).

Recommendations:

More research is needed to determine the sequence of construction and renovation throughout the years to the "power plant" and to the other barracks.

At all barracks, remove and stockpile loose veneer brick. Remove and discard miscellaneous non-historic debris. Fill floor with dirt or stonedust to provide level walking surface that is even with the door threshold height for accessibility.

[9] Bob Bromley.
[10] Bob Bromley.
[11] Bob Bromley.

At 1st-tier southwest barracks, stabilize the mostly intact wood ceiling joists and beadboard ceiling finish. Remove the modern frame partition and suspected asbestos transite ceiling panels. Provide beadboard infill at northwest barracks ceiling to match the existing. Retain concrete pads of the former "power plant."

As an optimal scope, full restoration is recommended for one 1st-tier and one 2nd-tier barracks, including masonry veneer walls, fireplace surrounds and painted beadboard ceiling on wood furring joists. At the restored and interpreted quarters, provide an accessible floor surface, such as stonedust, lightweight concrete fill, or wood tongue-and-groove flooring on pressure-treated joists and sleepers. More research is needed to determine historical accuracy for wall, floor and ceiling surfaces.


Figure 44. Door and window openings and fireplace in barracks.


Figure 45. Interior brick masonry walls with arched openings. Furring walls have been removed in many barracks.

Figure 46. Southwest barracks “power plant”.

Figure 47. Transite panels on top of wood beadboard and ceiling furring joists.

12. Embrasures

Tall, thin embrasures on the northwest elevation were designed for riffle fire during battle (Figure 48). The square gun embrasures on the rest of the elevations had 12" Rodman canons on carriages mounted in the casemates. The gun embrasures have iron trim on the inside and outside perimeter of the opening and "Totten Shutters" that closed off the larger square opening (Figure 49).

Totten shutters were an invention by General Joseph Totten, a coastal fort designer in the 1850's. The shutters were unlocked from a strike plate on the sill of the opening. The shutters would swing open right before the shot was fired, and would rebound back into place.[13]

Many of the Totten shutters are still in place at the embrasures. Some are preserved behind the concrete block infill, although none are in working order. Severe rust has deteriorated the hinges and iron trim (Figure 50). The rusting of the embedded iron has started to jack the surrounding granite stone out of place as well as cause cracking in the stones around the openings.

The 1st-tier rifle embrasures have modern, rusting metal barriers to prevent vandals from entering the fort, while the 2nd-tier rifle embrasures are still left open. The 1st-tier gun embrasures are blocked with concrete masonry units and painted black. The 2nd-tier gun embrasures have modern metal barriers, but some of the original Totten shutters are still in place.

Recommendations:

Remove concrete block infill at all applicable 1st-tier embrasures, taking care to protect existing Totten Shutters. Where shutters are missing, provide new steel barrier assemblies. Remove rust at exterior embrasure casings, extant Totten Shutters and modern steel barriers and paint with a zinc-rich primer.

An optimal scope would be to restore one casemate embrasure to full operation, including iron Totten Shutters and associated bronze hardware. Partner with the Military Museum and other organizations to include a Rodman Gun exhibit. See Figure 51 of Rodman gun at Fort Jefferson in Florida.

[13] . "Preserving Fort Jefferson." Dry Tortugas National Park. NPS restoration bulletin. www.nps.gove/drto.

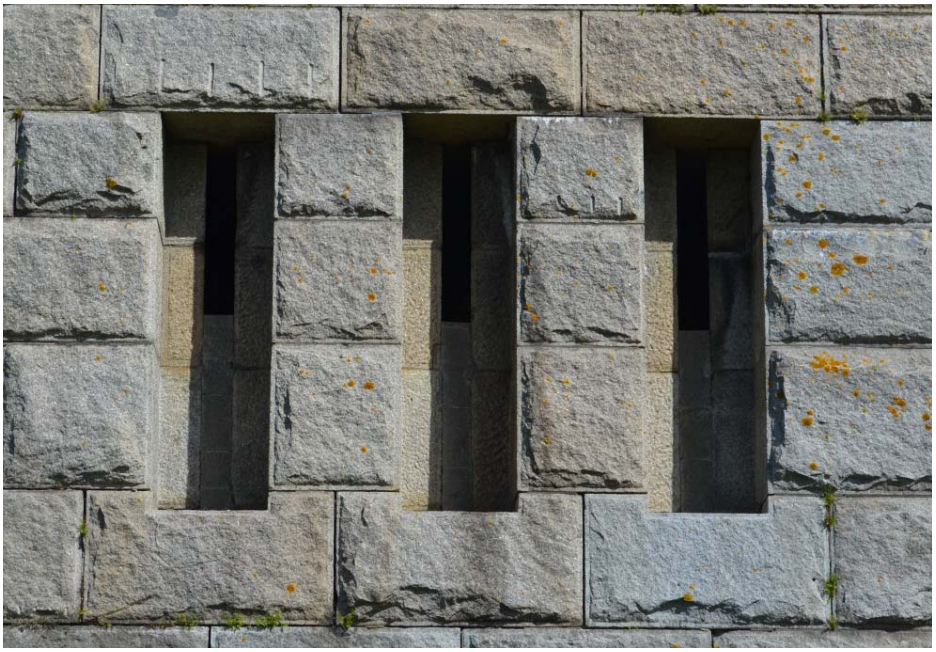


Figure 48. Riffle embrasures on northwest elevation. Concrete bunker can be seen behind embrasures.

Figure 49. Rodman canon embrasures on all other elevations. Note metal barriers and extant Totten shutters in the open position.

Figure 50. Rusted trim in foreground, with Totten shutter on right and modern barrier on left.

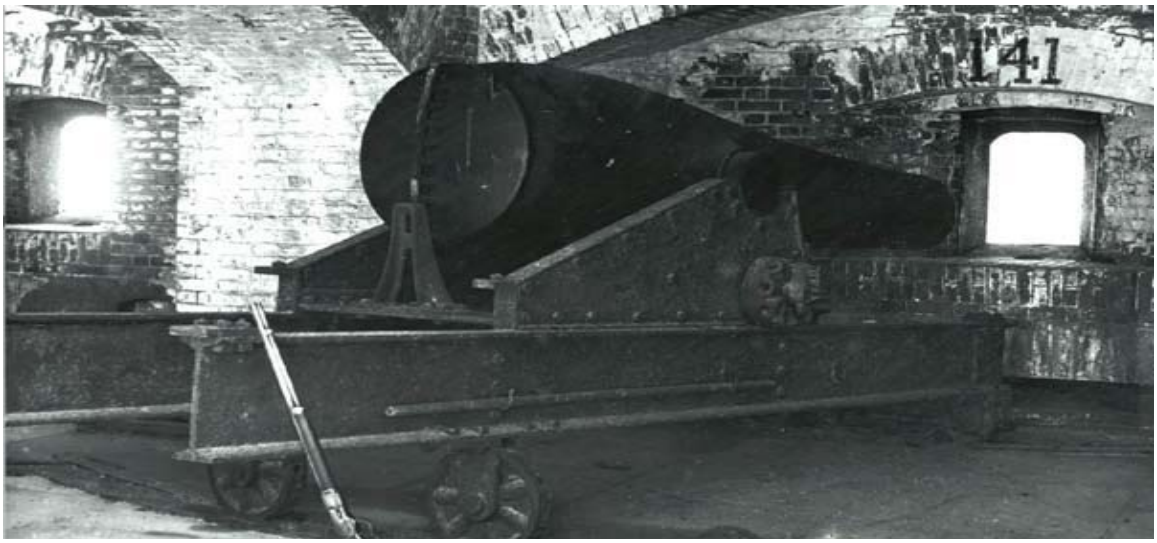


Figure 51. 10-inch Rodman gun on a carriage in Fort Jefferson, FL in 1899. ("Preserving Fort Jefferson, NPS Restoration Bulletin." Dry Tortugas National Park. National Park Service, www.nps.gove/drto)

13. Door and Window Openings

Wood doors and windows originally lined the northwest parade elevation on the 1st and 2nd tier. The double hung windows were tall and narrow and fit in the existing granite trim openings. In 1975, the City of New Bedford commissioned a project to reproduce the wood doors and windows in the celebration of the Bicentennial in 1976 (Figure 53). In the 1980's, vandals removed all of the doors and windows and stole them as salvage materials.[14]

Recommendations:

For a basic scope, art students could reinterpret the original door and windows of one barracks by painting plywood and attaching in to the masonry openings. A more costly option would be to reconstruct one operable door with transom and two window assemblies at one 1st-tier and one 2nd-tier barracks, including period-appropriate hardware.

Figure 52. Barracks door and window opening on the 1st-tier.

[14] Bob Bromley.

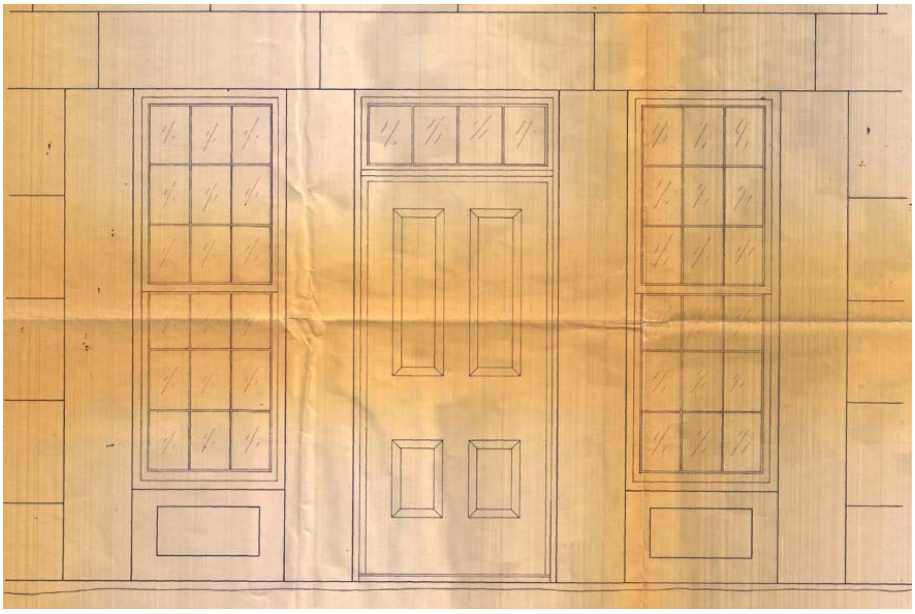


Figure 53. Drawings of door and window elevations from the New Bedford City Planning Department in January, 1975. The original door had a glass transom above it.

14. Front Doors

The original heavy wood doors to the entrance of the fort are still in working condition. The doors are made of small planks that have alternating bolts for reinforcement. A metal bar slides over the doors and is locked from the outside. During special events and public visitation, these doors are left in the open position so visitors do not have to close the heavy doors. The wood is weathered but in fair condition.

Recommendations:

Renew finishes on the door. Remove modern security hardware at the wood doors. Provide a new operable, welded steel gate assembly inboard of the inswinging doors that allows the original doors to remain open for after-hours views into Fort. Include integral cylinder locks and deadbolts.

Figure 54. View of door and sally port from interior of fort.

Figure 55. View of doors from exterior sally port.

15. Handrails/Guardrails

The City of New Bedford will be participating in the USACE DERP-FUDS Barricade Rail program to provide safety gates and rails in the fort. The planned gates are to be located at the four stairway entrances on the 1st tier, stairway entrances on the 2nd tier, and a fenced-in observation area on the terreplein.

The spiral granite stair towers on the east and south parade elevations access the first, second and terreplein levels. These stairs do not currently have handrails. The north iron stair handrails do not meet code and will require taller guardrails for public use.

Recommendations:

In coordination with USACE DERP-FUDS safety improvements, provide color-galvanized steel or painted, HDG steel handrails at the east spiral stair tower for three flights. Before the public use the south spiral stair tower, handrails should also be provided. Provide supplemental guardrails to meet height requirements of the current building code for the north stair tower.

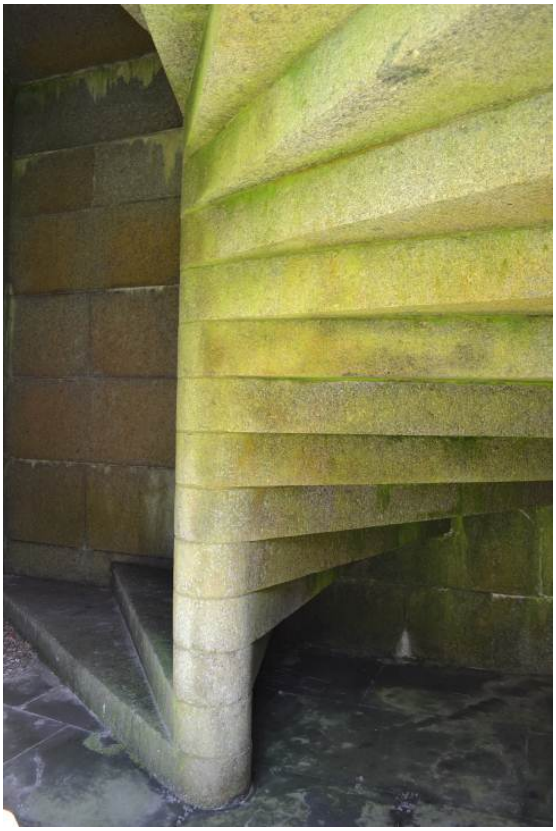


Figure 56. Base of granite spiral stair tower.

Figure 57. Top of East of granite spiral stair tower. Note historical photograph (Figure 10) with wood roof structure on top of stair tower.

16. Universal Accessibility : Horizontal Circulation

The site walkways that lead from the parking lot to the fort are accessible, but once in the sally port, the granite sett walkway ends and a gravel walkway begins. The gravel stones are too large and loose to meet the requirements of American's with Disabilities Act (ADA) and the Massachusetts Architectural Access Board (MAAB). The gravel walkway continues under the gallery to connect the north and south casemates. All of the interior spaces in the fort are not accessible because of a 3"–6" change in elevation from the parade ground to the barracks doorways and casemate entrances. The MAAB allows an elevation change of ½" maximum. The elevation change from the barracks door thresholds into the interior of the rooms differs from 3"-9" in certain areas. On the 2nd-tier stone gallery, the elevation change from the walkway to door threshold is about 3"-4" inches (Figure 58). Once in the casemate spaces, the deteriorating canon rails pose a tripping hazard as well as the spalling stone floor surfaces. The 2nd-tier barracks floor surfaces are uneven and not considered accessible surfaces.

Recommendations:

Remove or compact crushed stone fill at the sally port and 1st-tier gallery. Provide a stonedust path surface (4" thick) between the fort wall and cast iron columns at the parade level gallery to meet the existing stone threshold of the 1st tier barracks (Figure 59). Provide an ADA-compliant sloped walkway at the sally port to connect the exterior site walkways with the raised pathway at the interior. A slope of 1:20 or less than 5% is considered a "walkway" and does not require handrails. Fill in the 1st-tier barracks floor with dirt or stonedust fill to meet the elevation of the existing stone door threshold. Stonedust walkways can also be extended across the parade to the stair towers. See Accessibility Options A & B in the Appendix for plans and perspectives.

Once a wheelchair lift or LU/LA elevator is installed and the 2nd tier is accessible, a wood boardwalk can be provided on a portion of the 2nd-tier gallery that would be raised to align with the level of the door thresholds. The wood boardwalk would only be provided on a short section of the gallery and a few of the interpreted barracks and casemate rooms. Safety guardrails should be provided at edges of the boardwalk. See Accessibility Options A & B in the Appendix for plans and perspectives.

Figure 58. High threshold of 2nd-tier barracks.

Figure 59. Proposed walkway aligns with threshold on 1st and 2nd tier to access barracks.

17. Universal Accessibility: Vertical Circulation

The fort has four existing stair towers, but to have full public accessibility to the 2nd tier, an elevator or wheelchair lift would be required.

Recommendations:

Accessibility Option A (see Appendix) proposes to document and salvage the west metal staircase and insert a Limited Use/ Limited Application (LU/LA) elevator in the existing stone shaft (Figure 60). A LU/LA elevator is less costly and smaller than a conventional elevator, but has a height restriction. This type of elevator only travels 25 feet, therefore, could not go to the terreplein level. If terreplein access is necessary, a conventional elevator should be used. The elevator would need to be small enough to fit in the existing stair shaft. The visitors would access the new elevator through the existing doorways on the 1st and 2nd tier. The benefit of this option is that the elevator would be nearly invisible in the existing stair shaft, but would require a physical impact - the demolition of an original staircase.

Accessibility Option B (see Appendix) explores a low-impact, less expensive option to the LU/LA elevator. This option proposes to install a partially-enclosed vertical wheelchair lift adjacent to the east spiral stair tower (Figure 61). A ramping double-back boardwalk with 2" high wheel-guards leads to a slightly elevated wheelchair lift landing 12'-0" (elevator code) below the top landing. This boardwalk would be at a slope of 1:20 and would not require handrails. The existing 2nd-tier landing that is missing its original railings would be repurposed as the wheelchair lift platform.

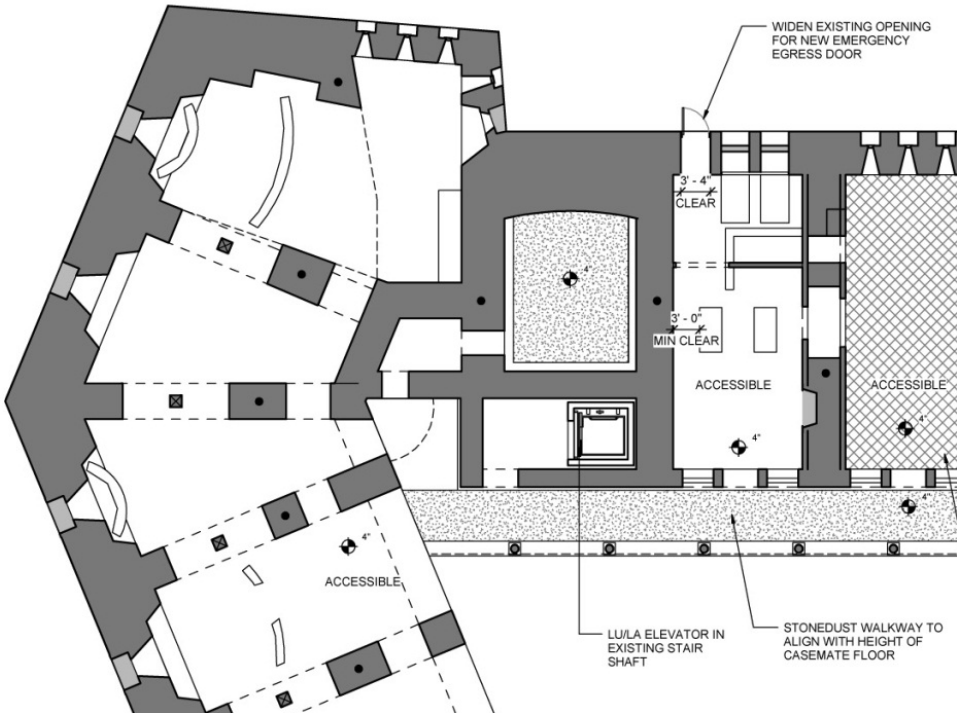


Figure 60. Accessibility Option A. Remove west metal stair for LU/LA elevator to 2nd tier.

Figure 61. Accessibility Option B. Wheelchair lift with walkway.

18. Second Egress

A second emergency exit is required by the International Building Code if a room or building has 50 or more occupants. It is expected that during events or tours, the fort will indeed have 50 visitors at one time. The main entrance is the large double door in the sally port on the northwest elevation. The fort has been modified over the years with a doorway and two windows cut out of the stone in two separate places on the northwest elevation. These opening are currently blocked up with concrete block, but could easily be opened. Initially, the north door was selected as a good option for a second egress. When the architectural and structural team surveyed the fort, it was quickly realized that an alternative egress was needed. In 1899, these north casemates were turned into a bomb-proof mine storage facility by encasing the first and second floor in very thick poured-in-place concrete walls.[15]

The second option for a new egress door is the masonry openings to the south on the northwest elevation. This door is also blocked in, but would lead directly into the "power plant" room that already has a concrete floor and easy access to the rest of the fort. There are 4 raised concrete pads on the floor that should be surveyed to make sure there is adequate clearance around them.

Recommendations:

Remove the concrete block infill at the door and windows in southwest barracks ("power plant"). Enlarge the masonry door opening as required and provide a new steel door and frame with exit hardware for the second means of egress.

If an opportunity for interpretation arises, the control room mine casemate could be opened for a learning experience. Remove the concrete block infill at exterior face of existing door and window openings and provide a new steel door and frame as well as welded steel gratings at window openings. Although challenging, an exit tunnel through the concrete mine casemate could be cored to provide a new egress path and connection to the interior of the fort. Interpretive waysides at the mine control room could describe the purpose for 1899 addition of the mine casemate and materials encountered.

Figure 62. Possible second egress door at northwest elevation of fort.

[15] Fort Taber/Fort Rodman Historical Association

Figure 63. Interior of egress door at “power plant.”


Figure 64. Door into mine control room does not access the rest of the fort.

Figure 65. Thick area of concrete at 2nd tier.

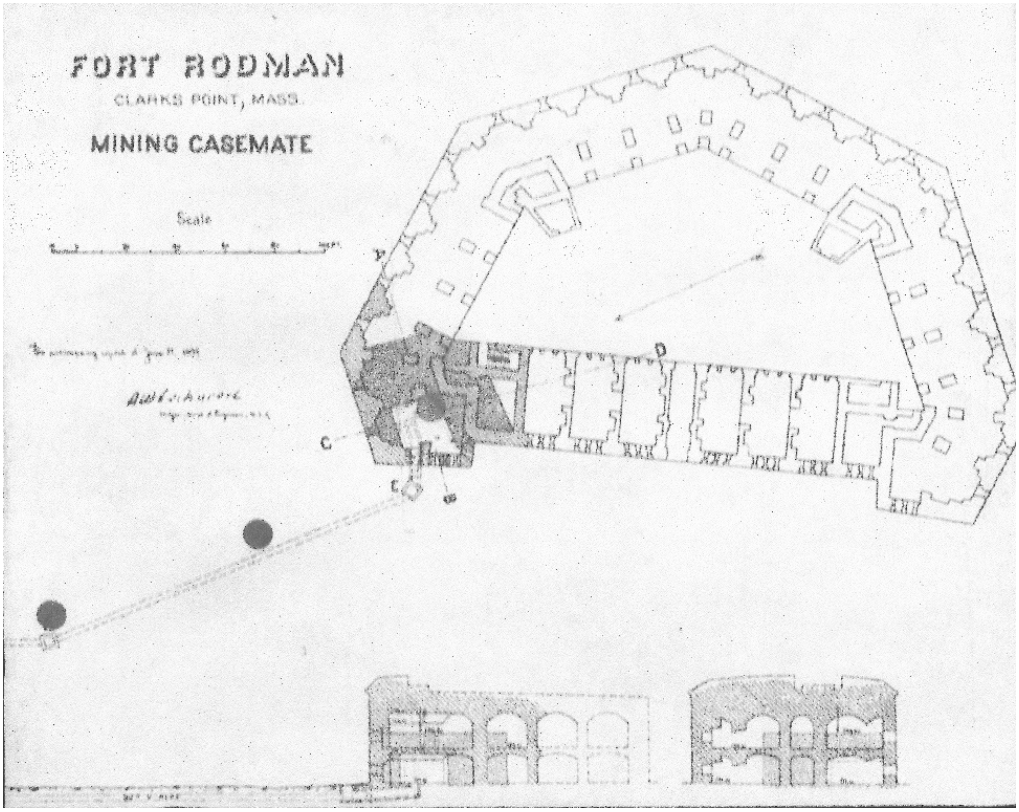


Figure 66. 1899 plan of mine casemate for control room. (Fort Taber/Fort Rodman Historical Association)

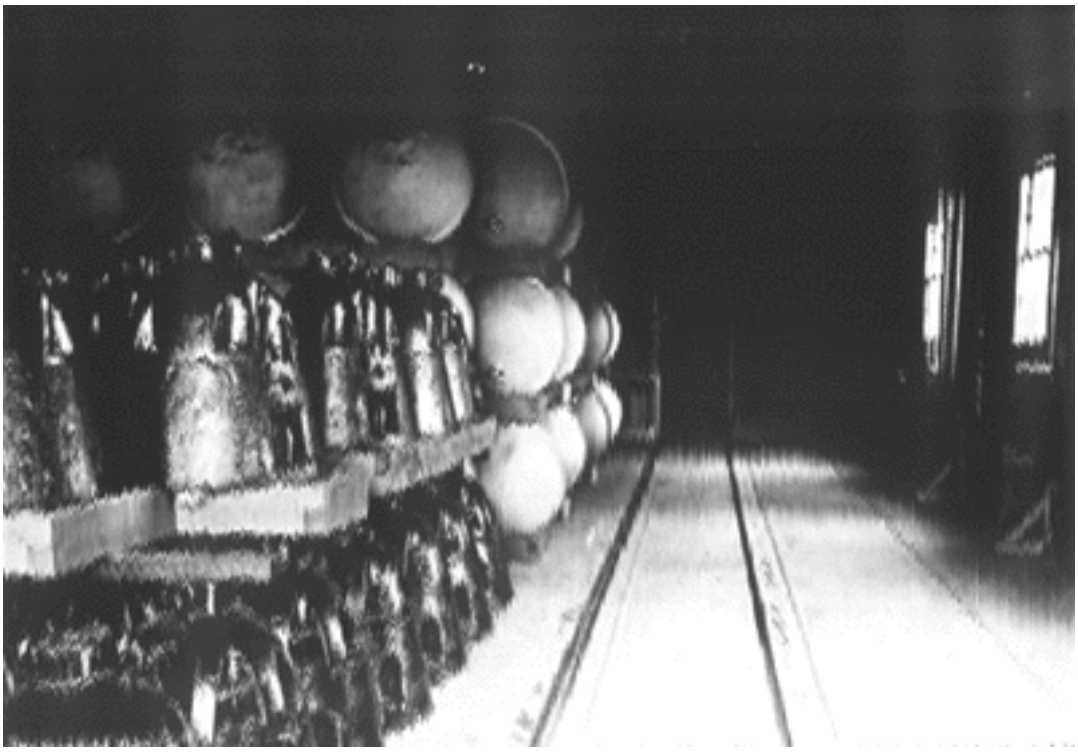


Figure 67. Mine storage house adjacent to fort. Mines in background, anchors in foreground. ("Fort Map & Gun Batteries." Fort Taber/ Fort Rodman Historical Association. New Bedford Internet, http://forttaber.org/fort-map-gun-batteries/)

Figure 68. Pier in 1926. Remote control shed on right. (Fort Map and Gun Batteries)

19. Fire Control Tower (also see SN Structural Conditions Report)

The fire control tower was built to have a commanding view of the harbor and bay, but still be protected in battle. The tower was used to detect and locate enemy vessels offshore. The roof is unique because of its reinforced concrete beam construction with purple glass lenses held in with a grid of rebar and concrete. The purple color allows moonlight to shine brightly through the glass and into the watch tower at night (Figure 72).

The fire control tower is in poor condition. The concrete stairs and base are spalling and exposing the rusting rebar (Figure 70). The glass at concrete roof is mostly intact, but action should be taken to stop deterioration and preserve the original glass lenses. The concrete roof beams are in poor condition because of rusting exposed rebar and large amounts of spalled concrete. The second level brick walls are in fair condition but have structural cracks and staining from rusting iron brackets. The glazed tiles on the interior are spalling and the metal window shutters are rusted (Figure 71).

Recommendations:

Provide shoring beneath the reinforced concrete stair, as required. Reset loose masonry and provide epoxy injection repairs at major cracks. The cracked brick masonry at the south elevation should be dismantled and re-set. The backup masonry should be reviewed and repaired as needed. All embedded metal to remain should be cleaned and painted. Prep and refinish exposed metalwork (e.g. railings, shutters and associated hardware). Treat exposed rebar and repair/patch concrete at access stairs. Repair the existing concrete roof structure and walls. At the roof, epoxy repair broken glass lenses and provide custom-fabricated purple glass replacements.

Figure 69. Fire control tower for observation activity in the harbor and bay.

Figure 70. Deteriorated concrete stairs.

Figure 71. Interior of fire control tower.

Figure 72. Deteriorating concrete exposes the rebar and breaks the glass disks.

20. Lighthouse

Two wooden lighthouses were built at Clark's Point and subsequently burned down between the years of 1797 to 1799. In 1804, an octagonal stone lighthouse was built on the same site. It was renovated in 1818 with a new octagonal iron lantern. As the tall fort walls were built, they blocked some angles of the beacon light. A rectangular wooden keepers shack was constructed on top of the north stair tower in 1869 and the light from the stone light house was moved to service this new one. The stone lighthouse tower remained standing until 1906 when it was demolished (Figure 6 & 7).[16]

The lighthouse was included in the fort restoration in 1975 for the Bicentennial, but was vandalized and left in ruins. In 2001, the City of New Bedford restored the lighthouse and relit the beacon. The City celebrated with a ceremony featuring the New Bedford Symphony Orchestra, cannon volleys and fireworks.[17]

The lighthouse shack has wood siding to resemble cut stone and has small, double hung windows along the north and east sides. The paint on the wood trim, siding, windows, and fascia is peeling and wearing thin. The window glazing is deteriorating and peeling off the windows.

Recommendations:
Scrape and repaint exterior wood siding and trim. Reglaze windows as needed, prep surfaces and repaint. Remove vegetation from mortar joints and repoint mortar joints as required. Replace existing door with historically appropriate stile-and-rail door.

[16] . D'Entremont, "History of Clark's Point Lighthouse, New Bedford."
[17] "New Bedford History / Lighthouse History." City of New Bedford Official Website. http://www.newbedford-ma.gov/Tourism/OurHistory/LighthouseHistory.html

Figure 73. Lighthouse at north corner of terreplein.

Figure 74. Steep wood ladder to access observation deck and light.

Figure 75. View of the batteries, pier, and Buzzards Bay from the lighthouse.

Figure 76. (D'Entremont, Jeremy. "History of Clark's Point Lighthouse, New Bedford.")

21. Plumbing (also see BER Site Visit Report)

There are no plumbing systems in the fort that are recognized by the modern plumbing code. There is a system of water drains and channels in place throughout the fort to collect the water from the terreplein and bring it down to the ground and out of the fort. There are about 35 roof drains that collect rain water from the terreplein and drain it to downspouts located inside the masonry walls (Figure 77). The interior conditions of the drains are unknown. The drains run down through the 2nd and 1st-tier masonry piers and most-likely connect to a perimeter channel under the parade ground. These water channels can be seen in Figure 79 & 80.

Privies on the first floor are indicated on the original drawings and a water trough was found in the southwest casemate. The privies were most-likely over the water trough and drained into a tidal cistern where the waste would wash out to sea during the changing of the tides (Figure 81 & 82).[18]

If installation of toilet rooms and a drinking fountain in the fort are requested by the City, a water supply and sanitary sewer system will need to be developed. Throughout the park, there is a system of underground water mains fed by the City of New Bedford public water supply. The closest water main to the fort runs under or parallel to the walkway at the northwest wall of the fort. This water pipe is assumed to be a minimum of 6 inches in diameter and will be a sufficient size for any renovation/improvement project. A sewer manhole was found approximately 60 feet to the south of the fort. More investigation is required to determine if this manhole could be used for untreated sanitary sewer discharge for new restrooms in the fort. It is possible this manhole is associated with the outfall from the New Bedford Wastewater Treatment

[18] Ron LaBelle. Commissioner, City of New Bedford Department of Public Infrastructure. Interview. July 31, 2013.

Plant located to the northwest of the fort. If so, another option should be developed. A second manhole was found approximately 75 feet northwest of the snack bar building. This manhole possibly collects the sanitary sewer lines from the snack bar and military museum and discharges them to a lift station across the road from the museum.

Recommendations:

The roof drains should be cleaned out and viewed by a drain camera to assess their condition and the possibly of reusing them. If not in suitable condition, it may be possible to install liners using a polymer based flow able sleeve. New or existing roof drains could be re-instated to drain to the parade ground channels underground drainage system and out of the fort. In-depth review would be needed for the downspouts, underground drainage, and drainage system outside the fort walls.

If a drinking fountain within fort walls is requested, a new water pipe would be required. The pipe would have to travel under the fort's foundation walls and connect to water main that passes 75 feet from the northwest wall of the fort.

If restrooms facilities are requested inside the fort walls, a new sanitary sewer line would need to be provided. The line would have to travel under the fort's foundation walls and run northwesterly, approximately 350 feet, to a new manhole and then approximately 250 feet to an existing manhole behind the Snack Bar. A small lift station or injector pump and a force main might be required to discharge the sanitary sewer to the existing manhole.

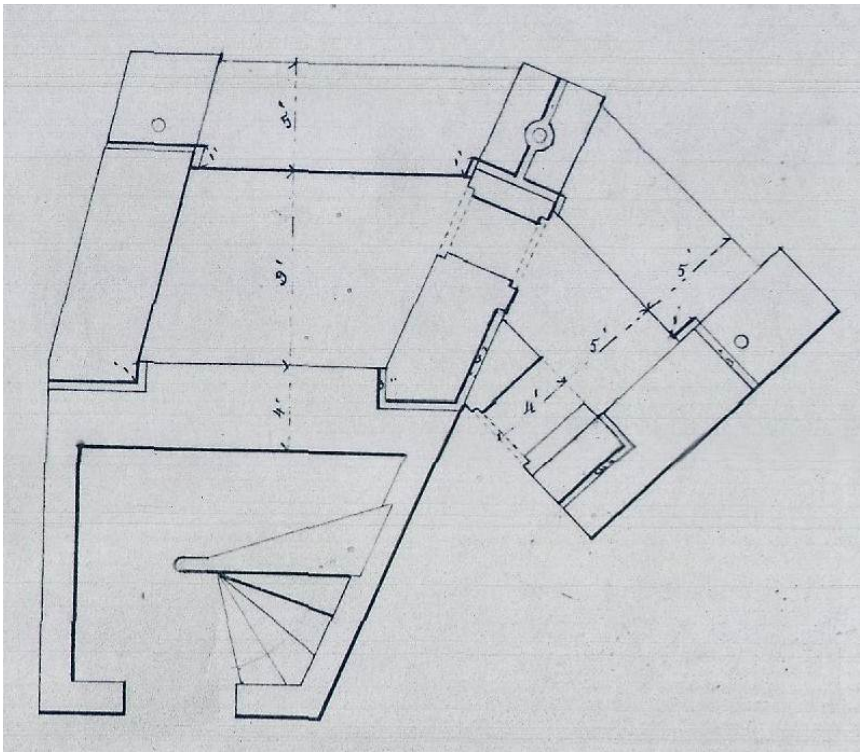


Figure 77. Original plan shows drainage downspouts and air channels in masonry walls

Figure 78. Drainage channel at interior parapet at terreplein.

Figure 79. Collapsed drainage channel at base of 1st-tier granite pier.

Figure 80. View of interior of drainage channel at 1st-tier.

Figure 81. Privy trough in southwest casemate.

Figure 82. Privy trough still has water collecting in it.

22. Electrical (also see BER Site Visit Report)

The current electrical service is found in the southwest "power plant" room. A 200 amp panel feeds the lighthouse, the fire control tower, a double duplex receptacle mounted on the front of the fort and a floodlight located on the 2nd tier over the main entry. There is no emergency power or fire alarm system in the fort. Conduit containing electrical wires run from the electrical panel, under the 1st-tier gallery roof to the southwest corner of the fort, and then up along the wall to the terreplein (Figure 83 & 84). The conduit then runs under the earthen fill on the terreplein to service the fire control tower (Figure 85).

Outside the footprint of the fort, a dry transformer is located on the south side of the fort and is assumed to be dedicated to the fort. On the east side of the site, a stainless steel pedestal is a box to power up equipment for events at the park. More investigation is needed to locate underground utilities and points of connections.

Recommendations:

If restrooms are provided in the fort, power for new lighting, water heating, and exhaust fans to service the restrooms can be connected to the existing electrical service. Power would also need to be provided to a future drinking fountain from the existing service.

Emergency lighting and exist signs are recommended if the fort will be used by the public. Emergency lighting to illuminate the path of egress along with exit signage at egress locations is recommended. A central battery system in a heated and air conditioned enclosure is recommended to service the emergency lights. The existing electrical service is adequate for emergency lighting and battery power.

Flood lights at the parade ground, magazines, and dark corners of fort are recommended. Lights for interior pathways and accent lighting at barracks, casemates, lighthouse and fire control tower can be added without needing to upgrade the existing service.

For the installation of an elevator, the existing electrical service would need to be upgraded to 225 amps along with a new panel to house the service. The new service will require a new underground duct bank to the existing pad mount transformer approximately 100 feet away. Also, addition of a dedicated phone line to the building for elevator car communications will be required.


Figure 83. Conduit and electrical line exiting “power plant” barracks.


Figure 84. Conduit and electrical line at top of west stair tower.

Figure 85. Conduit and electrical line entering the fire control tower at the terreplein.

Figure 86. Existing electrical panel in “power plant” barracks.

Figure 87. Existing dry type transformer outside of fort at southwest wall.

23.Site (also see Site Narrative)

The Fort Taber Park is one of the largest recreational parks in New Bedford. The park features historical landmarks as well as walking and biking trails, a playground, a pier, a snack bar, the military museum, a community center and a boat house. A 116 car parking lot is easily filled in the summer months. A small fee is charged in the summer to keep the lot from overflowing. The lot services all of the amenities of the park. Six accessible parking spaces are provided, which exceeds the minimum amount of spaces required per the American's with Disability Act (ADA) and the Massachusetts Architectural Access Board (MAAB). The concrete curb ramp at the southwest is cracked and has settled possibly due to maintenance vehicles using the ramp for access to the lawn.

A wide, maroon-colored chip-and-seal path with granite sett edges extends from the pier to a circular plaza at the front of the fort and to a sitting area just southwest of the fort. The granite sett path continues to the front entrance of the fort on the northwest elevation. The sally port and gallery walkway on the interior of the fort is paved with loose gravel that does not meet ADA or MAAB requirements for accessible surfaces. Existing site lighting in concrete enclosures are not functional due to vandalism.

Recommendations:
The ramp and curb at the parking lot should be repaired. Some minor repair of the walkways from the parking lot to the fort is recommended. Alternate materials such as stonedust, chip-and-seal asphalt, bluestone, or granite walkways should be considered to replace the loose gravel at the sally port and gallery walkway inside the fort. Repair existing site lighting around fort.

Figure 88. View of walkway from parking lot to fort.

Figure 89. View of walkway and sitting area at the southwest of the fort.

24. Mortar Analysis (also see Mortar Analysis Report)

Mortar analysis was performed to aid in the specification of new mortar to match the original mortar. The analysis provides information about the sand composition and size distribution and well as characteristics of the binder.

Nine samples were provided to Schnabel Conservation for analysis. Four of these were selected by Schnabel Conservation for an in-depth analysis:

Granite Mortar Sample #2: Spiral stair vertical joint at granite (top level exposed to weather)
Granite Mortar Sample #4: 2nd Tier casemate at granite
Brick Mortar Sample #5: 2nd Tier mortar dropped between brick veneer and brick pier
Brick Mortar Sample #9: 1st Tier interior brick veneer wall – bedding mortar

The granite mortars are mostly similar with three layers of material that have recrystallized by water percolating through them. Samples #2 and #4 were selected for thin-section analysis. The brick mortars generally contained one material and were also recrystallized due to water. Some of the brick samples were similar in character to some of the granite mortar layers. Two of the brick mortar samples were found to be modern cement mortars and were not analyzed any further. Brick mortar samples #5 and #9 were selected for thin-section analysis and Sample #9 was selected for gravimetric analysis as well.

Conclusions and Recommendations

All but the modern mortars are similar in appearance, having tan to dark-tan binders with rounded nodules of tan to orange-red colors. The mortars are hard and cannot be broken by hand, except for Sample #9 that was the softest of the mortar samples. For most of the samples, two distinct layers of mortar were found at different depths in the joint. The aggregate in the outer layer is finer and more abundant than the aggregate in the inner layer. Two different conclusions can be made, but many more samples would need to be analyzed before coming to a final conclusion. The first concept is that a lime-natural cement-sand mortar was used as a setting mortar and a natural cement-sand mortar was used as a pointing mortar. The other concept is that the original joint was filled with the lime-natural cement-sand mortar and the outer layer was repointed later with a natural cement-sand mortar.

Based on the composition of the samples, either a natural cement-sand mortar with a mix of 1 part sand to 3 parts natural cement, or a lime-natural cement-sand mortar with a mix of 1 part natural cement to 1 part lime to 5 parts sand could be used. The sand should be tan in color and fine-grained to match Sample #9. The sand for the outer mortars should be finer-grained to match the outer mortars of Samples #2 and #4. Repointing mortars should also take into consideration the condition of the masonry and length of exposure to water. Recommendations for repointing mortar based on current conditions in the fort is to use a less cement-rich mortar, air entraining additives, or air-entrained lime to prolong the life of the mortar in wet outdoor environments. The mortar will most-likely require the addition of pigment to match the tan color of the existing natural cement mortar. To avoid variation of color throughout the building, great care must be taken in proportioning, mixing and installing the pigmented mortar. The use of pre-proportioned pigmented bagged mortar mix is strongly recommended.

Figure 90. Granite Mortar Sample #2 location at spiral stair vertical joint at granite

Figure 91. Granite Mortar Sample #4: 2nd Tier casemate at granite

Figure 92. Brick Mortar Sample #5: 2nd Tier mortar dropped between brick veneer and brick pier

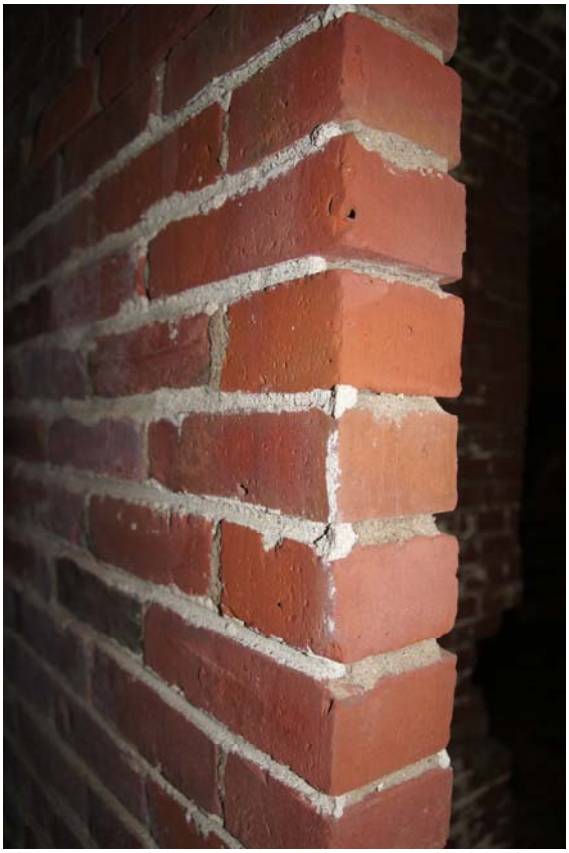


Figure 93. Brick Mortar Sample #9: 1st Tier interior brick veneer wall – bedding mortar

[Note: this page deliberately left blank.]

C. Treatment Recommendations and Cost Estimate

The following scope matrix assembles the recommendations from the Conditions Assessment Report and arranges them in (1) Minimal, (2) Basic, and (3) Optimal treatment categories. This matrix will give the City of New Bedford multiple alternatives with differing degrees of treatment for the same scope item. Each treatment category has an associated cost estimate.

Cost Estimates prepared by:
D.G. Jones
3 Baldwin Green Common
Suite 202
Woburn MA 01801
(781) 932 - 3131

The cost estimates include:
General Requirements/General Conditions
Escalation to Mid-point of Construction (first quarter 2015)
Design Contingency
Permit Fee
Construction Contingency

It was assumed that construction would start in the third quarter of 2014.

[Note: this page deliberately left blank.]

ARCHITECTURAL / STRUCTURAL ASSESSMENT AND FEASIBILITY STUDY FOR ACCESSIBILITY

Project Goal/Component 	Treatment					
	Minimal	Cost	Basic	Cost	Optimal	Cost
1 Roof (including terreplein, ramparts, etc.)	Cut back plant growth at existing terreplein. Locate and document existing drains and chimneys.	$162,600	Same as minimal scope, plus apply herbicide to cut stems of invasive plant species, clear debris and clean out clogs in roof drainage system if possible. Stabilize extant chimney ruins. Repoint exposed copings and parapets as needed.	$224,300	Same as basic scope, plus remove all plant materials and fill above casemates and barracks, stockpiling materials suitable for reinstallation. Provide waterproof membrane roofing system and fill above, restoring ca. 1906 profile and appearance. Re-establish drainage system down through piers and walls to below-grade channels and thence to known pipes. Reconstruct (capped) chimneys, based on physical evidence, construction drawings and old photographs. Seed disturbed areas with a no-mow fescue turf mix.	$1,512,000
2 Masonry Walls: Exterior of Fort	Minimal repointing of granite walls; allow 10% of mortar joints.	$95,900	Epoxy-inject cracked granite stones to prevent water infiltration. Remove algae from granite surfaces and vegetation from mortar joints throughout. Treat rust stains with chemical cleaners. Basic repointing; allow 30% of mortar joints.	$353,800	Same as basic scope but reset any dislocated stones and/or anchor stones to walls below. Provide lead weather caps at sky-facing joints. Allow repointing of 100% of mortar joints.	$1,060,000
3 Granite and Brick Masonry Piers and Walls: Interior of Fort	Remove inappropriate concrete patches at brick veneer walls and infill with brick. Remove vegetation from mortar joints and algae from granite; remove graffiti and treat rust stains. Minimal repointing of granite and brick masonry; allow 10%.	$253,600	Same as minimal scope, plus epoxy-inject cracked granite stones.	$273,100	Same as basic scope, plus dismantle and reconstruct all shifted masonry at buckled walls (e.g., 2nd-tier magazine). Removed and replace spalled brick. Pin-repair cracked granite lintels over doorways and injection-grout all cracks at walls. Repoint masonry; allow 100%.	$2,351,600
4 Brick Masonry Arches and Vaulted Ceilings	Adjust, repair and/or supplement temporary shoring as required. Wash and/or brush off efflorescence throughout to create a "clean slate," for observing patterns of subsequent moisture infiltration over time. Install plywood forms at the loose brick masonry with in the vaults and arched openings to protect the public from falling debris.	$253,600	Injection-grout all cracks at arches and vaults. At failed facings of arches between casemates, remove and stockpile loose face brick, allow 50%	$486,000	Same as minimal scope, plus injection-grout all cracks at arches and vaults. Dismantle and partially reconstruct approximately 1/3 of the brick arches and fully reconstruct select brick arches. Dismantle and partially reconstruct select brick vaults. Remove all wood support columns. Repoint masonry 100%.	$4,431,900
5 Bluestone Floor Surfaces	At bluestone slabs that have caved-in or collapsed over drainage channels, provide new (removable) bluestone slabs to match originals.	$2,500	Same as minimal scope but remove vegetation and biological growth throughout. Remove shattered and disintegrated stones and other paving deemed a tripping hazard and replace with salvaged and/or new bluestone slabs; allow 750 sf.	$104,100	Same as minimal scope but replace all paving stones in poor condition; allow 1,500 sf. Stabilize and epoxy-repair delaminated and cracked pavers otherwise in fair to good condition.	$189,400
6 Other Interior Walking Surfaces	At 1st- and 2nd-tier magazines and 1-st tier barracks with depressed or sunken floor levels, remove debris and provide new clean fill, compacted. Align finish grade with existing door thresholds.	$86,900	Same as minimal scope.	$86,900	Same as basic scope.	$86,900

ARCHITECTURAL / STRUCTURAL ASSESSMENT AND FEASIBILITY STUDY FOR ACCESSIBILITY

Project Goal/Component 	Treatment					
	Minimal	Cost	Basic	Cost	Optimal	Cost
7 Cast Iron Columns and Capitals	Remove rust in situ and apply zinc-rich primer.	$4,700	Same as minimal scope but remove broken acanthus leaves at capitals and add application of 2-3 epoxy finish coats throughout.	$11,000	Same as basic scope but restore acanthus leaf features by casting replicas in aluminum or fiberglass and finish restored assembly with appropriate primer and finish coats. Repair or replace cracked and shifted column to the south of the sally port.	$46,800
8 Upper Galleries (Wood Decking, Cast-Iron Brackets, Rails, and Guardrails)	Remove deteriorated wood plank decking at upper gallery. Remove rust in situ and apply zinc-rich primer. Resecure loose angle at east corner.	$131,700	Same as minimal scope but add application of 2-3 epoxy finish coats to metalwork. Remove one intact bracket for documentation and replication; reinstall original bracket, repair support rails as needed and install replica. Reconstruct wood gallery decking at north section and lighthouse entrance.	$163,400	Same as basic scope but reconstruct wood gallery decking throughout. Repair guardrails and install replica guardrails throughout.	$315,100
9 Cast- and Wrought-Iron Railing Assemblies	Remove rust in situ and apply zinc-rich primer. Measure and document existing railing assemblies currently stored on 1st tier.	$13,000	Same as minimal scope but add application of 2-3 epoxy finish coats.	$22,800	Same as basic scope but restore cast-iron posts by casting replicas in aluminum or fiberglass and fabricating wrought-iron guards to match originals. Finish restored assembly of old and new components with appropriate primer and epoxy finish coats.	$42,300
10 Cast- and Wrought-Iron Stair Assemblies (Northwest Stair Only)	Remove rust in situ and apply zinc-rich primer. Install temporary pressure-treated wood shoring as required.	$15,300	Same as minimal scope but add photo-documentation and removal of broken components and application of 2-3 epoxy finish coats throughout.	$24,400	Same as basic scope but restore stair assemblies (stair treads/risers, stringers, balusters, handrails) by casting replica components in aluminum or fiberglass or reusing components from the southwest stair. Finish restored assembly with appropriate primer and finish coats.	$38,000
11 Barracks Interiors	At 1st-tier southwest barracks, stabilize mostly intact wood ceiling joists and beadboard ceiling finish. Remove modern frame partition and suspected (asbestos) transite ceiling panels. At all barracks, remove and stockpile loose veneer brick and remove and discard miscellaneous non-historic debris; broom-clean.	$69,100	Same as minimal scope but provide beadboard infill at southwest barracks ceiling to match existing, allow 100 sf; prep and paint old/new ceiling. Retain concrete pads for former "power plant."	$120,400	Same as basic scope but add full restoration of one 1st-tier and one 2nd-tier barracks, including masonry veneer walls and fireplace surrounds and painted beadboard ceiling on wood joists. At restored/interpreted barracks, provide lightweight concrete fill and/or wood t&g flooring on pressure-treated joists and sleepers.	$200,000
12 Embrasures	Remove rust at exterior embrasure casings, extant "Totten Shutters" and modern steel barriers and paint with zinc-rich primer.	$8,100	Same as minimal scope but add removal of concrete block infill at all applicable 1st-tier embrasures, taking care to protect existing Totten Shutters, as applicable. Where shutters are missing, provide new steel barrier assemblies.	$38,000	Same as basic scope but restore one casemate embrasure to full operation, including iron Totten Shutters and associated bronze hardware. Partner with Military Museum, et al to include Rodman Gun exhibit.	$48,900
13 Door and Window Openings at Barracks (Facing Parade)	No work.	$0	Possible art students' project: at one barracks bay, infill door and flanking window openings with (non-operable) painted plywood "trompe l'oeil" of original millwork.	$800	Reconstruct operable door and window and transom assemblies at one 1st-tier and one 2nd-tier barracks, including period-appropriate hardware.	$21,000

ARCHITECTURAL / STRUCTURAL ASSESSMENT AND FEASIBILITY STUDY FOR ACCESSIBILITY

Project Goal/Component 	Treatment					
	Minimal	Cost	Basic	Cost	Optimal	Cost
14 Front Doors	No work.	$0	Renew finishes on door.	$800	Remove modern security hardware at wood doors. Provide new operable, welded steel gate assembly inboard of inswinging doors that allows wood doors to remain open for after-hours views into Fort. Include integral cylinder locks and deadbolts (allow 2).	$11,400
15 Handrails/Guardrails	In coordination with USACE DERP-FUDS safety improvements, provide color-galvanized steel (or painted, HDG steel) handrails at east stair tower spiral stair, three flights	$30,100	Same as minimal scope but add south stair tower spiral stair.	$60,200	Same as basic scope but add supplemental handrails/guardrails for north stair tower.	$90,200
16 Universal Accessibility: Horizontal Circulation	Remove and/or compact crushed stone fill at Sally Port and 1st-tier gallery. Replace and/or cover crushed stone with accessible stonedust walking surface.	$36,600	Same as minimal scope but place stonedust path surface (4" thick) between fort wall and cast iron columns at parade level gallery to meet existing stone threshold of 1st tier barracks. Provide ADA-compliant slope at Sally Port and ADA-compliant floor surfaces at 1st Tier barracks. See Accessibility Option A&B	$48,800	Same as basic scope but provide wood "boardwalk" assembly with compliant guard rails at a portion of the 2nd-tier gallery aligning with existing granite casemate and barracks thresholds. Provide access to 2nd-tier interpreted spaces (casemate and/or barracks). See Accessibility Option A&B. Extend walkway to casemates at parade level.	$154,000
17 Universal Accessibility: Vertical Circulation	No work.	$0	Provide wheelchair lift, complete; no floor penetrations. Provide wood boardwalk ramp and landing to wheelchair lift. See Accessibility Option B. Provide power for wheelchair lift from existing power panel.	$93,200	Document and remove west metal stair. Provide new enclosed LU/LA elevator inside west stair tower. See Accessibility Option A. Provide power for LU/LA elevator. Provide service upgrade to 225 amps at three phase. The new service will require a new underground duct bank to the existing pad mount transformer approximately 100 feet away. Provide a new 225 amp service rated panel. Provide for reconnection of existing loads. Add a dedicated phone line to the building for elevator car communications.	$305,600
18 Second Egress	No work.	$0	Remove concrete block infill at door and windows in southwest barracks ("power plant"). Enlarge masonry door opening as required and provide new steel door and frame with exit hardware for second means of egress.	$2,300	Core exit tunnel through bomb-proof concrete Mine Casemate and remove concrete block infill at exterior face. Provide new steel door and frame, including exit hardware. Provide new welded steel gratings at window openings. Provide interpretive waysides at core, describing purpose for 1899 addition of Mine Casemate and materials encountered, etc.	$30,200
19 Fire Control Tower	Provide shoring beneath reinforced concrete stair, as required.	$16,600	Same as minimal scope but reset loose masonry and provide epoxy injection repairs at major cracks. Prep and refinish exposed metalwork (e.g. railings, shutters and associated hardware).	$30,400	Same as basic scope, plus treat exposed rebar and repair/patch concrete at access stairs. Repair existing concrete roof structure and walls. At roof, epoxy repair broken glass lenses and provide custom-fabricated purple-glass replacements.	$63,800

ARCHITECTURAL / STRUCTURAL ASSESSMENT AND FEASIBILITY STUDY FOR ACCESSIBILITY

Project Goal/Component 	Treatment					
	Minimal	Cost	Basic	Cost	Optimal	Cost
20 Lighthouse	Scrape and repaint exterior wood siding. Reglaze windows as needed, prep surfaces and repaint.	$20,400	Same as minimal scope but add removal of vegetation from mortar joints and repoint mortar joints as required.	$21,200	Same as basic scope but add replacement of "builder" door with historically appropriate stile-and-rail door.	$27,400
21 Restrooms/ Drinking Fountain	No work.	$0	Provide drinking fountain within fort walls. Provide new water pipe in fort, traveling under the foundation walls, and connecting to water main that passes 75 ft from the northwest wall of the fort. Provide power to the drinking fountain from existing service.	$7,100	Same as basic scope. Provide three season, accessible restrooms within fort walls. Provide power for new lighting, water heating, and exhaust fans for restrooms from existing service. Provide a sanitary sewer line, traveling from inside of fort under foundations, running northwesterly approximately 350 ft to a new manhole and then approximately 250 ft to an existing manhole behind the Snack Bar. Provide a small lift station or injector pump and a force main to discharge the sanitary sewer to the existing manhole.	$363,700
22 Interior Lighting	Provide power for flood lights at parade ground, magazines, and dark corners of fort.	$47,000	Same as minimal scope.	$47,000	Same as basic scope plus provide power for interior pathway lighting and accent lighting at barracks, casemates, lighthouse and fire control tower.	$127,900
23 Interior Egress (Exit) and Emergency Lighting	Provide a central battery system in a heated and air conditioned enclosure and emergency lighting remote head to illuminate the path of egress. Provide Exit signage along egress. Existing electrical service is adequate; no service upgrade is required.	$36,900	Same as minimal scope.	$36,900	Same as minimal scope.	$36,900
24 Site	No work.	$0	Add one universally accessible parking space in parking lot to meet required percentage. Repair broken concrete panels at curb ramp at existing accessible parking. Repair damaged chip and seal surface along accessible route from parking to fort.	$1,400	Same as minimal scope. Repair existing floodlights for fort facade.	$67,200
Total Construction Cost	Minimal	$1,284,600	Basic	$2,258,300	Optimal	$11,622,200

D. Prioritized Treatment Recommendations

The following scope matrix assembles the recommendations from the Conditions Assessment Report and prioritizes them to give the City of New Bedford an understanding of the stabilization and preservation needs of Fort Taber/Fort Rodman. The scope items are organized into three categories: Emergency (1-3 years), Short Term (3-5 years) and Long Term (more than 5 years). The Emergency scope of work deals with priority stabilization items that are recommended to retain the existing structural integrity of the fort. The Short Term scope includes limited public use items and preservation of the fort's character-defining features. Long Term items include interpretation of spaces, conveniences and aesthetics of the fort.

[Note: this page deliberately left blank.]

ARCHITECTURAL / STRUCTURAL ASSESSMENT AND FEASIBILITY STUDY FOR ACCESSIBILITY

Project Goal/Component 	Prioritized Treatment Recommendations		
	Emergency (1-3 years)	Short Term (3-5 years)	Long Term (more than 5 years)
1 Roof (including terreplein, ramparts, etc.)	Remove all plant materials and fill above casemates and quarters, stockpiling materials suitable for reinstallation. Provide waterproof membrane roofing system and fill above, restoring ca. 1906 profile and appearance. Re-establish drainage system down through piers and walls to below-grade channels and thence to known pipes. Reconstruct (capped) chimneys, based on physical evidence, construction drawings and old photographs. Seed disturbed areas with a no-mow fescue turf mix.		
2 Masonry Walls: Exterior of Fort		Epoxy-inject cracked granite stones to prevent water infiltration. Remove algae from granite surfaces and vegetation from mortar joints throughout. Treat rust stains with chemical cleaners. Wash and/or brush off efflorescence throughout. Reset any dislocated stones and/or anchor stones to walls below. Provide lead weather caps at sky-facing joints. Allow repointing of 100% of mortar joints.	
3 Granite and Brick Masonry Piers and Walls: Interior of Fort	Dismantle and reconstruct all shifted masonry at buckled walls (e.g., 2nd-tier magazine). Injection-grout all cracks at walls. Epoxy-inject cracked granite stones. Repoint masonry; allow 100%. Wash and/or brush off efflorescence throughout.	Remove algae from granite; remove graffiti and treat rust stains.	
4 Brick Masonry Arches and Vaulted Ceilings	Dismantle and partially reconstruct approximately 1/3 of the brick arches and fully reconstruct select brick arches. Dismantle and partially reconstruct select brick vaults. Where brick masonry is stable, grout inject cracks. Remove all wood support columns. Repoint masonry 100%. Wash and/or brush off efflorescence throughout to create a "clean slate," for observing patterns of subsequent moisture infiltration over time.		
5 Bluestone Floor Surfaces	At bluestone slabs that have caved-in or collapsed over drainage channels, provide new (removable) bluestone slabs to match originals.	Remove vegetation and biological growth throughout. Remove shattered and disintegrated stones and other paving deemed a tripping hazard and replace with salvaged and/or new bluestone slabs	Replace all paving stones in poor condition. Stabilize and epoxy-repair delaminated and cracked pavers otherwise in fair to good condition.
6 Other Interior Walking Surfaces		At 1st- and 2nd-tier magazines and 1st-tier barracks with depressed or sunken floor levels, remove debris and provide new clean fill, compacted. Align finish grade with existing door thresholds.	

ARCHITECTURAL / STRUCTURAL ASSESSMENT AND FEASIBILITY STUDY FOR ACCESSIBILITY

Project Goal/Component 	Prioritized Treatment Recommendations		
	Emergency (1-3 years)	Short Term (3-5 years)	Long Term (more than 5 years)
7 Cast Iron Columns and Capitals	Repair or replace cracked and shifted column at south of sally port.	Remove rust in situ and apply zinc-rich primer. Remove broken acanthus leaves at capitals and add application of 2-3 epoxy finish coats throughout.	Restore acanthus leaf features by casting replicas in aluminum or fiberglass and finish restored assembly with appropriate primer and finish coats.
8 Upper Galleries (Wood Decking, Cast-Iron Brackets, Rails, and Guardrails)		Remove deteriorated wood plank decking at upper gallery. Remove rust in situ and apply zinc-rich primer. Resecure loose angle at east corner. Same as minimal scope but add application of 2-3 epoxy finish coats to metalwork. Remove one intact bracket for documentation and replication; reinstall original bracket, repair support rails as needed and install replica. Reconstruct wood gallery decking at north section and lighthouse entrance.	Same as basic scope but reconstruct wood gallery decking throughout. . Repair guardrails and install replica guardrails throughout.
9 Cast- and Wrought-Iron Railing Assemblies		Remove rust in situ and apply zinc-rich primer. Measure and document existing railing assemblies currently stored on 1st tier. Application of 2-3 epoxy finish coats.	Restore cast-iron posts by casting replicas in aluminum or fiberglass and fabricating wrought-iron guards to match originals. Finish restored assembly of old and new components with appropriate primer and epoxy finish coats.
10 Cast- and Wrought-Iron Stair Assemblies (Northwest Stair Only)		Remove rust in situ and apply zinc-rich primer. Install temporary pressure-treated wood shoring as required. Photo-documentation and removal of broken components and application of 2-3 epoxy finish coats throughout.	Restore stair assemblies (stair treads/risers, stringers, balusters, handrails) by casting replica components in aluminum or fiberglass or reusing components from the southwest stair. Finish restored assembly with appropriate primer and finish coats.
11 Barracks Interiors		At all barracks, remove and stockpile loose veneer brick and remove and discard miscellaneous non-historic debris; broom-clean. Wash and/or brush off efflorescence throughout. At 1st-tier southwest barracks, stabilize mostly intact wood ceiling joists and beadboard ceiling finish. Provide beadboard infill at southwest barracks ceiling to match existing. Prep and paint old/new ceiling. Remove modern frame partition and suspected (asbestos) transite ceiling panels. Retain concrete pads for former "power plant."	Full restoration of one 1st-tier and one 2nd-tier barracks, including masonry veneer walls and fireplace surrounds and painted beadboard ceiling on wood joists. At restored/interpreted barracks, provide lightweight concrete fill and/or wood t&g flooring on pressure-treated joists and sleepers.
12 Embrasures		Remove rust at exterior embrasure casings, extant "Totten Shutters" and modern steel barriers and paint with zinc-rich primer. Removal of concrete block infill at all applicable 1st-tier embrasures, taking care to protect existing Totten Shutters, as applicable. Where shutters are missing, provide new steel barrier assemblies.	Restore one casemate embrasure to full operation, including iron Totten Shutters and associated bronze hardware. Partner with Military Museum, et al to include Rodman Gun exhibit.
13 Door and Window Openings at Barracks (Facing Parade)		Possible art students' project: at one barracks bay, infill door and flanking window openings with (non-operable) painted plywood "trompe l'oeil" of original millwork.	Reconstruct operable door and window and transom assemblies at one 1st-tier and one 2nd-tier barracks, including period-appropriate hardware.

ARCHITECTURAL / STRUCTURAL ASSESSMENT AND FEASIBILITY STUDY FOR ACCESSIBILITY

Project Goal/Component 	Prioritized Treatment Recommendations		
	Emergency (1-3 years)	Short Term (3-5 years)	Long Term (more than 5 years)
14 Front Doors		Renew finishes on door. Remove modern security hardware at wood doors. Provide new operable, welded steel gate assembly inboard of inswinging doors that allows wood doors to remain open for after-hours views into Fort. Include integral cylinder locks and deadbolts (allow 2).	
15 Handrails/Guardrails		In coordination with USACE DERP-FUDS safety improvements, provide color-galvanized steel (or painted, HDG steel) handrails at east stair tower spiral stair, three flights.	Provide handrails at south stair tower spiral stair. Provide supplemental handrails/guardrails for north stair tower.
16 Universal Accessibility: Horizontal Circulation		Remove and/or compact crushed stone fill at Sally Port and 1st-tier gallery. Place stonedust path surface (4" thick) between fort wall and cast iron columns at parade level gallery to meet existing stone threshold of 1st tier barracks. Provide ADA-compliant slope at Sally Port and ADA-compliant floor surfaces at 1st Tier barracks. See Accessibility Option A&B	Provide wood "boardwalk" assembly with compliant guard rails at a portion of the 2nd-tier gallery aligning with existing granite casemate and barracks thresholds. Provide access to 2nd-tier interpreted spaces (casemate and/or barracks). See Accessibility Option A&B. Extend walkway to casemates at parade level.
17 Universal Accessibility: Vertical Circulation			Document and remove west metal stair. Provide new enclosed LU/LA elevator inside west stair tower. See Accessibility Option A. Provide power for LU/LA elevator. Provide service upgrade to 225 amps at three phase. The new service will require a new underground duct bank to the existing pad mount transformer approximately 100 feet away. Provide a new 225 amp service rated panel. Provide for reconnection of existing loads. Add a dedicated phone line to the building for elevator car communications.
18 Second Egress	Remove concrete block infill at door and windows in southwest barracks ("power plant"). Enlarge masonry door opening as required and provide new steel door and frame with exit hardware for second means of egress.		Core exit tunnel through bomb-proof concrete Mine Casemate and remove concrete block infill at exterior face. Provide new steel door and frame, including exit hardware. Provide new welded steel gratings at window openings. Provide interpretive waysides at core, describing purpose for 1899 addition of Mine Casemate and materials encountered, etc.
19 Fire Control Tower		Provide shoring beneath reinforced concrete stair, as required. Reset loose masonry and provide epoxy injection repairs at major cracks. Prep and refinish exposed metalwork (e.g. railings, shutters and associated hardware).	Treat exposed rebar and repair/patch concrete at access stairs. Repair existing concrete roof structure and walls. At roof, epoxy repair broken glass lenses and provide custom-fabricated purple-glass replacements.

ARCHITECTURAL / STRUCTURAL ASSESSMENT AND FEASIBILITY STUDY FOR ACCESSIBILITY

Project Goal/Component 	Prioritized Treatment Recommendations		
	Emergency (1-3 years)	Short Term (3-5 years)	Long Term (more than 5 years)
20 Lighthouse		Remove vegetation from mortar joints and repoint mortar joints as required. Scrape and repaint exterior wood siding. Reglaze windows as needed, prep surfaces and repaint.	Replace "builder" door with historically appropriate stile-and-rail door.
21 Restrooms/ Drinking Fountain			Note: A drinking fountain and restrooms are not required, but could be provided. Provide drinking fountain within fort walls. Provide new water pipe in fort connecting to water main. Provide power to the drinking fountain from existing service. Provide three season, accessible restrooms within fort walls. Provide power for new lighting, water heating, and exhaust fans for restrooms from existing service. Provide a sanitary sewer line. Provide a small lift station or injector pump and a force main to discharge the sanitary sewer to the existing manhole.
22 Interior Lighting		Provide power for flood lights at parade ground, magazines, and dark corners of fort.	Provide power for interior pathway lighting and accent lighting at barracks, casemates, lighthouse and fire control tower.
23 Interior Egress (Exit) and Emergency Lighting		Provide a central battery system in a heated and air conditioned enclosure and emergency lighting remote head to illuminate the path of egress. Provide Exit signage along egress. Existing electrical service is adequate; no service upgrade is required.	
24 Site		Add one universally accessible parking space in parking lot to meet required percentage. Repair broken concrete panels at curb ramp at existing accessible parking. Repair damaged chip and seal surface along accessible route from parking to fort. Repair existing floodlights for fort facade.	

E. Cyclical Maintenance Plan

The following scope matrix assembles the cyclical maintenance items that are required to keep the fort in good condition and categorizes the maintenance for Every year, Every 5 years, and Every 20 years. The scope items are under the assumption that all of the recommended work items from the Prioritized Treatment Matrix have been completed. Some items may need to be reviewed more or less times than noted in the matrix, depending on unforeseen factors, such as quality of work performed, quality of materials, and unexpected ware of scope items. Costs are associated with each item and will aid in allocating yearly funding and preparing the City for the larger scale maintenance items every twenty years.

[Note: this page deliberately left blank.]

ARCHITECTURAL / STRUCTURAL ASSESSMENT AND FEASIBILITY STUDY FOR ACCESSIBILITY

Project Goal/Component 		Cyclical Maintenance Items					
		Once a year	Cost	Every 5 years	Cost	Every 20 years	Cost
1	Roof (including terreplein, ramparts, etc.)	Mow turf at terreplein. Weed and remove invasive species. Inspect roof drainage system and clear out any clogs.	$40,000	Inspect brick masonry and mortar at chimneys; spot repoint any areas with missing or deteriorated mortar.	$15,000	Repoint chimney masonry as necessary, including resetting and rebuilding masonry units. Investigate and repair compromised roofing membrane and flashings, if water is discovered infiltrating through vaults below.	$100,000
2	Masonry Walls: Exterior of Fort	Visual inspection of conditions, from ground level. Submit Letter Report.	$2,000	Inspect granite masonry for cracked or dislocated stones and for missing or loose mortar joints. Scrub algae from exposed granite surfaces and remove vegetation from mortar joints. Treat rust stains with chemical cleaners. Spot repoint any areas with missing or deteriorated mortar.	$80,000	Repoint granite masonry as needed. Utilizing appropriate structural staging and equipment, reset dislocated stones as required.	$300,000
3	Granite and Brick Masonry Piers and Walls: Interior of Fort	Visual inspection of conditions. Submit Letter Report.	$2,500	Inspect granite and brick for cracks or dislocated units. Remove algae from all masonry mortar joints; remove graffiti and treat rust stains.	$20,000	Repoint brick and granite masonry as needed.	$200,000
4	Brick Masonry Arches and Vaulted Ceilings	Visually inspect brick arches and vaults for cracks or dislocated units. Observe efflorescence as applicable for patterns of subsequent moisture infiltration over time.	$2,500	Inspect brick arches and vaults for any major failures or areas of major water infiltration. Develop and execute detailed repair/restoration plans.	$25,000	Repair, reset and repoint arches and vaults, including injection-grouting observed cracks, as needed.	$200,000
5	Bluestone Floor Surfaces	Visually inspect bluestone slabs for collapsed or delaminating stones. Provide temporary safety barriers or enclosures to minimize safety hazards.	$2,000	Remove vegetation from joints. Remove significant biological growth from stone surfaces, using appropriate cleaning products.	$20,000	Remove shattered and disintegrated paving stones and replace with salvaged and/or new bluestone slabs. Level and/or reset sloping and dislocated stones deemed a tripping hazard.	$60,000
6	Other Interior Walking Surfaces	Inspect condition and level of new lightweight fill in publicly accessible interior rooms to ensure that there are no tripping hazards at thresholds, etc.	$500	Renew and supplement lightweight fill to maintain universal accessibility and prevent tripping hazards.	$10,000	[See "Every 5 years"]	
7	Cast Iron Columns and Capitals	Visual inspection of conditions from ground level.	$500	Working from ladders or platforms, inspect columns for cracks, deformation or other failure. Likewise, inspect capitals and bases for damage or deterioration. Passivate rust, prime and spot repaint.	$3,000	Remove all rust and strip all paint; apply new zinc-rich primer and 2-3 epoxy finish coats throughout.	$15,000
8	Upper Galleries (Wood Decking, Cast-Iron Brackets, Rails and Guardrails)	Visually and physically inspect wood galleries for structural stability.	$2,500	Passivate rust, prime and spot repaint ironwork. Resecure loose decking as required.	$30,000	Repair any damaged or deformed support rails or guardrails as needed. Prep all exposed metalwork (including brackets) and apply 2-3 epoxy finish coats. Replace in kind all deteriorated wood decking at gallery.	$170,000
9	Cast- and Wrought-Iron Railing Assemblies	Inspect iron railings for structural stability. Submit Letter Report.	$1,500	Passivate rust, prime and spot repaint ironwork.	$5,000	Repair any railing components as needed; prep all surfaces and apply 2-3 epoxy finish coats.	$25,000
10	Cast- and Wrought-Iron Stair Assemblies (Northwest Stair Only)	Inspect iron stair components for structural stability. Submit Letter Report.	$2,000	Passivate rust, prime and spot repaint ironwork.	$5,000	Repair any stair components as needed; prep all surfaces and apply 2-3 epoxy finish coats.	$25,000
11	Barracks Interiors	Visual inspection of conditions, looking for any safety hazards at Quarters and other interior rooms.	$500	Spot repaint interior finishes. Inspect brick veneer walls and fireplace surrounds; reset any loose bricks and spot repoint as needed.	$10,000	Repair or replace deteriorated sections of wood ceiling joists and beadboard ceiling. Repoint veneer brick and fireplace surrounds (assume 25%).	$50,000
12	Embrasures	Inspect existing iron Totten Shutters and replica "shutter" plates. Carefully inspect operational Totten Shutter.	$2,000	Passivate rust, prime and spot repaint iron and steel.	$15,000	Restore extant Totten shutters to operation (if possible without rebuilding entire masonry opening). Prep all shutters and steel "shutter" plates, apply zinc-rich primer and provide epoxy finish coats.	$130,000
13	Door and Window Openings at Barracks (Facing Parade)	No work.		Inspect operable door and window assemblies at one 1st-tier and one 2nd-tier barracks. Repair and patch damage to wood and reglaze, as required.	$3,000	If required, reconstruct operable door and window and transom assemblies at one 1st-tier and one 2nd-tier barracks; salvage and reuse period-appropriate hardware if possible.	$15,000

ARCHITECTURAL / STRUCTURAL ASSESSMENT AND FEASIBILITY STUDY FOR ACCESSIBILITY

Project Goal/Component 	Cyclical Maintenance Items					
	Once a year	Cost	Every 5 years	Cost	Every 20 years	Cost
14 Front Doors (Sally Port)	Inspect door and steel gate assembly for security and proper operation.	$500	Inspect door and steel gate assembly. Renew finishes on door. Passivate rust, prime and spot repaint iron and steel components.	$1,500	If required, restore door and steel gate assemblies 100%.	$5,000
15 Handrails/Guardrails	Inspect all handrails and guards, including mounting hardware.	$1,500	Passivate rust, prime and spot repaint steel.	$5,000	Remove all rust and strip all paint; apply new zinc-rich primer and 2-3 epoxy finish coats throughout.	$35,000
16 Universal Accessibility: Horizontal Circulation	Inspect and maintain compacted crushed stone at all accessible pathways.	$2,000	Inspect boardwalk assembly at 2nd tier gallery; repair as needed. Add crushed stone as required to restore universal accessibility in compliance with MAAB regulations and ADAAG guidelines.	$5,000	As required, replace boardwalk assembly in kind. Retain guardrails for reuse.	$30,000
17 Universal Accessibility: Vertical Circulation	Service LU/LA elevator as required by manufacturer.	$5,000	[See "Once a year"]		Access current (20-year) needs to determine if vertical circulation system meets programmatic needs.	
18 Second Egress	No work.		Inspect bomb-proof mine casemate for deterioration, cracks, and exposed rebar.	$3,000	Re-examine usage of facility to see if egress meets current codes and programmatic needs for assembly usage. Patch and restore deteriorated concrete slabs as required.	$10,000
19 Fire Control Tower	Visually inspect concrete stairs, noting any further deterioration of reinforced concrete. Stabilize (or remove and store) steel window shutters in danger of falling.	$3,000	Inspect concrete base, brick building, and concrete and glass roof for further deterioration. Passivate exposed rebar and treat with zinc-rich primer; grout cracks and repair/patch deteriorated concrete at access stairs. Prep, prime and paint steel window shutters.	$15,000	Repair all deterioration at concrete roof structure and concrete and masonry walls. Repair/restore concrete and glass roof and steel window shutter assemblies.	$60,000
20 Lighthouse	Inspect ladder to top of lighthouse, including all support hardware and blocking.	$500	Inspect entire lighthouse structure. Spot repaint wood- and metal-work as required. Inspect windows and glazing putty for damage and deterioration; repair as needed. Remove vegetation from mortar joints and algae from masonry walls.	$20,000	Repair wood deterioration, reglaze and repaint building interior and exterior as needed. Repoint mortar joints.	$35,000
21 Restrooms/ Drinking Fountain	If facilities have been installed: Drain plumbing system every fall before water freezes in pipes.	$2,000	Inspect plumbing fixtures and restroom facilities. Repair finishes as needed. Inspect water heater, exhaust fans and lift station for proper working conditions.	$5,000	Inspect all plumbing, including sanitary sewage system. Access future plumbing needs to see if current system is adequate.	$5,000
22 Interior Lighting	Inspect all light fixtures and replace burned-out light bulbs.	$1,000	Inspect all light fixtures and replace burned-out light bulbs. Inspect wiring and conduit for damage and potential safety hazards.	$1,500	Access future electrical needs to see if current system is adequate.	
23 Interior Egress (Exit) and Emergency Lighting	Inspect and test exit and emergency light systems. Replace any failed lamps.	$1,500	Inspect emergency lighting batteries and/or wiring and conduit for damage and potential safety hazards.	$1,500	Access future electrical needs to see if current system is adequate.	
24 Site	Mow grass on routine basis. Replace lamps in existing site lighting fixtures as required.	$7,500	Repair/renew chip-and-seal surface along accessible route from parking to fort. Upgrade existing floodlights illuminating Fort façade, using latest technology.	$5,000	Assess programmatic needs.	
Total Maintenance Cost	Every Year	$83,000	Every 5 years	$303,500	Every 20 years	$1,470,000

F. Appendix

1. Consultant Narratives

   KZLA Site Narrative
   Structures North Structural Conditions Report
   BER Electrical and Plumbing Report
   Schnabel Conservation Mortar Analysis

2. Condition Drawings

   Existing Drawings
   Landscape Condition Drawings
   Architectural Condition Drawings
   Structural Condition Drawings

3. Accessibility Option A & B

4. Bibliography

[Note: this page deliberately left blank.]

Site Narrative

General

Fort Taber Park is a 47 acre public park on New Bedford's southern tip known as Clark's Point. The park offers commanding views of Buzzard's Bay, Clark's Cove, the city's outer harbor, and the Elizabeth Islands. Fort Taber Park includes Fort Taber, several batteries, a military museum, and passive recreation.

Parking

The park and fort are served by a 116 car parking lot to the north of the fort. Set three hundred feet from the fort, sufficient setback is given so the parking doesn't encroach on the fort setting. Parking is provided for multiple facilities and general recreation in the park. The American's with Disabilities Act (ADA) and the Massachusetts Architectural Access Board (MAAB) require that for every 25 parking spaces there is 1 accessible parking space, meaning 5 accessible spaces should be provided. Six spaces are provided within the existing parking lot. Of the two locations where there are a pair of accessible parking spaces, the curb ramp at the southwestern location requires repair to the concrete sidewalk because it is cracked and unevenly settled. This is caused by maintenance vehicles using the curb ramp for vehicular access.

Access to the Fort

Asphalt paths traverse the park providing visitor access to the water's edge, the fort, and other park destinations. Bisecting the space between the parking lot and fort is a north-south path aligned with a pier to the north and a war memorial to the south. This maroon colored chip and seal path with granite setts edges leads visitors to a formal circular plaza in front of the fort. A granite sett path connects the circular plaza to the fort gate. The path widths and gradients are all compliant leading from the parking to the fort. Repair of the walkway chip and seal and granite setts is needed to remove potential tripping hazards.

Figure 1. Maroon colored chip and seal path from parking lot to entrance of fort.

Fort Site

Fort Taber is the prominent architectural feature within Fort Taber Park. Dramatic water views attract park users to the many paths and earthworks for various forms of recreation. The ground plane is largely lawn with areas of ornamental planting. Architectural floodlights are located around the perimeter of the fort housed in concrete enclosures. The lights aren't functional due to vandalism.

Figure 2. View of east elevation of fort from park

Fort Entry

A large solid wooden two- leaf gate secures the entry to the fort and is sufficient for universal access. The gravel path surface from the granite sett walkway to the gate has too large a stone size and loose stone that does not meet the requirements for a "firm and stable" walkway per ADA or MAAB. Alternative materials should be considered i.e. stonedust, chip and seal asphalt, bluestone, or granite.

Figure 3. Granite sett and gravel walkway at entrance to fort.

Parade

The parade within the interior of Fort Taber is a very simple lawn panel bounded by the two-tiered granite fort. Subtle elevation changes crown the lawn panel to drain to the perimeter. A gravel walkway along the northern side of the parade connects the various casemates. The gravel walkway is three to four inches below each casemate threshold. Universal access could be provided to each of the casemates if the walkway were raised in elevation to be flush with the top of granite threshold. A stonedust walkway would be appropriate for this application as it is economical, durable, and appropriate in the historic setting. Bluestone or granite could also be used at a much greater expense. The edge condition of this walkway should consider how to address the cast iron column bases.

There is potential to expand the scope of the walkways within the parade to provide access to other casemates that bound the parade.

Further investigation of the fort drainage system is needed to better understand how stormwater was intended to drain through and out of the fort. A drain was observed at the midpoint of the southern edge of the parade.

Figure 4. Loose gravel walkway at gallery on northwest parade elevation.

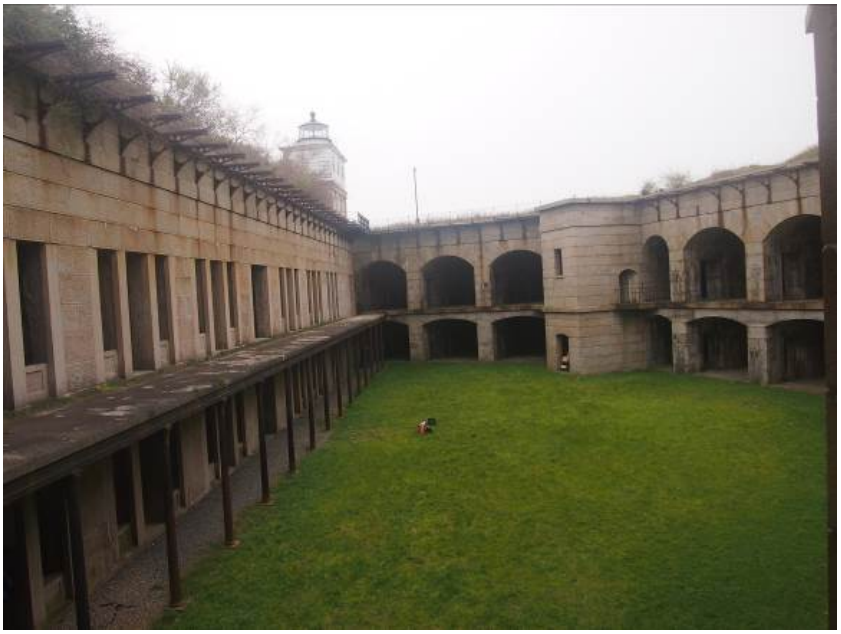


Figure 5. View of parade ground from 2nd tier.

Terreplein

The terreplein level is accessed by a series of stairs leading from the parade and second floor. This roof level is largely vegetated and is punctuated with a lighthouse and other architectural features. Panoramic views from this level are dramatic. Lack of edge protection, sinkholes, unprotected flues and other obstacles make this level not suitable for visitation in its current state.

Turf, shrubs and trees all grow among the varied vegetation on the terreplein. Invasive plant species are colonizing quite aggressively as is poison ivy. Vines, root systems of plants, moss and lichen are all impacting the historic masonry. Steep slopes and the unprotected edges make maintenance of the vegetation extremely difficult. Woody vegetation should be removed from the terreplein to prevent damage to the masonry, drainage system and other elements of the fort. Annually, the vegetation should be cut back to prevent this woody growth. In flat areas, the turf could be maintained with brush mowers (if they can be lifted to this height) or hand-held weed trimmers, but on the steep slopes bucket trucks may be needed to perform this work safely.

Should the soil and vegetation be stripped to repair the fort drainage, a no-mow fescue turf mix should be established on the terreplein. This turf only needs to be mowed once annually and is tolerant of the seaside conditions. Geogrids or other devices should be included in the soil profile on the steep slopes to prevent sliding of the soil profile.

Figure 6. Overgrown brush at terreplein.

Figure 7. Retaining wall, earth fill, and overgrown brush at magazine on terreplein.

[Note: this page deliberately left blank.]

Structures North
CONSULTING ENGINEERS, INC.

60 Washington St, Suite 401
Salem, Massachusetts 01970-3517
P.O. Box 01971-8560
T 978.745.6817 | F 978.745.6067
www.structures-north.com

23 August 2013

Jack Glassman
Bargmann, Hendrie and Archetype, Inc
300 A Street
Boston, MA 02210-1710

Reference: Fort Taber Structural Conditions Report

Dear Jack

We completed a visual survey of Fort Taber in New Bedford, MA on 7 May 2013 and 14 May 2013 to review the existing conditions of the brick and granite fort. We have summarized the conditions of the fort in our report dated 17 May 2013. In this report we are expanding upon the conditions described therein, in addition to noting location of the damage in the attached drawings. For the purposes of this report the entrance to the fort is on the north elevation.

General Description

The two-story fort was constructed in the late 1860's with brick vaults and arches, and granite piers and walls. There are 24 casemate vaults on each of the two levels. These contained cannons and face out to the New Bedford Harbor and the Narragansett Bay. Four of the casemates are no longer accessible because of a concrete vault that was built as a magazine for mines and other explosives. The north side of the fort is comprised of brick barrel vaults with brick interior walls that were architecturally finished and most likely used barracks. All of the vaults open onto the central Parade. Along the north Parade wall, there is an iron and concrete balcony which allows access two the second floor rooms. Most of the rooms are currently accessible without exiting to the parade, but originally the interior brick walls would have separated the rooms. The casemate vaults are connected by brick arched openings located near the exterior wall, allowing for complete circumferential access through the interior. There is also a rectangular door opening in the vault spring walls near the parade which allows for access to the casemate vaults and avoids area where the cannons were located.

There are four brick magazines (powder rooms) at each of the two enclosed levels; one of the rooms on each level is no longer accessible. The roof of the fort is currently covered with soil and vegetation. Earth has been removed at one location, exposing what appears to be the concrete base of large gun emplacement. On the roof there are three magazines, the upper levels of the enclosed stairs on the north parade face - one of which now houses the lighthouse lantern and keepers shack, a brick head house with a small railway, and a two story brick and concrete Fire Control Tower.

Noted Building Conditions and Repair Recommendations

Below are the noted conditions of the masonry at Fort Taber and our recommend repairs in italics. The numbered items can be found on the attached plans noting the locations of the condition.

Casemate and Barrack Vaults:

101. Throughout the fort's vaults and barracks there are eroded mortar joints in the brick and stone masonry walls. Most of the eroded joints can be found in the brick walls in the barracks and magazines with some eroded joints within the stone walls of the casemate vaults, particularly at the exterior walls. *The eroded mortar joints should be cut and pointed with a compatible mortar.*

102. In both the barracks and the casemate vaults, the mortar joints in the brick vaulted ceilings have eroded. The eroded vault joints can be found in all rooms at both levels of the barracks. Within the casemate vaults, the eroded joints are mostly located at the ground level. *The eroded mortar joints should be cut and pointed with a compatible mortar.*

103. There is significant efflorescence throughout the entire fort at both the walls and ceilings. At the ground level casemate vaults there are areas where the efflorescence has built up enough to start forming stalactites and stalagmites. Combined with the gap at the exterior wall, noted below in item 109, between the upper vaults and the exterior granite wall it appears that a significant amount of water is getting into the fort through the soil covered roof and running down the tops of the brick arched vaults to the supporting walls where it is being absorbed into the masonry. The water is fully saturating the bricks and evaporating through the face of the masonry leaving behind the white salt deposits. *The first step to repairing the brick masonry is to remove the soil on the roof and expose the top of the vaults. It should be determined how the water is entering the masonry and the openings eliminated. All of the efflorescence should be removed once the sources of water leakage have been eliminated.. Although it is not damaging the masonry, the removal of existing efflorescence will allow any new accumulation to be a visible signal that water is continuing to enter the masonry.*

104. There are cracks across the brick masonry vaults of both the casemates and the barracks. Generally, the cracks run transversely across each vault between the granite support walls. Most of the cracks are relatively narrow, but at a few of the vaults the arch spans have shifted laterally with respect to the cracks. The total extent of vault cracking is relatively minor in the upper level of the casemate vaults but is more significant in the lower level. In the barracks, the cracking is evenly distributed between both levels.

    The cracking is a result of the water infiltration from above and absorption into the brick masonry, which materially swells the brickwork by saturating the fired clay matrix, which then undergoes freezing and thawing. A greater amount of

saturation appears to be occurring at the lower level vaults, as the damage is generally worse there. *Where the surrounding brick masonry is stable the cracks should be jet cleaned, pointed, and injected with a compatible grout.*

105. In addition to cracking across the brick vaults, the brick masonry expansion has also caused the tops of brick arched openings joining the vaults to spread. This movement has caused the arches to crack, slip and widen, and has partially failed the outer wythes of brick. *Approximately 1/3 of these arches will require significant repair and partial reconstruction; as noted on the drawings. From our visual survey it appears that the remaining, less damaged arched openings will only require the resetting of portions of the exposed wythes of brick. It should be noted that when the brick back up is exposed, additional reconstruction may be found to be required.*

106. Within the barracks' barrel vaults on the north side of the fort, most of what were once interior furring walls have collapsed, exposing the brick and granite structure behind. *As these walls are not structural, they may be removed, repaired, or reconstructed as deemed historically or architecturally appropriate. .*

107. The extensive moisture within the masonry has been exuded through the vault, arch and upper wall surfaces, causing individual bricks to spall. *Where the masonry is to be reconstructed or repaired the spalled bricks should be replaced. Where no repair is required only the most damaged bricks should be replaced.*

108. The movement of the vaults has changed the loading of the interior vault walls, adding load to the stone lintels over the interior stone openings at the casemate vaults along the parade. *The cracked granite lintels should be pin repaired and the crack repaired with epoxy injection.*

109. The surface brick wythe of the eastern upper level magazine is buckling. *The brick masonry should be dismantled and reconstructed.*

110. There are open joints between exterior granite wall and outer vault ends at both levels of the casemates and at the upper level of the barracks. *The recommended removal of the soil will reduce the outward radial pressures on the exterior wall. The open joints may also be the result of circumferential lengthening of the walls due to the expansion of embedded rusting metal (please see below). The open joints do not need to be filled for structural reasons but may be considered via pointing and grout injection after the soil is removed, in order to reduce future movement that could stress a waterproofing system. Depending upon the depth of fill removal and replacement, geogrids can be laid into the replaced grade to reduce lateral soil pressures.*

111. At all of the embrasure openings at the upper level casemate vaults there have been movements and cracking in individual stones as well as cracking in mortar joints. This may be caused by rusting of embedded metal shutter hardware, which may also be related to the outward movement of the wall, as noted above. *The cracked stones should be pin and epoxy repaired, the mortar joints*

repointed and any extremely shifted stones reset. Rusted metal inserts should be removed and/or replaced with stainless steel.

112. The movement of the exterior wall can also be noted in the widened mortar joints at the cornice stones as well as the outward bowing and lifting of these stones at multiple walls. *The mortar joints should be repointed and the bowing stones anchored to the stone walls below. Lead weather caps should be considered for widened sky-facing joints.*

113. There are door lintels that have rusted in the barrack vaults. *Deteriorated lintels should be cleaned and painted, or replaced depending on the extent of rust damage.*

114. There are cracked stone units at the far corners of two barrack vaults. *These should be pinned and adhesive-bonded back together.*

Rooftop Magazine:

201. At the parade side wall of the southern roof magazine, the wall coping stones are bowed outward, most likely due to the unresisted soil loads on the structure. There are also spalled and cracked stones near the entrance of the magazine. *The soil should be removed from above the magazine and shifted stones re-set and/or anchored to the wall below. The spalled and cracked stones should be replaced or Dutchman repaired.*

Fire Control Tower:

202. At the two-story brick and concrete fire control tower the concrete is in poor condition as the majority of it cracked and spalled. *The spalls should be patch repaired and the cracks pinned, patched and epoxy-injected. Any exposed reinforcing should be cleaned and painted prior to repairing the concrete.*

203. The concrete stairs leading to the fire control tower are in poor condition as there is upward movement and spalling concrete. *The stairs should be repaired and reinforced or replaced.*

204. There are multiple cracks in the brick masonry on the fire control tower's southern elevation from the rust jacking of the metal shutter suports. *The cracked masonry should be dismantled and re-set. The backup masonry should be reviewed and repaired as needed. All embedded metal to remain should be cleaned and painted.*

205. The concrete beams supporting the glass panel roof are in poor condition. The bottom reinforcing has been exposed at most locations with additional cracking above at some beams. *The beams require extensive repair or replacement. Sadly, this may endanger the glass panels, so the beam repair will need to be more of a "conservation" than "reconstruction" type operation.*

Parade Elevations:

301. As with the interior of the fort, there is efflorescence on the stones on the parade elevations from the water infiltration into the masonry. *After water has been properly managed, the efflorescence should be removed from all the masonry. Although it is not damaging the masonry, its removal will allow any new efflorescence to be visible signal that water is still entering the masonry*

302. Most of the mortar joints at the stone wall of the barracks have eroded. There are also some eroded mortar joints along the piers of the casemate vault elevations. *The eroded mortar joints should be cut and pointed with a compatible mortar.*

303. Around the doorways on the western end of the barracks wall there are widened and open mortar joints that indicate potential movement. *The mortar joints should be cut and pointed with a compatible mortar.*

304. Many of the transverse tie beams and rod ends have retro-fit connections to the face of the granite parade wall, which are rusting. *These should be re-worked as more permanent repairs*.

305. There is rust exfoliation on most of the iron beam soffits near the center of their span between the columns. *The beams should be cleaned and painted with a rust inhibiting paint.*

306. One of the columns located at the entrance to the fort is cracked at its mid-height and has deflected laterally at the break. *The column should be repaired and reinforced, or replaced.*

Exterior Elevations

401. As with the interior of the fort, there is efflorescence on the stonework of the exterior elevations as well as moss and other vegetation growth from entrapped moisture within the masonry. *The efflorescence and vegetation should be removed, for the same reasons as noted above.*

402. The majority of the mortar joints on the exterior elevations have eroded. The elevation outside of the barracks is in better condition than the rest of the fort as it is protected from the ocean weather. *The eroded mortar joints should be cut and pointed with a compatible mortar.*

403. The embrasure shutters are rusted and starting to jack the surrounding stone masonry has caused granite stones around the windows to crack. *The cracked stones should be epoxy repaired after the metal shutters are cleaned and painted. All rusted metal embedments should be removed and replaced with new stainless steel.*

404. The concrete vault exhibits spalling where the windows and door have been infilled. *The concrete should be repaired and any exposed reinforcement cleaned and painted.*

Thank you for the opportunity to evaluate this fascinating and important structure. If you have any questions regarding this report, please do not hesitate to contact us.

Respectfully Yours,
Structures North Consulting Engineers, Inc.

Stephanie Davis, EIT

John M Wathne, PE

B | E | R

BUILDING ENGINEERING RESOURCES, INC.

SITE VISIT REPORT

DATE OF REPORT: May 17, 2013

RE: **Fort Taber/Fort Rodman**
Rodney French Boulevard
New Bedford, MA

PERFORMED BY: Doug Curry – Electrical
David Ferguson – Plumbing

GENERAL:

The purpose of this site visit performed on May 14, 2013 was to identify existing Electrical and Plumbing (water and sewer) services that can be used in support of a proposed restoration project for the Fort including universal accessibility and reuse and architectural conservation. Building Engineering Resources reviewed the existing structure, its infrastructure and surrounding park to review the existing services noted above.

ELECTRICAL:

1. Electric service enters the building from a handhole located just outside the Fort approximately 35 feet southwest of the main entry. The service is fed underground to a pit located in front of the service panel. The panel is located in a NEMA 4X rated stainless steel enclosure in the southwest barracks. According to the Electrical Drawings provided to BER, the electric service is 100 amps at 120/208 volt, 3 phase, 4 wire, although during an interview with Ron Labelle, Commissioner of the Department of Public Infrastructure, he noted that it is a 200 amp panel.[1] The electric service serves four (4) loads:

    - Feed to lighthouse.
    - Feed to rooftop structure.
    - A double duplex receptacle mounted on the front of the Fort.
    - A floodlight located on the second floor over the main entry.

[1] Ron Labelle. Commissioner, City of New Bedford Department of Public Infrastructure. Interview. July 31, 2013.

Services to the Park are unidentified. A dry type transformer located adjacent to the Fort on the south side is assumed to be the service point of connection. This electrical transformer is dedicated to the Fort. A stainless steel pedestal on the east side of the site, outside the fort, is a box to power up equipment for events at the park.[2] BER requests a copy of As-built drawings for the site development project to determine underground utility locations and points of connection.

2. There is no interior lighting or power in the Fort other than those mentioned above.

3. There is no Fire Alarm system.

PLUMBING:

1. General:
   Presently there are no plumbing systems in the Fort that would be recognized by the current Plumbing and Building Codes. Any modernization, including the installation of accessible toilet rooms or drinking fountains, etc., will require the development of a water supply and sanitary sewer system inside the Fort.

2. Water:
   There is a system of underground water mains fed by the City of New Bedford public water supply throughout the park. Fire hydrants are located on both the northwest and southeast sides of the Fort. The closest water main to the Fort appears to run either under or parallel to the walkway that passes approximately 75 feet from the northwest wall of the Fort. This line is assumed to be a minimum of 6-inches in diameter and is of sufficient size to meet any needs of the Fort renovation/improvement project.

3. Sewer:
   The original drawings of the Fort show a system of 35 roof drains and storm water conductors traversing each pier and many of the walls carrying rain water into a system of subsurface open channels. The drawings show these channels collecting below grade on the interior of the Fort and presumably discharging into the ocean but that is unknown at this time. Additionally, the drawings show and there is evidence that some sort of Water Closet arrangement existed in the living quarters on the 2nd level and there were privies on the first floor. All of these appeared to be drained into a tidal cistern where the waste would wash out to sea during the changing of the tides.

   A sewer manhole was found approximately 60 feet to the south-southeast of the Fort. It appears however that this line and manhole are associated with the outfall from the New Bedford Wastewater Treatment Plant located to the northwest of the Fort. Further, if this line is associated with the outfall of the WWTP, it will not be useable for untreated sanitary

[2] Ron Labelle

sewer discharge. This will require further investigation and access to site utility plans for the park.

A second sanitary sewer manhole was found approximately 75 feet northwest of the Snack Bar building. This presumably collects the sanitary sewer lines for the Snack Bar and Military Museum and then discharges into a Lift Station noted to the northwest of the tank on display on site. The inverts of the manhole are not known at this time and requires further review but a sanitary sewer line could run northwesterly out of the Fort for approximately 325 feet into a new manhole then turn north for approximately another 250 feet to the manhole noted above. If the inverts are too high to complete this installation by gravity a small lift station or ejector pump could be installed within the confines of the Fort or outboard of the walls and provide a force main to discharge the sanitary sewer to the manhole serving the Museum and Snack Bar.

3. Storm Drains:
Catch basins are located throughout the park and in close proximity to the Fort. As noted above there is a system of roof drains for the existing structure. Their interior condition is unknown. These should be cleaned and viewed via a drain camera to assess their viability for reuse. If found not to be sound it may be possible to install liners using polymer based flow able sleeve. Any proposed new roof drains, area drains or the existing roof drainage system could be easily piped to this underground system. All of this needs in-depth review and study.


Lift Station
Fort Taber - Fort Rodman Military Museum
Sanitary Manhole
Fire Hydrant
Transformer
Outfall Sanitary Manhole
Google earth
© 2013 Google


Google earth
feet
meters
900
200

MORTAR ANALYSIS

For

FORT TABER

New Bedford, Massachusetts

Prepared For

Bargmann Hendrie + Archetype, Inc.
300 A Street
Boston, Massachusetts

Prepared By

Schnabel Conservation L.L.C.
110 Kensington Avenue
Trenton, New Jersey 08618

August 16, 2013

INTRODUCTION

This report presents the analysis of three mortar samples from Fort Taber in New Bedford, Massachusetts. The granite fort was constructed in the late ninteenth century, c.1860, and has granite exterior walls with brick interior walls. Mortar analysis is an evaluation of the composition of historic mortar materials performed to aid in the specification of appropriate replacement materials. Generally, the combination of microscopic and acid digestion (gravimetric or weight-based) methods used for the analysis gives valuable, objective information about the sand, including composition and size distribution. Characterization of the binder is inherently more subjective due to the chemical changes that take place as the mortar cures. However, mortars can generally be classified as hydraulic or non-hydraulic, and some sense of the original starting ingredients obtained through the process. Other cementitious construction materials such as stucco and plaster can also be evaluated using the same techniques.

Analysis of building materials from existing constructions presents unique problems. Most standard tests used to characterize building materials are intended for pre-construction materials evaluations. The test designs take material variablity into consideration, typically requiring a large number of large-sized samples to assess a particular physical property such as absorption or strength. However, when sampling materials from historic structures, compromises must be made in the size and number of samples taken. There are also aesthetic and logistic physical limitations on sample locations. Care should be used when interpreting test results obtained by analysis of a small number of small-sized samples not to treat values obtained as representative. Final selection of materials to be used in the restoration of the existing masonry is the responsibility of the architect and/or engineer in charge of the work.

SAMPLING

Nine mortar samples were provided by Bargmann Hendrie + Archetype, Inc. (BH+A), along with photographic documentation of each sample location. Each sample included at least one large intact joint fragment; most of the samples included multiple joint fragments. Sample numbers and locations were provided by BH+A as follows:

Sample #1: Terreplein horizontal joint at granite tower
Sample #2: Spiral stair vertical joint at granite (top level exposed to weather, Photos 1-2; all photos are at the end of the report)
Sample #3: Stairwell at 2nd Tier vertical joint for granite
Sample #4: 2nd Tier casemate at granite (Photos 3-4)
Sample #5: 2nd Tier mortar dropped between brick veneer and brick pier (Photos 5-6)
Sample #6: 1st Tier interior brick veneer wall-pointing mortar
Sample #7: 2nd Tier Quarters-brick wall between quarters
Sample #8: 1st Tier lime mortar at brick masonry
Sample #9: 1st Tier interior brick veneer wall—bedding mortar (Photo 7)

MORTAR ANALYSIS

All samples were first examined microscopically with a Nikon stereo-binocular microscope at magnifications from 10x to 63x. All surfaces of the samples were

examined, including the exposed weathered surface (where present), the joint surfaces, and the surface of a fresh break. This examination was used to select material for thin-sectioning and acid digestion, and for a preliminary assessment of binder color and characteristics, proportion and characteristics of voids, and relationship between aggregate and binder.

All of the mortars are hard; most cannot be broken by hand. The mortars from the granite masonry (Samples #1-#4) are all quite similar. They all have multiple layers of material; most have three; Sample #2 has two layers. These samples are also significantly recrystallized from water percolating around and/or through them (Sample #3 has a carbonate crust almost 1/8 inch thick on the outer surface). Samples #2 and #4 were selected for analysis because they contained all of the representative layers observed in the mortar samples from the granite. Analysis was by thin-section only; grinding hard mortars for acid digestion breaks the aggregate, altering the grading and appearance of the sand.

The brick mortar samples generally contained one material per sample. However, they are also altered by recrystallization of the binder due to exposure to water. Samples #6 and #8 are modern air-entrained cement mortars. Samples #5 and #7 are similar in character to some of the layers of the granite mortar. Sample # 9 is the softest of all the mortar samples provided, and is similar to some of the deepest layers of the granite mortars. Samples #5 and #9 were selected for analysis. Sample #5 was analyzed by thin-section only; sample #9 was analyzed by both thin-section analysis and gravimetric analysis.

The portion of each sample selected for thin-sectioning was submitted to Weatherford Laboratories in Houston, Texas for preparation of the thin section. There, the samples were impregnated with blue epoxy, mounted on a microscope slide, and ground to a thickness of approximately 25 microns. The sample was ground in oil to preserve any potentially water soluble components that might be lost through water grinding. The thin sections were examined in polarized transmitted light with a Nikon petrographic microscope. The binder composition and characteristics, the aggregate composition, and the proportion and characteristics of the voids were all evaluated at magnifications from 40x to 400x.

The portion of Sample #9 set aside for gravimetric analysis was ground in a ceramic mortar to disaggregate the mortar without crushing the aggregate. The sample was then digested in dilute hydrochloric acid to free the acid-insoluble aggregate and fines for examination and weighing; the acid soluble portion of the mortar was calculated by difference. The aggregate was then sieved to determine the size distribution, and examined microscopically. Data from the gravimetric analysis is included in Appendix A.

OBSERVATIONS

Samples #1-5, #7 and #9 are all somewhat similar in appearance. They have tan to dark tan binders with rounded nodules that vary from tan to orange-red in color. As previously

noted, they are typically hard and cannot be broken by hand; sample #9 is the exception, being somewhat softer. Samples #6 and #8 are both similar to each other and distinctly different from the other samples, with cream-colored binders and abundant void volume in the form of numerous rounded voids over a broad range of sizes. The characteristic of the void system in these samples is typical of air-entrained mortars. The void characteristics and the distinctly different binder characteristics suggest these two samples are modern repair mortars.

Samples #2, #4, #5, and #9 were selected for analysis. Each sample selected for analysis is described individually.

Sample #2

Each of the joint fragments consists of two layers of mortar. Based on the character of the fragments, these layers were at two different depths in the joint, suggesting the outer might be a re-pointing mortar. Alternatively, the inner mortar (that deeper in the joint) could be a setting mortar and the outer a pointing mortar). Both layers are similar in appearance, the primary difference being the amount of aggregate. The mortar fragments are hard and cannot be broken by hand. Both mortar layers are tan in color, matte-textured and almost smooth. Rounded nodules that are tan with reddish inclusions were noted in both layers. These inclusions have the appearance of nodules of natural cement. Void volume in the layers as estimated visually is moderate, approximately 10% of the volume of the sample. The voids are irregularly-shaped entrapped air voids typically larger than the aggregate and some fissure voids; many in the outer layer appear to be lined with fine-grained white material. The binder to aggregate ratio of the outer layer is estimated visually at 1 part binder to 3 parts aggregate; the binder to aggregate ratio of the inner layer is approximately 1 part binder to 2 or less parts aggregate.

In thin section, the binder of both layers is observed to consist of micro-crystalline calcium carbonate and calcium silicates. The character is of a carbonated natural cement mortar from an incompletely calcined natural cement. (Photo 8). There are abundant nodules of this cement in various stages of calcination, hydration and carbonation; they are typically quite large (Photos 8 and 9). There are also smaller relics in the binder (Photo 10).

Viewed in thin-section, the aggregate consists primarily of subangular to angular grains of quartz and feldspar (Photos 8-9). The aggregate in the outer layer is finer and significantly more abundant than the aggregate in the inner layer, and is subangular to subrounded.

Sample #4

Like Sample #2, this mortar also consists of multiple layers. The outer layer is similar in character to that of the outer layer of Sample #2: hard, tan in color with tan nodules and fine quartz aggregate. The inner layer is similar to that of the inner layer of Sample #2, but is lighter in color and contains more aggregate. Void volume in both layers as estimated visually is moderate, approximately 10% of the volume of the sample. The voids are irregularly-shaped entrapped air voids typically larger than the aggregate. The binder to aggregate ratio of the outer layer is estimated visually at 1 part binder to 3 parts

aggregate; the inner layer has a binder to aggregate ratio of 1 part binder to 2-2.5 parts aggregate.

In thin section, the character and composition of the outer mortar layer is virtually identical to that of Sample #2. Evidence of recrystallization is even more pronounced, with all voids filled or lined with fairly coarsely crystalline calcite.

The composition of the inner layer is different from that of Sample #2 (Photo 11). Though there is evidence of natural cement, one lime nodule was also observed, and the binder is overall lighter in color than that of the inner mortar of Sample #2. There is also more aggregate; binder to aggregate ratio of the inner layer is estimated at 1 part binder to 2-2.5 parts aggregate. The aggregate of the inner mortar of this sample consists of quartz, feldspar, and also a few grains of glauconite. There are both large and small entrapped air voids; small voids are typically filled with calcite, indicating water movement through this layer as well.

Sample #5

This sample is somewhat similar to the inner layer of Sample #4. The mortar is hard and cannot be broken by hand. The binder is tan in color, matte-textured and slightly granular. In-thin-section, the binder contains nodules of natural cement and relic partially hydrated grains, but does not appear to contain any lime nodules (Photo 12). The color of the binder is more similar to the inner layer of Sample #4 than Sample #2. The aggregate consists primarily of quartz with some feldspar and lithic grains. The aggregate is well graded, and the grains are subrounded to subangular, with the larger grains typically more rounded than the smaller. Void volume in both layers as estimated visually is moderate, approximately 10% of the volume of the sample. The voids are irregularly-shaped and rounded entrapped air voids of varying sizes; some are quite large. However, this sample also has a large number of smaller voids, some of which are rounded. Some of the voids are lined with calcite crystals, but overall there is less evidence of water percolation through this mortar.

Sample #9

Sample #9 is somewhat similar to Sample #5, but there are some differences. The mortar is softer than Sample #5 and can be broken by hand. Dark tan in color, the binder is matte-textured and granular. Brown nodules were noted in the binder. Void volume as estimated visually is minimal, from 5-10% as large irregularly-shaped entrapped air voids. There are also smaller and more rounded voids. Many of the voids are lined with calcite crystals. In thin-section, the binder appears the same as that of Sample #5 (Photo 13) though there is some substantially larger aggregate in Sample #9. The binder is also composed of natural cement; no lime nodules were observed, but there are abundant relic natural cement grains.

Examination of the sand separated from the mortar at low magnification in reflected light reveals predominantly subrounded grains of quartz and feldspar, with traces of lithic (rock) grains and anthracite. The overall color of the sand is tan. The sand-size fraction also contains a small amount of undigested binder in the form of nodules. These are brown in color (like the binder) and quite soft; they are most likely the relic cement grains that were unaffected by the acid digestion.

DISCUSSION AND RECOMMENDATIONS

The results of the analysis suggest that the mortars from Fort Taber are composed of natural cement and sand; one of the mortars analyzed also appeared to contain lime. Based on the character of the samples, it seems possible that the lime-containing mortar may have been used as a setting mortar with natural cement-sand mortars used for pointing. Alternatively, the lime-natural cement-sand mortar may have been the original mortar with the outer layers of natural cement and sand mortar representing a later pointing. Many more samples would need to be examined to draw a final conclusion.

Considering the date of the building, a finding of natural cement in the mortar is not surprising. Based solely on the composition of the samples analyzed, either a natural cement-sand mortar or a lime-natural cement-sand mortar could be used for repointing. A mix of 1 part natural cement to 1 part lime to 5 parts sand is would approximate the visual characteristics of the mortar containing lime; a mix of 1 part sand to 3 parts natural cement would approximate the visual characteristics of the mortars containing natural cement. The sand extracted from Sample #9 is fine-grained and tan in color; the sand selected for the pointing should match this sand. A finer-grained sand should be used to approximate the outer mortars of Samples #2 and #4.

However, formulation of an appropriate repair mortar must take into consideration the condition of the masonry and the conditions of exposure. The highly re-crystallized character of the mortar samples submitted for analysis suggest that the mortar joints have had prolonged exposure to water. A less cement-rich mortar may be more appropriate in conditions of harsh exposure. Use of air entraining additives (or an air-entrained lime) may also prolong the life of mortars in harsh, wet environments.

The recommended mix takes into consideration the characteristics and ingredients of the mortars as determined by this analysis. However, this recommendation can only be considered a starting point. Final mortar selection by the professional of record for the work should be based on evaluation of material submittals for binder materials and sand, on observation of samples of sand proposed for the work, and on observation of field samples (test panels), and must take into consideration the existing cause(s) of mortar failure, the current physical state of the masonry, and any changes in the environment of the building that might necessitate alteration of the mortar formulation.

Both the lime-natural cement and the natural cement mortars would likely require the addition of pigment to confer the tan color derived from the original natural cement. Pigment additions to mortars are limited because pigments are inert, and can therefore compromise the strength of the cured mortar, particularly of cement mortars. However, it is unlikely that the amount of pigment required will exceed that permitted by ASTM C 270, *Standard Specification for Mortar for Unit Masonry*. Pigments used should be alkali stable, meeting the requirements of ASTM C 979, *Standard Specification for Pigments for Integrally Colored Concrete*. Great care must be used in proportioning, mixing, and installing pigmented mortars to avoid color variation in the finished product. For large-scale repointing with pigmented mortars use of a pre-proportioned pigmented bagged mortar mix, with or without sand already added, is strongly recommended.

With any type of mortar mixing, but particularly pigmented mortars, all parts should be measured by volume using an accurate measuring tool, such as a coffee can or bucket (not a shovel). Mix dry ingredients (including pigments) thoroughly before adding water; water addition must be more carefully monitored for pigmented mortars than for mortars without pigment. To avoid oversanding, the sand must be added in a damp, loose condition. If pre-proportioned mixes are not used, pigments of a given color should be from a single lot; check lot number to ensure consistent color.

Photo 1: Overall view of the location of Sample #2 (Photo 2 taken near arrow; all sample location photos taken by BH+A).

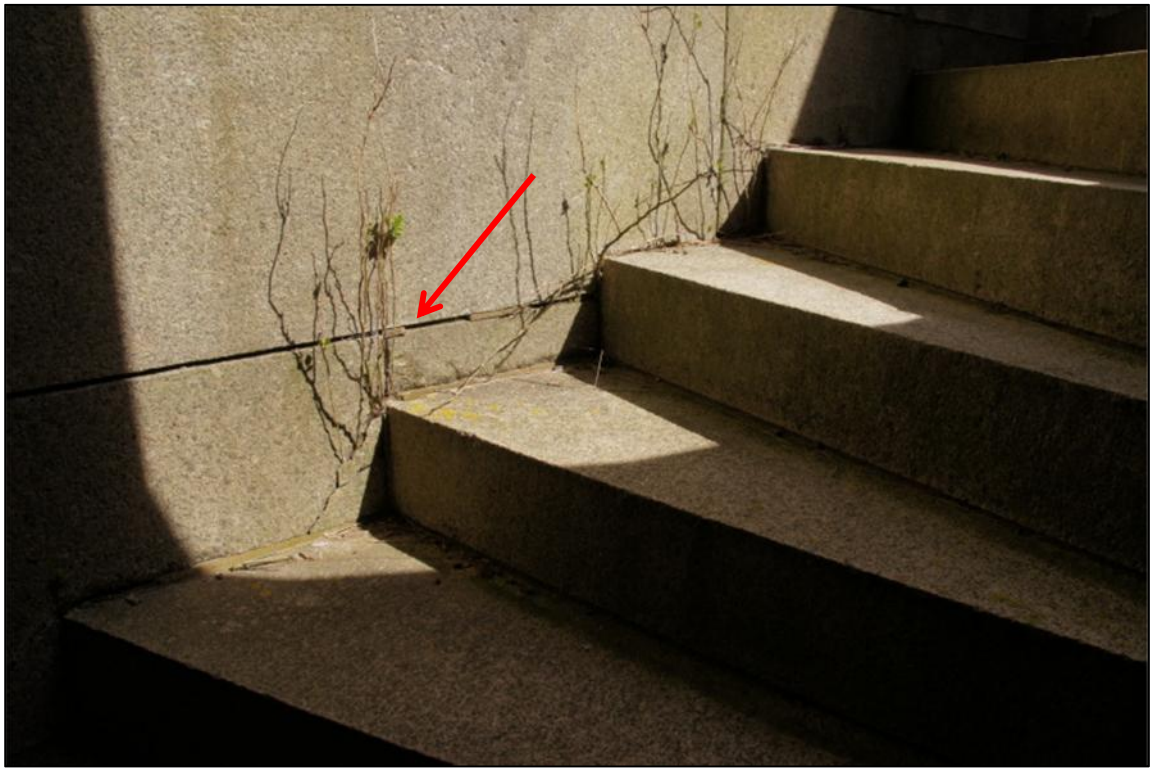


Photo 2: Detail of location of Sample #2.

Photo 3: View of the location of Sample #5.

Photo 4: Detail of location of sample #4.

Photo 5: Overall view of the location of Sample #5.

Photo 6: Detail view of the location of Sample #5.

Photo 7: View of the location of Sample #9.

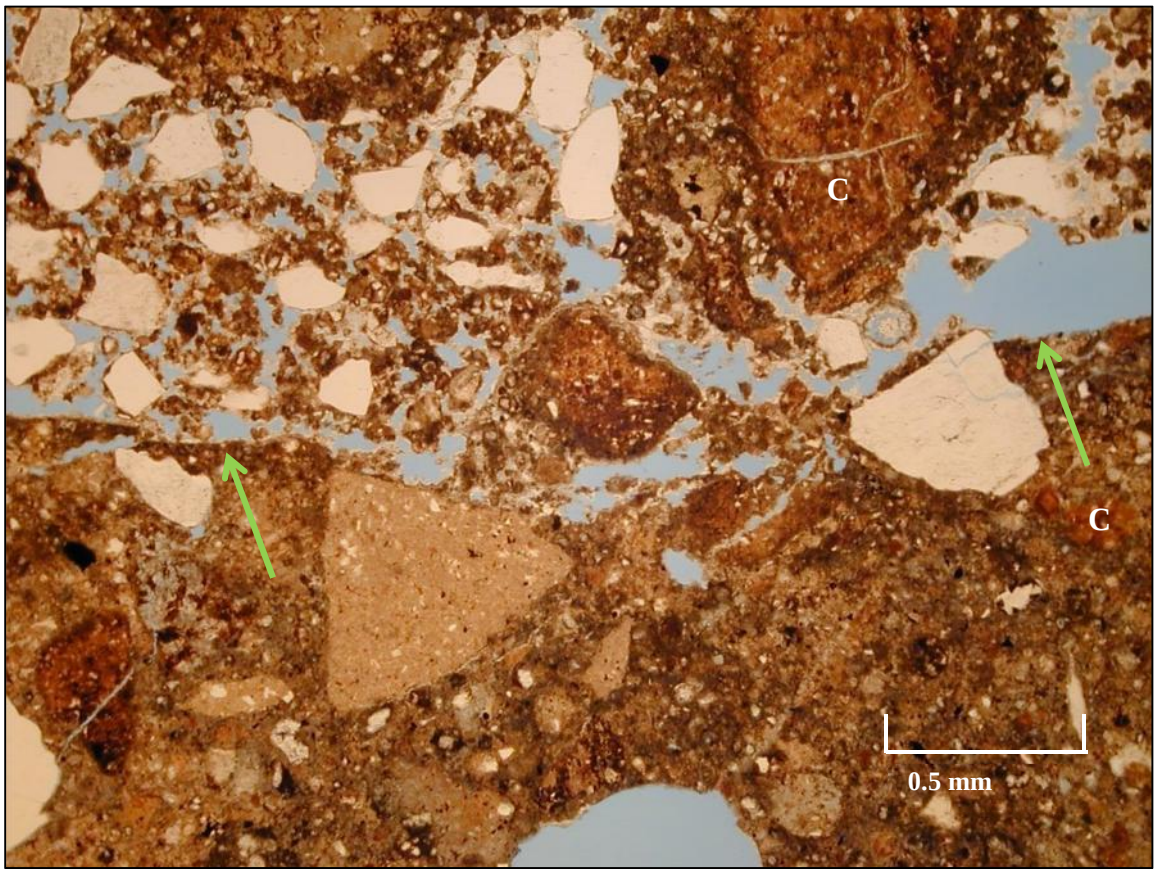


Photo 8: View of Sample #2 in thin-section showing the boundary between the outer (top) and inner (bottom) layers (green arrow). Uncrossed polars (ppl), 40 times magnification (40x). The difference in character with respect to voids and aggregate is clearly apparent. The light colored material in the voids of the outer layer is calcite. The dark red nodules are natural cement that is incompletely calcined and partially hydrated; the tan nodules appear to be uncalcined. Both types of nodules appear in both layers. The binder of both layers is variously carbonated.

L

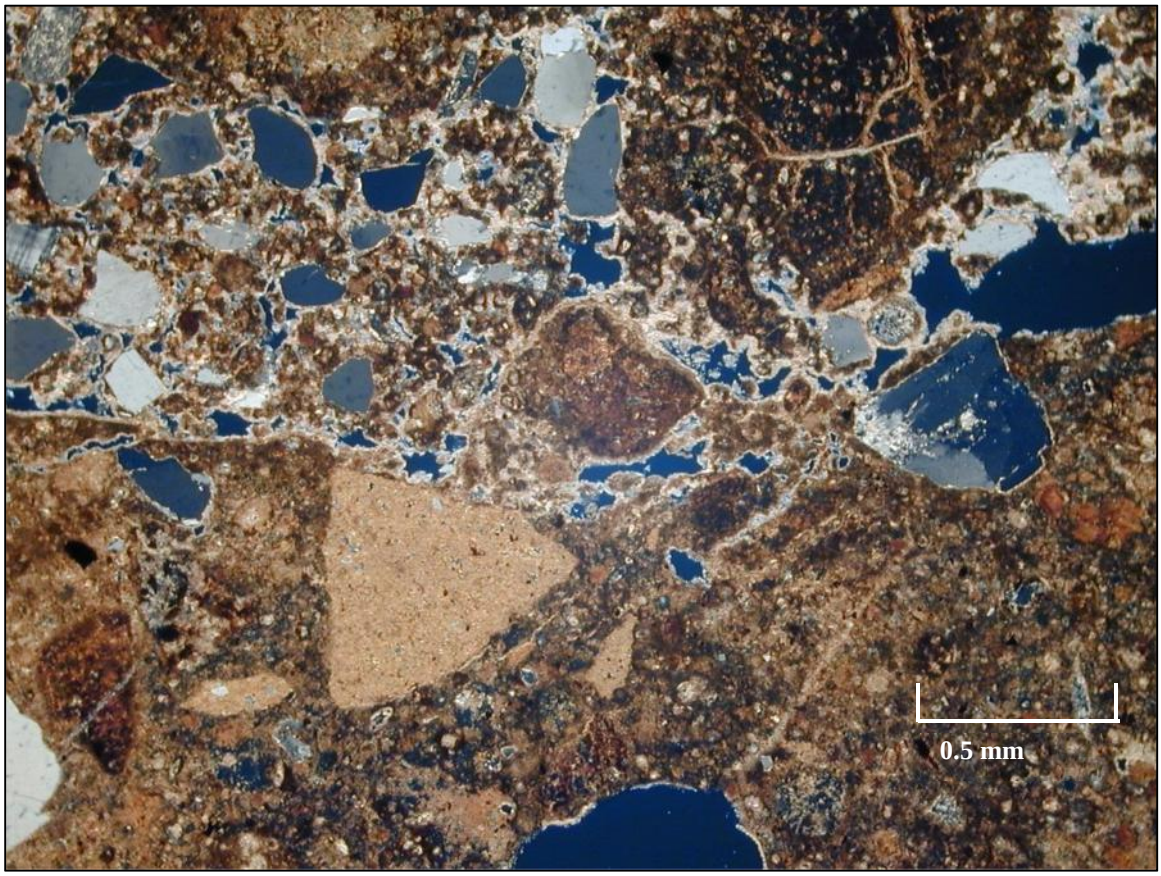


Photo 9: Same view as Photo 8, crossed polars (xpl), 100x. The white material lining the voids is calcite that is fairly coarsely crystalline; the binder of both layers is also composed largely of microcrystalline calcite and hydrated cement.

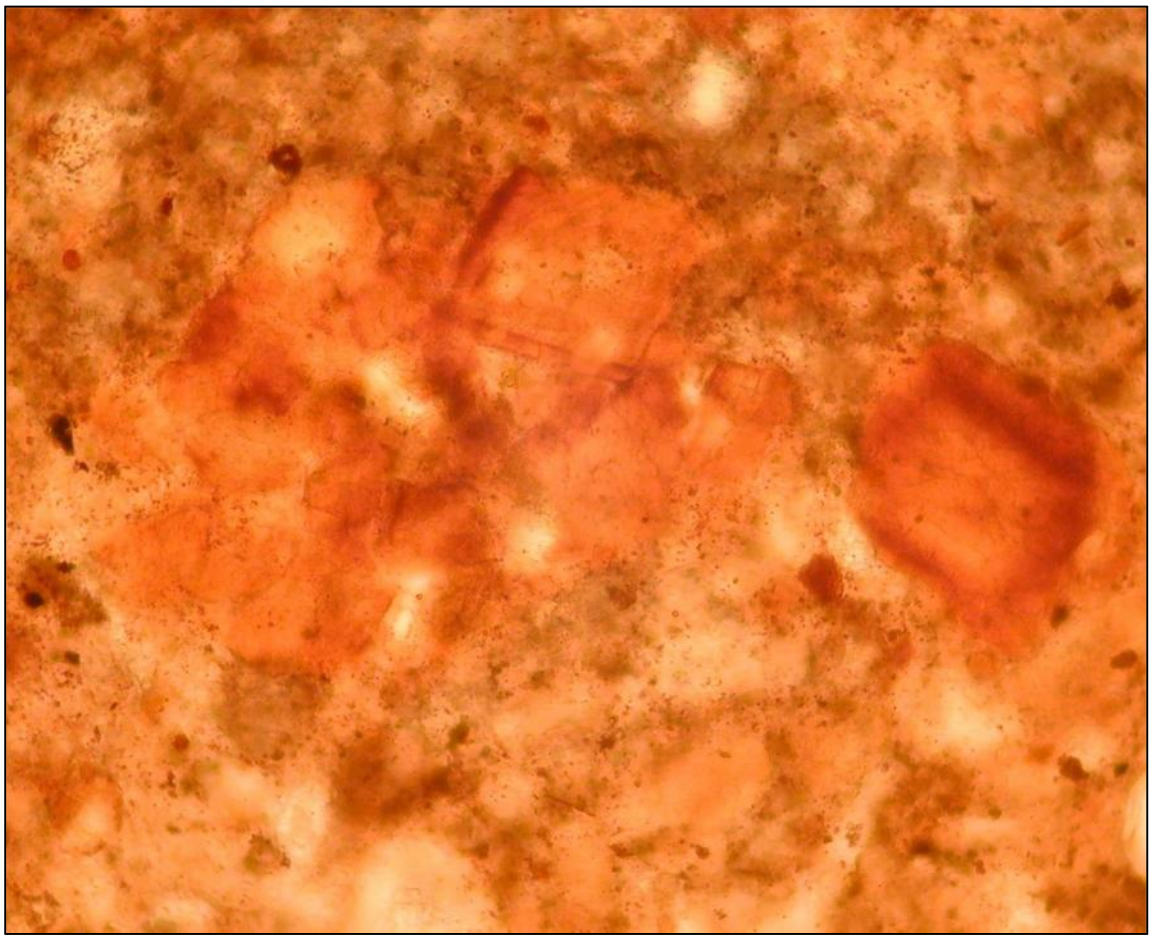


Photo 10: Detail of a relic grain from the natural cement showing the retained shape of the dolomite crystals. 400x, ppl.

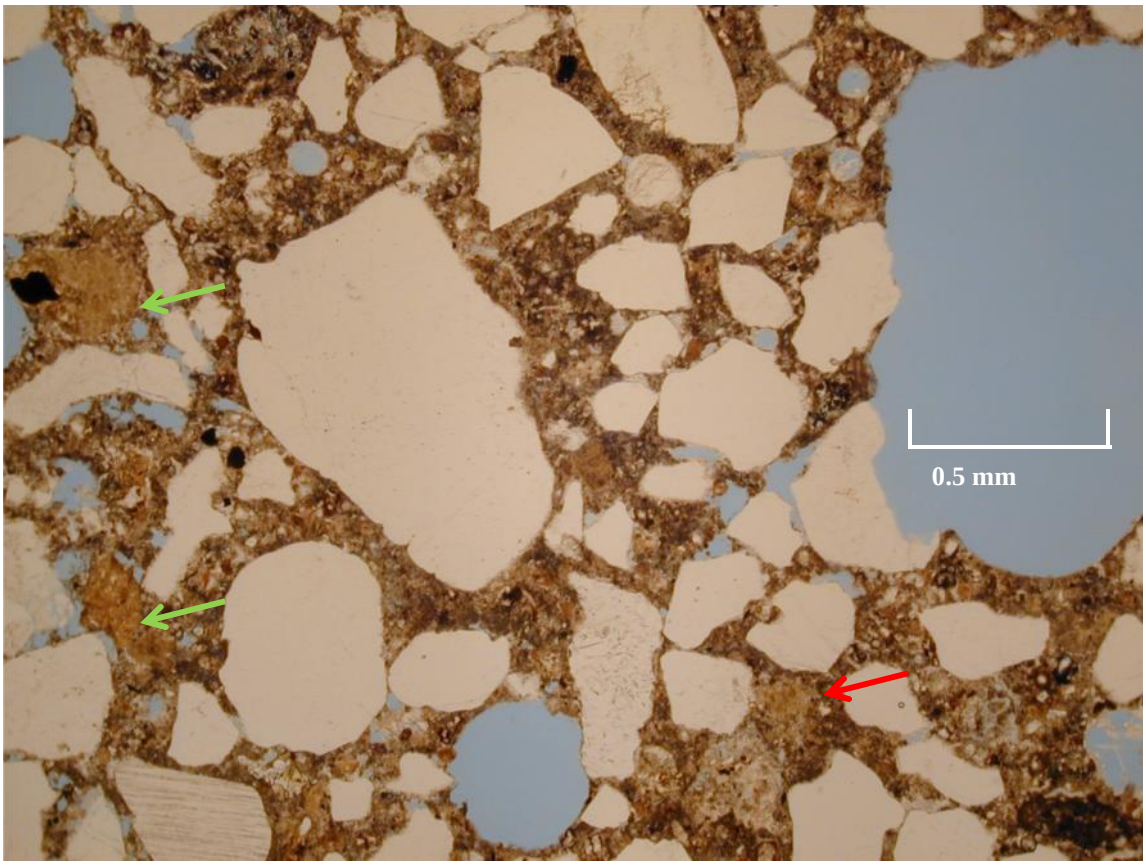


Photo 11: Overall view of the inner mortar layer of Sample #4, 40x, ppl. Aggregate grains are white, void space is blue, and the binder is pale tan. There is a lime nodule at the lower right (red arrow) and natural cement relic grains at the upper and lower left (green arrows).

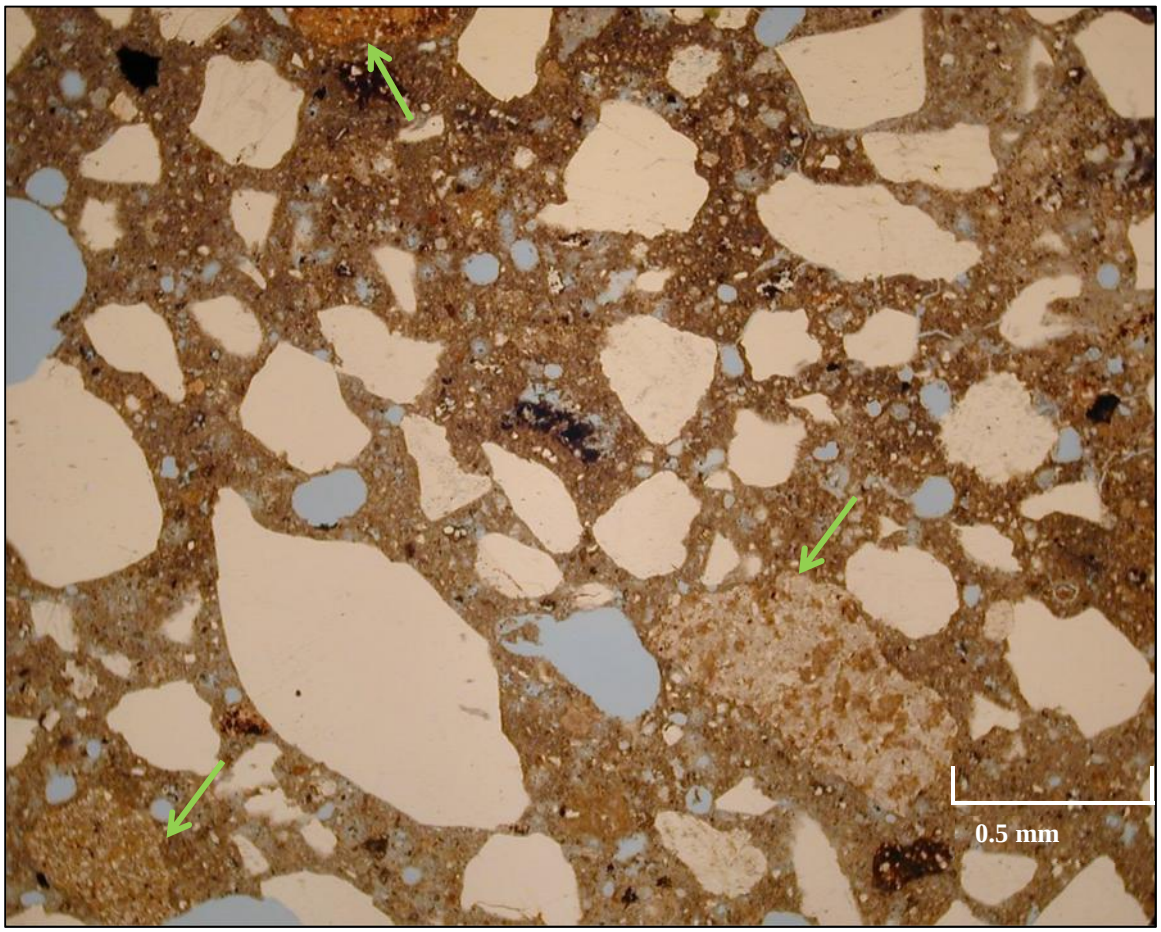


Photo 12: Overall view of Sample #5, 40x, ppl. Compare with Photo 11. Examples of natural cement relics are indicated with green arrows. The relic grains are calcined and hydrated to varying degrees.

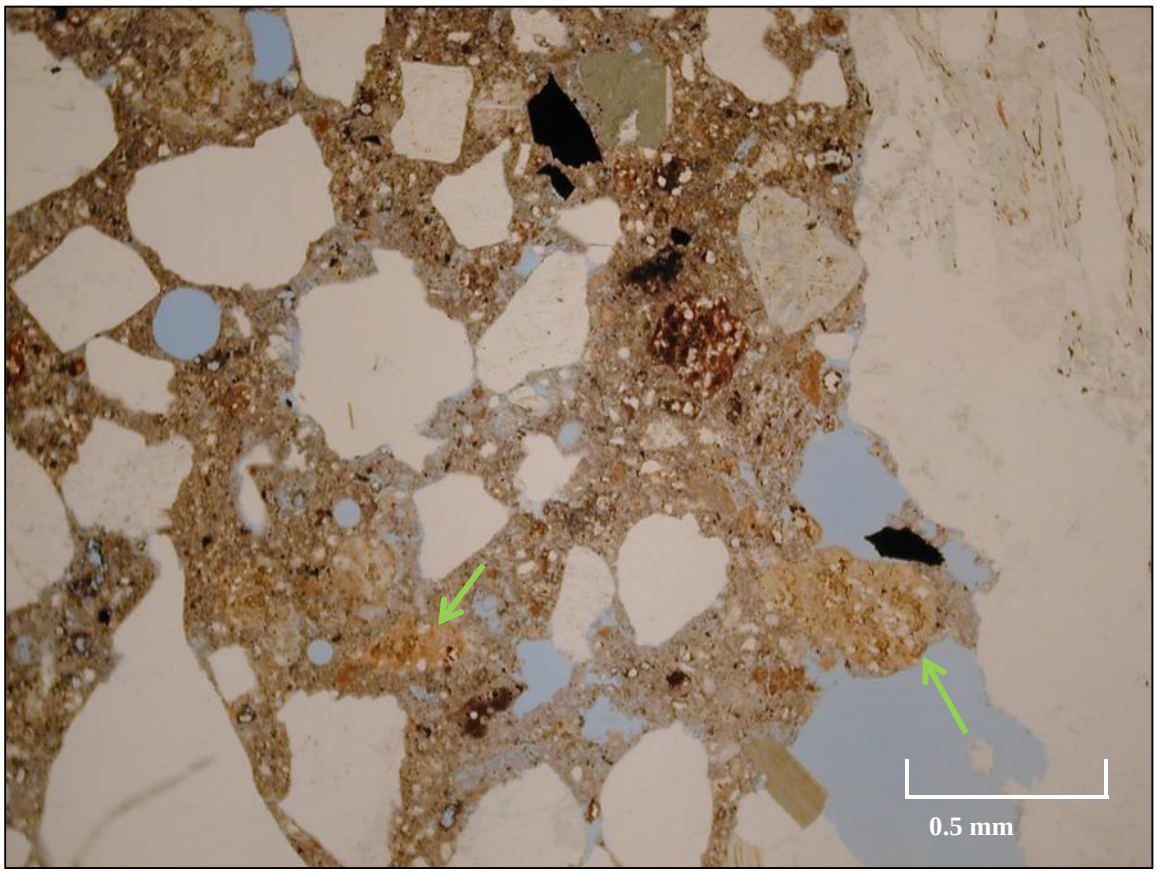


Photo 13: Overall view of Sample #9 in thin-section, 40x, ppl. Compare with Photo 12; note the large aggregate grain to the right of the field of view. Examples of natural cement relics are indicated with green arrows.

APPENDIX A-MORTAR DATA SHEET

MORTAR ANALYSIS SUMMARY SHEET

Project Name: Fort Taber
Location: Sample #9
Date: 8/2013

Chemical Analysis

Weight Percent Sand	59.80
Weight Percent Acid Soluble	30.33
Weight Percent Fines	9.87

Mortar Characteristics

Mortar Color: Dark Tan

	soft									hard
Relative Hardness:	**1**	2	3	4	5	6	7	8	9	10

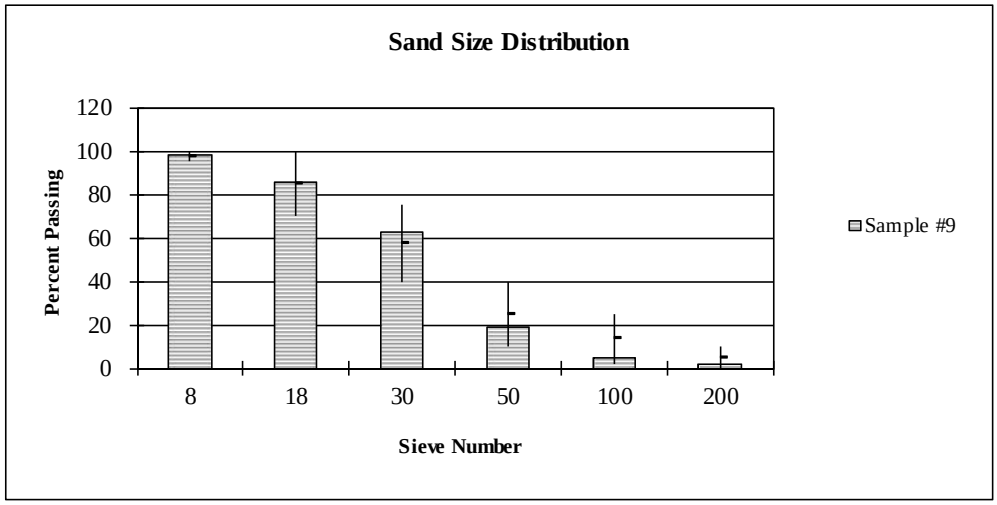
Sand Characteristics

Color: Tan
Angularity: Subrounded to subangular
Composition: Predominantly quartz and feldspar with traces of lithic grains and anthracite.
Nodules of undigested material are intermingled with the sand.

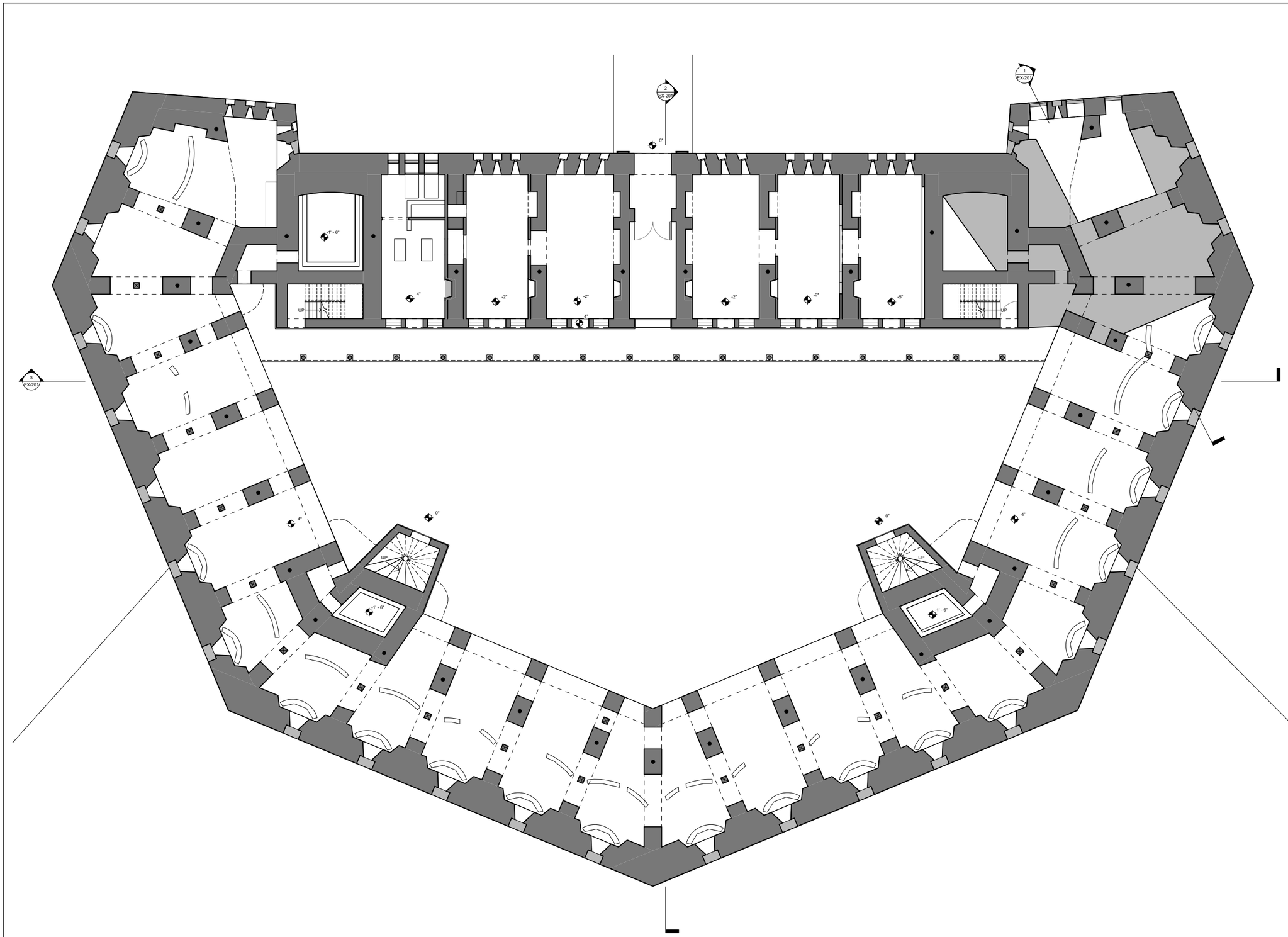
Size:	Sieve No.	Weight	Percent Passing
	8	0.19 grams	98 %
	18	1.59 grams	86 %
	30	2.88 grams	62 %
	50	5.43 grams	19 %
	100	1.71 grams	5 %
	200	0.40 grams	2 %
	<200	0.05 grams	1 %

Fines Color: Brown

Notes: Brisk effervesence.



Note: Each thin, black vertical line represents the range allowable in a mortar sand for a given particle size as specified by ASTM C 144 Standard Specification for Aggregate for Masonry Mortar. Allowable percentages are different for natural and manufactured sands; this chart represents the absolute maximum and minimum of both aggregate types considered together. The bars represent the particle size distribution of the sample analyzed.



ARCHITECT

bh+a

Bargmann Hendrie + Archetype, Inc.
300 A Street
Boston, MA 02210
617 350-0450 Tel

PROJECT NAME

Fort Taber, Assessment and Feasibility Study

1000c Rodney French Blvd
New Bedford, MA 02744

CLIENT

City of New Bedford

133 William Street
New Bedford, MA 02740

PROJECT TEAM

LANDSCAPE ARCHITECTS
Kyle Zick Landscape Architecture, Inc.
36 Bromfield Street, Suite 202
Boston, MA 02108
(617) 451-1018

STRUCTURAL ENGINEERS
Structures North Engineers, Inc.
60 Washington Street, Suite 401
Salem, MA 01970
(978) 745-6817

M/E/P/FP ENGINEERS
Building Engineering Resources, Inc.
66 Main Street
North Easton, MA 02356
(508) 230-0260

COST ESTIMATING
D.J. Jones International, Inc.
3 Baldwin Green Common
Suite 202
Woburn, MA 01801-1868
(781) 932-3131

REVISIONS

1		
2		
3		
4		
5		
		DATE

DRAWING TITLE

Existing First Floor Plan

DRAWING INFORMATION

May 31, 2013
DATE OF ISSUE

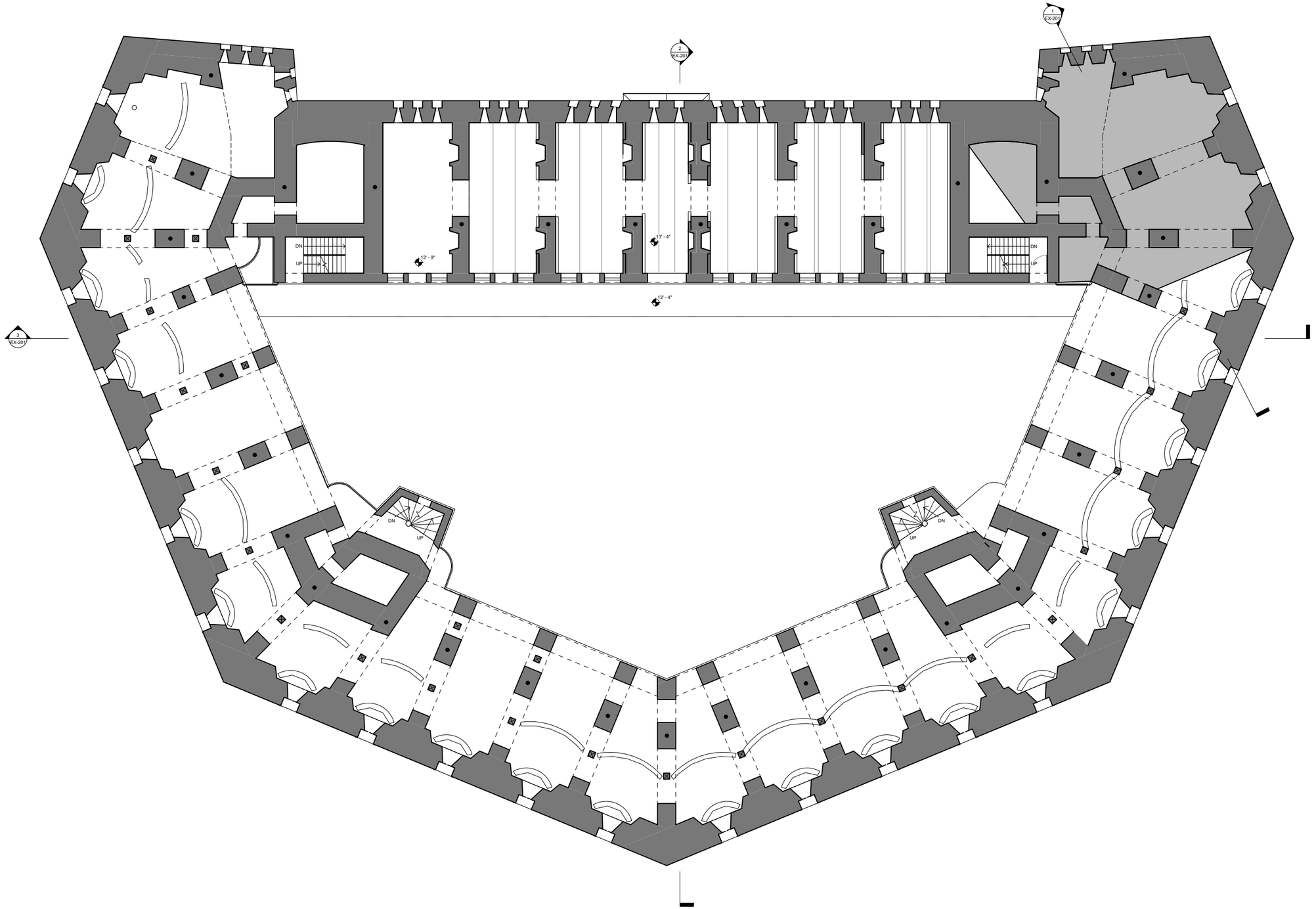
Conditions Assessment
DESCRIPTION

Graphic	arc
SCALE	DRAWN BY
3124.00	3124_Fort Taber.rvt
PROJECT #	FILE NAME

DRAWING NUMBER

EX-101

P:\3124 New Bedford - Fort Taber\Dwg\Revit\3124 Fort Taber Study.rvt
5/31/2013 11:22:43 AM arc



ARCHITECT

bh+a

Bargmann Hendrie + Archetype, Inc.
300 A Street
Boston, MA 02210
617 350-0450 Tel

PROJECT NAME

Fort Taber, Assessment and Feasibility Study

1000c Rodney French Blvd
New Bedford, MA 02744

CLIENT

City of New Bedford

133 William Street
New Bedford, MA 02740

PROJECT TEAM

LANDSCAPE ARCHITECTS
Kyle Zick Landscape Architecture, Inc.
36 Bromfield Street, Suite 202
Boston, MA 02108
(617) 451-1018

STRUCTURAL ENGINEERS
Structures North Engineers, Inc.
60 Washington Street, Suite 401
Salem, MA 01970
(978) 745-6817

M/E/P/FP ENGINEERS
Building Engineering Resources, Inc.
66 Main Street
North Easton, MA 02356
(508) 230-0260

COST ESTIMATING
D.J. Jones International, Inc.
3 Baldwin Green Common
Suite 202
Woburn, MA 01801-1868
(781) 932-3131

REVISIONS

1	
2	
3	
4	
5	
	DATE

DRAWING TITLE

Existing Second Floor Plan

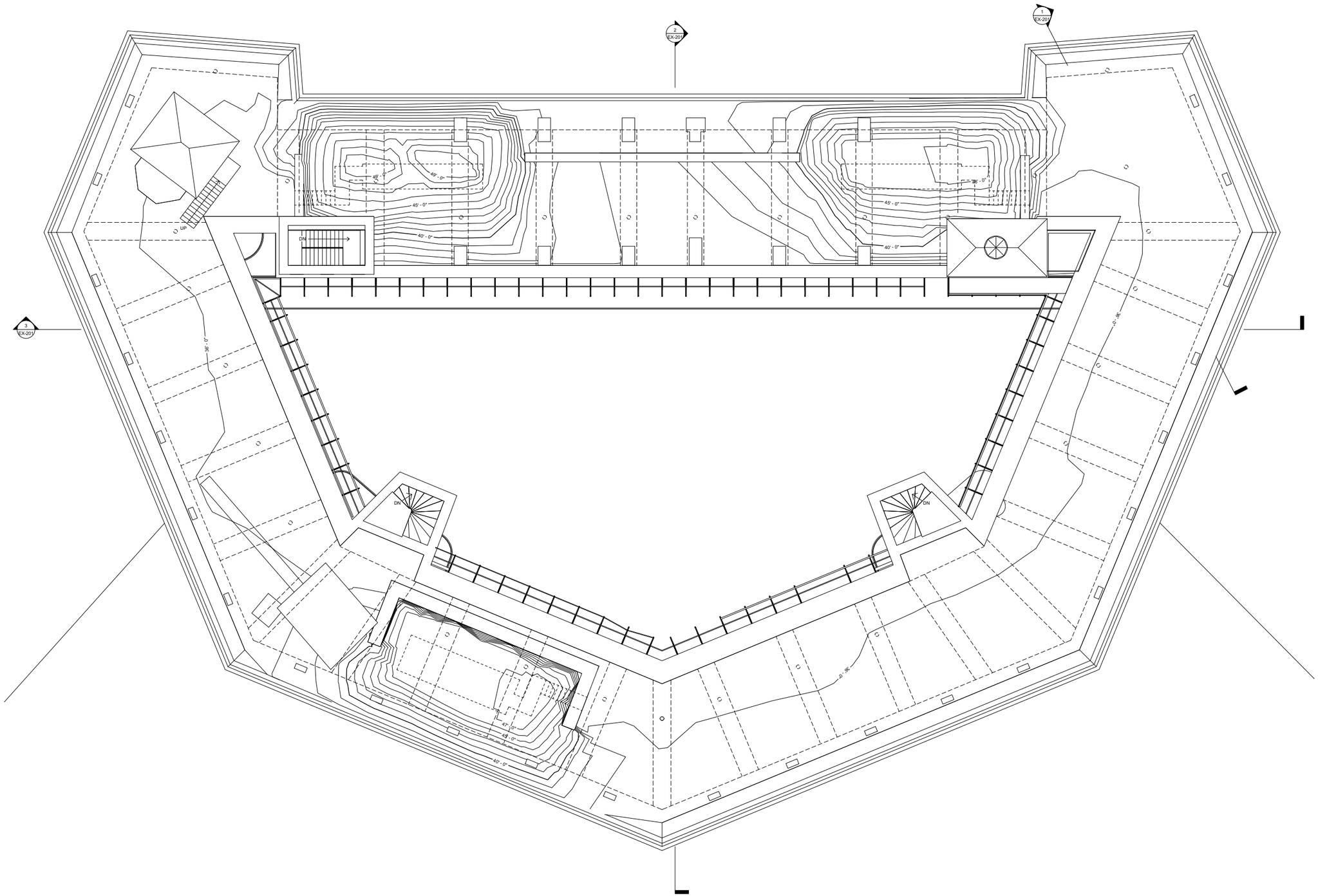
DRAWING INFORMATION

May 31, 2013	
DATE OF ISSUE	
Conditions Assessment	
DESCRIPTION	
Graphic	arc
SCALE	DRAWN BY
3124.00	3124_Fort Taber.rvt
PROJECT #	FILE NAME

DRAWING NUMBER

EX-102

P:\3124 New Bedford - Fort Taber\dwg\Revit\3124 Fort Taber Study.rvt
5/31/2013 11:22:45 AM arc



ARCHITECT

bh+a

Bargmann Hendrie + Archetype, Inc.
300 A Street
Boston, MA 02210
617 350-0450 Tel

PROJECT NAME

Fort Taber, Assessment and Feasibility Study

1000c Rodney French Blvd
New Bedford, MA 02744

CLIENT

City of New Bedford

133 William Street
New Bedford, MA 02740

PROJECT TEAM

LANDSCAPE ARCHITECTS
Kyle Zick Landscape Architecture, Inc.
36 Bromfield Street, Suite 202
Boston, MA 02108
(617) 451-1018

STRUCTURAL ENGINEERS
Structures North Engineers, Inc.
60 Washington Street, Suite 401
Salem, MA 01970
(978) 745-6817

M/E/P/FP ENGINEERS
Building Engineering Resources, Inc.
66 Main Street
North Easton, MA 02356
(508) 230-0260

COST ESTIMATING
D.J. Jones International, Inc.
3 Baldwin Green Common
Suite 202
Woburn, MA 01801-1868
(781) 932-3131

REVISIONS

1		
2		
3		
4		
5		
		DATE

DRAWING TITLE

Existing Roof Plan

DRAWING INFORMATION

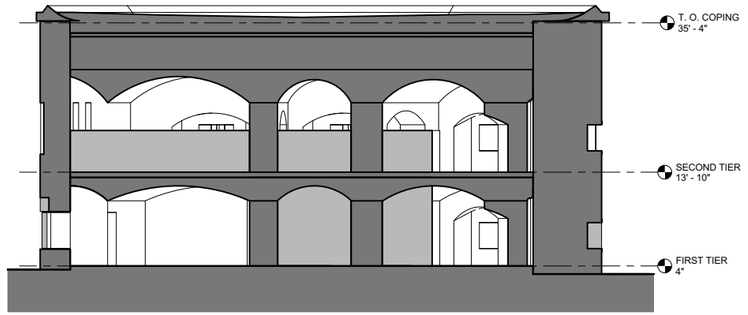
May 31, 2013	
DATE OF ISSUE	
Conditions Assessment	
DESCRIPTION	
Graphic	arc
SCALE	DRAWN BY
3124.00	3124_Fort Taber.rvt
PROJECT #	FILE NAME

DRAWING NUMBER

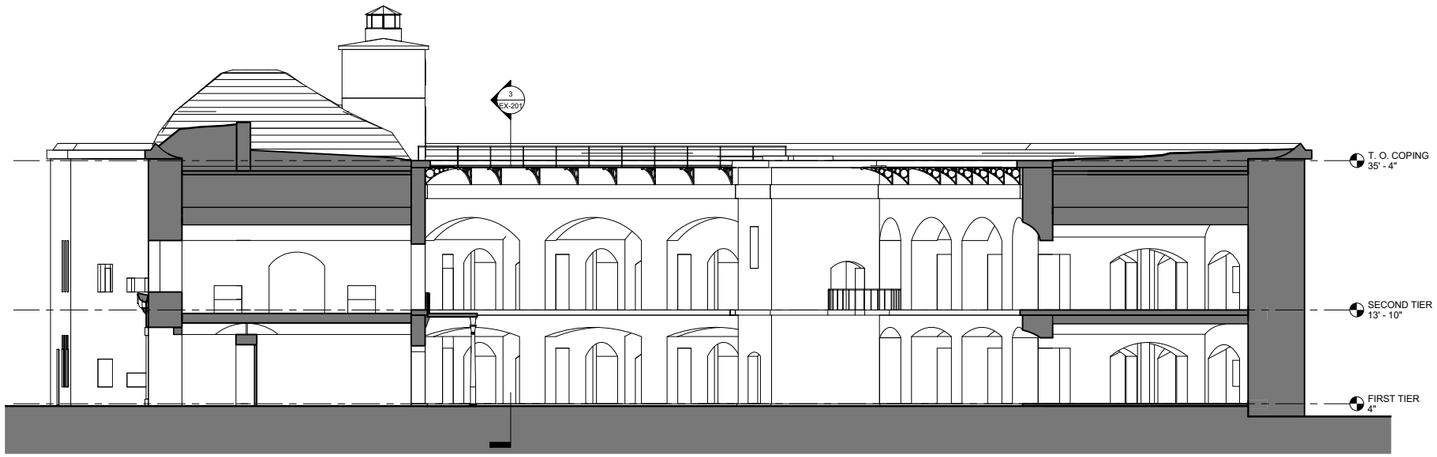
EX-103

0 4' 8'

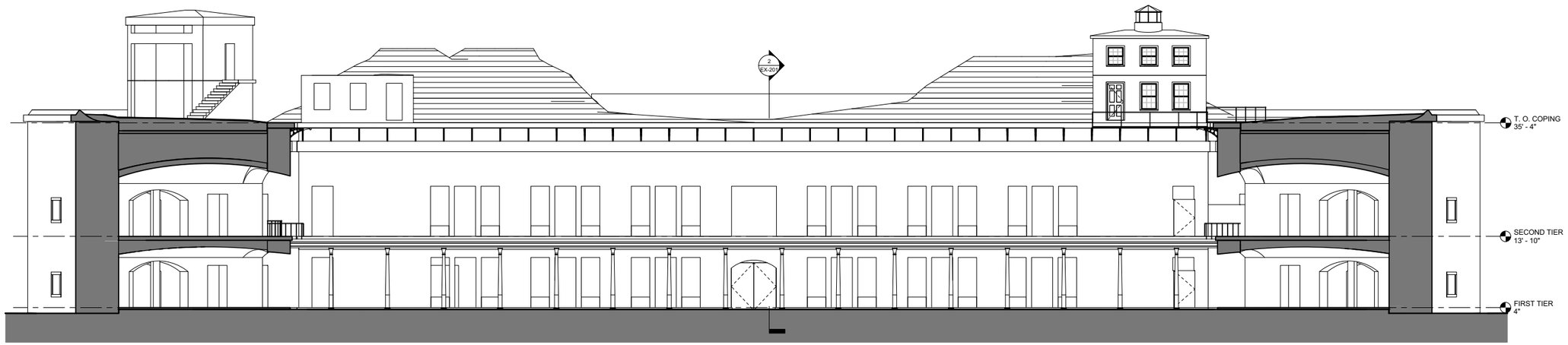
P:\3124 New Bedford - Fort Taber\dwg\Revit\3124 Fort Taber Study.rvt
5/31/2013 11:22:47 AM arc



1 MINE CASEMATE SECTION



2 LONGITUDINAL SECTION



3 LATITUDINAL SECTION

P:\3124 New Bedford - Fort Taber\dwg\Revit\3124 Fort Taber Study.rvt
5/31/2013 11:22:49 AM arc

ARCHITECT

bh+a

Bargmann Hendrie + Archetype, Inc.
300 A Street
Boston, MA 02210
617 350-0450 Tel

PROJECT NAME

Fort Taber, Assessment and Feasibility Study

1000c Rodney French Blvd
New Bedford, MA 02744

CLIENT

City of New Bedford

133 William Street
New Bedford, MA 02740

PROJECT TEAM

LANDSCAPE ARCHITECTS
Kyle Zick Landscape Architecture, Inc.
36 Bromfield Street, Suite 202
Boston, MA 02108
(617) 451-1018

STRUCTURAL ENGINEERS
Structures North Engineers, Inc.
60 Washington Street, Suite 401
Salem, MA 01970
(978) 745-6817

M/E/P/FP ENGINEERS
Building Engineering Resources, Inc.
66 Main Street
North Easton, MA 02356
(508) 230-0260

COST ESTIMATING
D.J. Jones International, Inc.
3 Baldwin Green Common
Suite 202
Woburn, MA 01801-1868
(781) 932-3131

REVISIONS

1	
2	
3	
4	
5	
	DATE

DRAWING TITLE

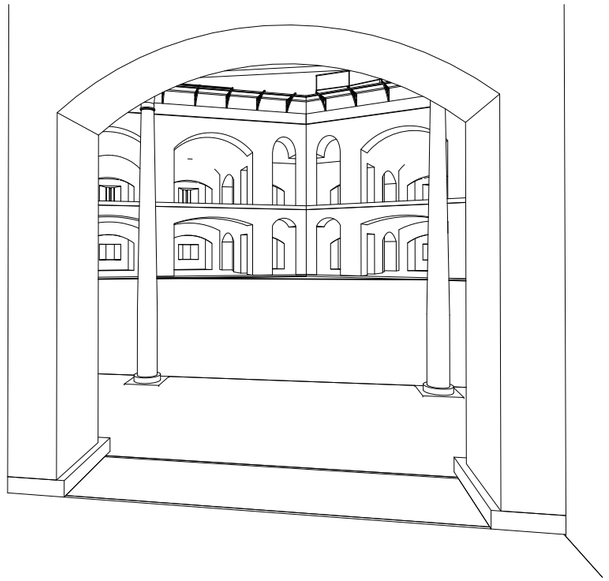
Existing Sections

DRAWING INFORMATION

May 31, 2013	
DATE OF ISSUE	
Conditions Assessment	
DESCRIPTION	
Graphic	arc
SCALE	DRAWN BY
3124.00	3124_Fort Taber.rvt
PROJECT #	FILE NAME

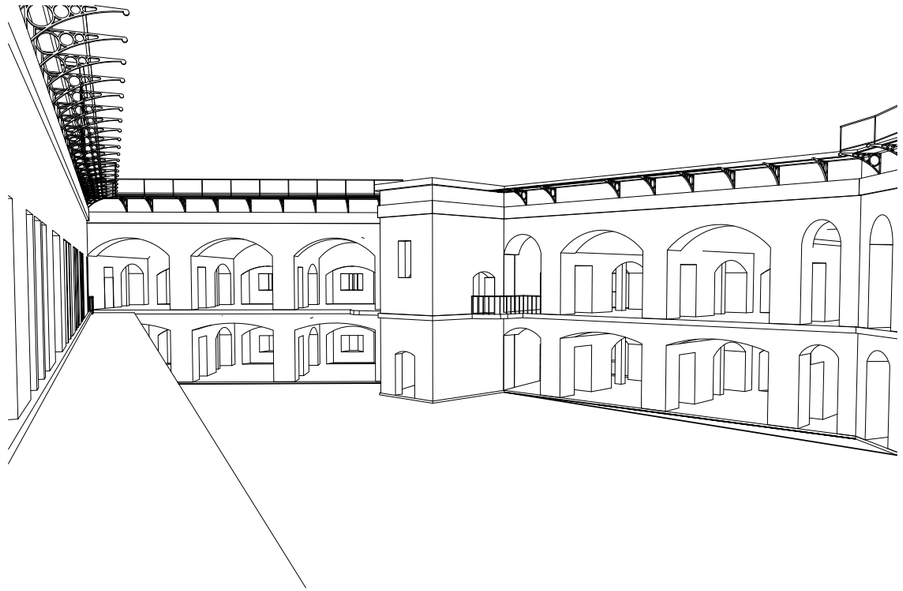
DRAWING NUMBER

EX-201



1 VIEW THROUGH ENTRANCE

2 VIEW OF PARADE GROUND



3 VIEW AT SECOND FLOOR GALLERY

4 VIEW OF FIRST FLOOR GALLERY

P:\3124 New Bedford - Fort Taber\dwg\Revit\3124 Fort Taber Study.rvt
5/31/2013 11:22:51 AM ARC

ARCHITECT

bh+a

Bargmann Hendrie + Archetype, Inc.
300 A Street
Boston, MA 02210
617 350-0450 Tel

PROJECT NAME

Fort Taber, Assessment and Feasibility Study

1000c Rodney French Blvd
New Bedford, MA 02744

CLIENT

City of New Bedford

133 William Street
New Bedford, MA 02740

PROJECT TEAM

LANDSCAPE ARCHITECTS
Kyle Zick Landscape Architecture, Inc.
36 Bromfield Street, Suite 202
Boston, MA 02108
(617) 451-1018

STRUCTURAL ENGINEERS
Structures North Engineers, Inc.
60 Washington Street, Suite 401
Salem, MA 01970
(978) 745-6817

M/E/P/FP ENGINEERS
Building Engineering Resources, Inc.
66 Main Street
North Easton, MA 02356
(508) 230-0260

COST ESTIMATING
D.J. Jones International, Inc.
3 Baldwin Green Common
Suite 202
Woburn, MA 01801-1868
(781) 932-3131

REVISIONS

1		
2		
3		
4		
5		
		DATE

DRAWING TITLE

Existing Perspectives

DRAWING INFORMATION

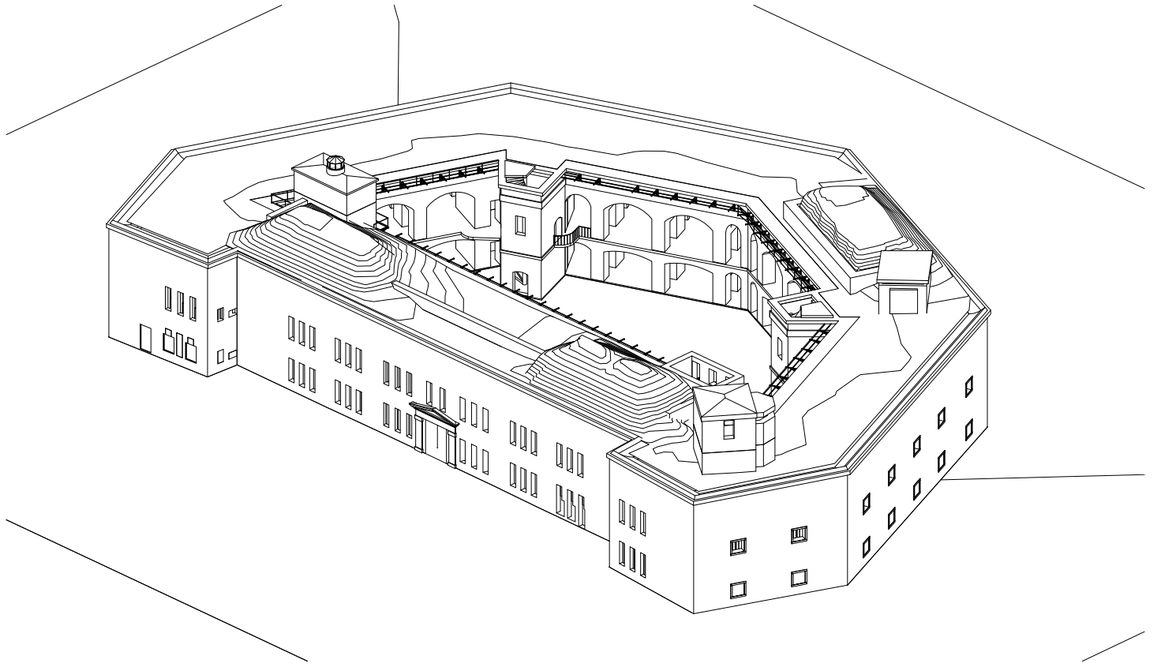
May 31, 2013
DATE OF ISSUE

Conditions Assessment
DESCRIPTION

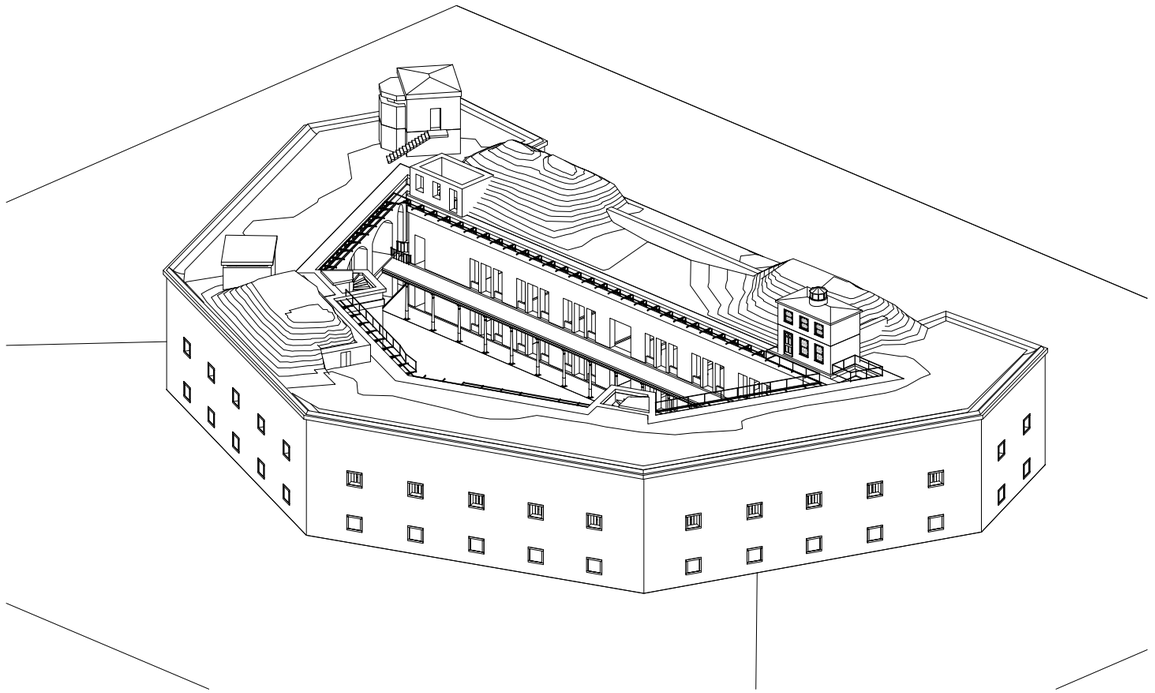
N.T.S.	ARC
SCALE	DRAWN BY
3124.00	3124_Fort Taber.rvt
PROJECT #	FILE NAME

DRAWING NUMBER

EX-202



1 BIRD'S EYE FROM NORTHWEST



2 BIRD'S EYE FROM SOUTHEAST

ARCHITECT

bh+a

Bargmann Hendrie + Archetype, Inc.
300 A Street
Boston, MA 02210
617 350-0450 Tel

PROJECT NAME

Fort Taber, Assessment and Feasibility Study

1000c Rodney French Blvd
New Bedford, MA 02744

CLIENT

City of New Bedford

133 William Street
New Bedford, MA 02740

PROJECT TEAM

LANDSCAPE ARCHITECTS
Kyle Zick Landscape Architecture, Inc.
36 Bromfield Street, Suite 202
Boston, MA 02108
(617) 451-1018

STRUCTURAL ENGINEERS
Structures North Engineers, Inc.
60 Washington Street, Suite 401
Salem, MA 01970
(978) 745-6817

M/E/P/FP ENGINEERS
Building Engineering Resources, Inc.
66 Main Street
North Easton, MA 02356
(508) 230-0260

COST ESTIMATING
D.J. Jones International, Inc.
3 Baldwin Green Common
Suite 202
Woburn, MA 01801-1868
(781) 932-3131

REVISIONS

1		
2		
3		
4		
5		
		DATE

DRAWING TITLE

Existing Bird's Eye Views

DRAWING INFORMATION

May 31, 2013
DATE OF ISSUE

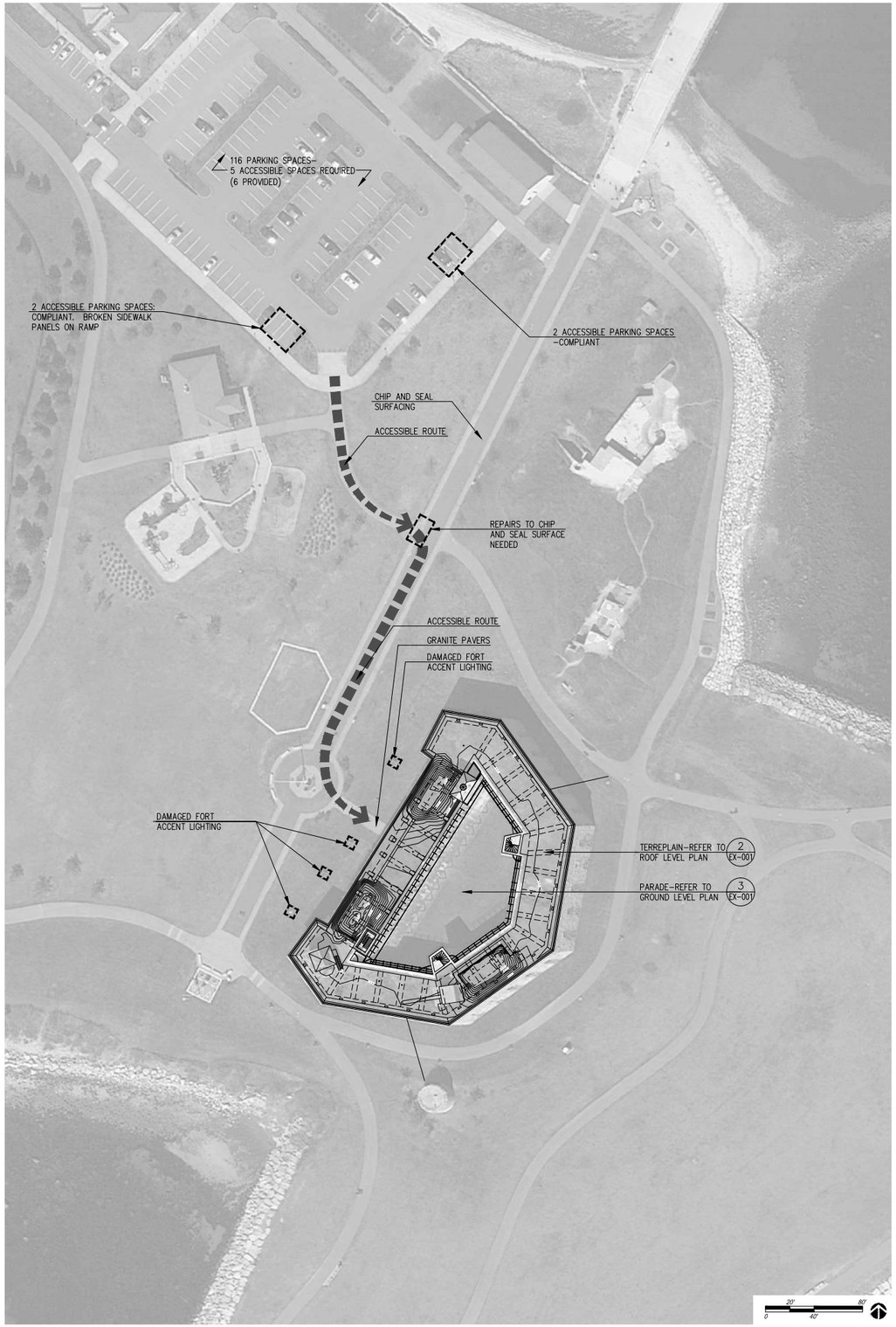
Conditions Assessment
DESCRIPTION

N.T.S.	arc
SCALE	DRAWN BY
3124.00	3124_Fort Taber.rvt
PROJECT #	FILE NAME

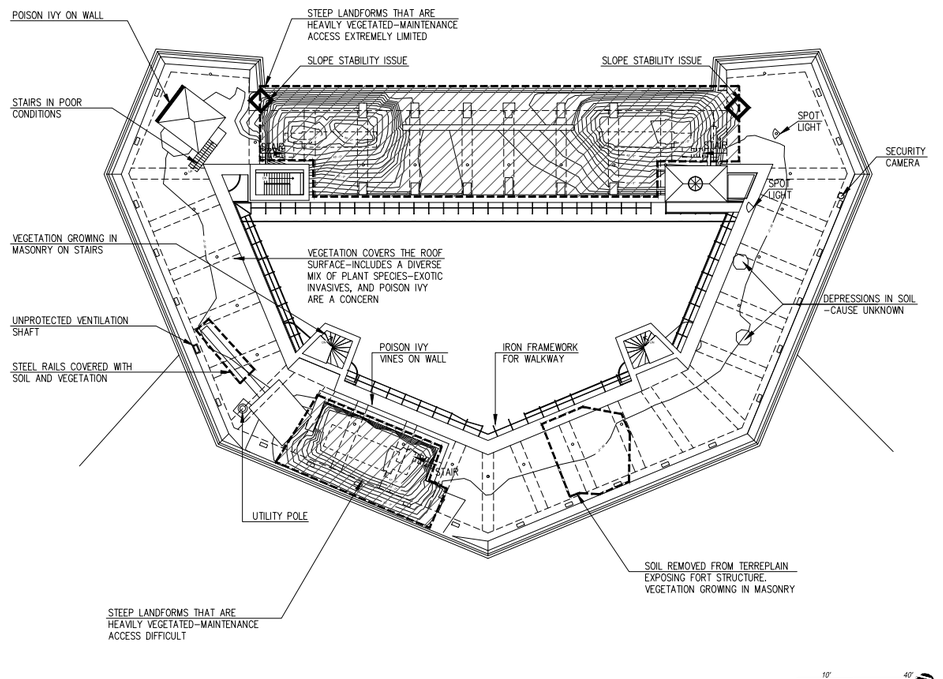
DRAWING NUMBER

EX-203

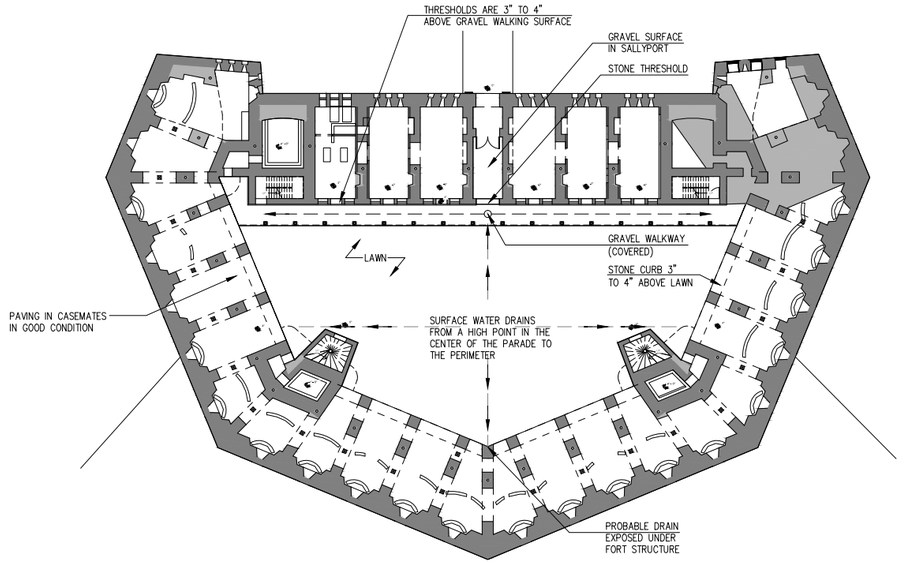
P:\3124 New Bedford - Fort Taber\dwg\Revit\3124 Fort Taber Study.rvt
5/31/2013 11:22:53 AM arc



1 SITE PLAN
SCALE: 1"=40'–0"



2 ROOF LEVEL PLAN
SCALE: 1"=20'–0"



3 GROUND LEVEL PLAN
SCALE: 1"=20'–0"

ARCHITECT

bh+a

Bargmann Hendrie + Archetype, Inc.
300 A Street
Boston, MA 02210
617 350-0450 Tel

PROJECT NAME

Fort Taber, Assessment and Feasibility Study

1000c Rodney French Blvd
New Bedford, MA 02744

CLIENT

City of New Bedford

133 William Street
New Bedford, MA 02740

PROJECT TEAM

LANDSCAPE ARCHITECTS
Kyle Zick Landscape Architecture, Inc.
36 Bromfield Street, Suite 202
Boston, MA 02108
(617) 451-1018

STRUCTURAL ENGINEERS
Structures North Engineers, Inc.
60 Washington Street, Suite 401
Salem, MA 01970
(978) 745-6817

M/E/P/FP ENGINEERS
Building Engineering Resources, Inc.
66 Main Street
North Easton, MA 02356
(508) 230-0260

COST ESTIMATING
D.J. Jones International, Inc.
3 Baldwin Green Common
Suite 202
Woburn, MA 01801-1868
(781) 932-3131

REVISIONS

1
2
3
4
5 SITE

DRAWING TITLE

Existing Conditions Site Plan

DRAWING INFORMATION

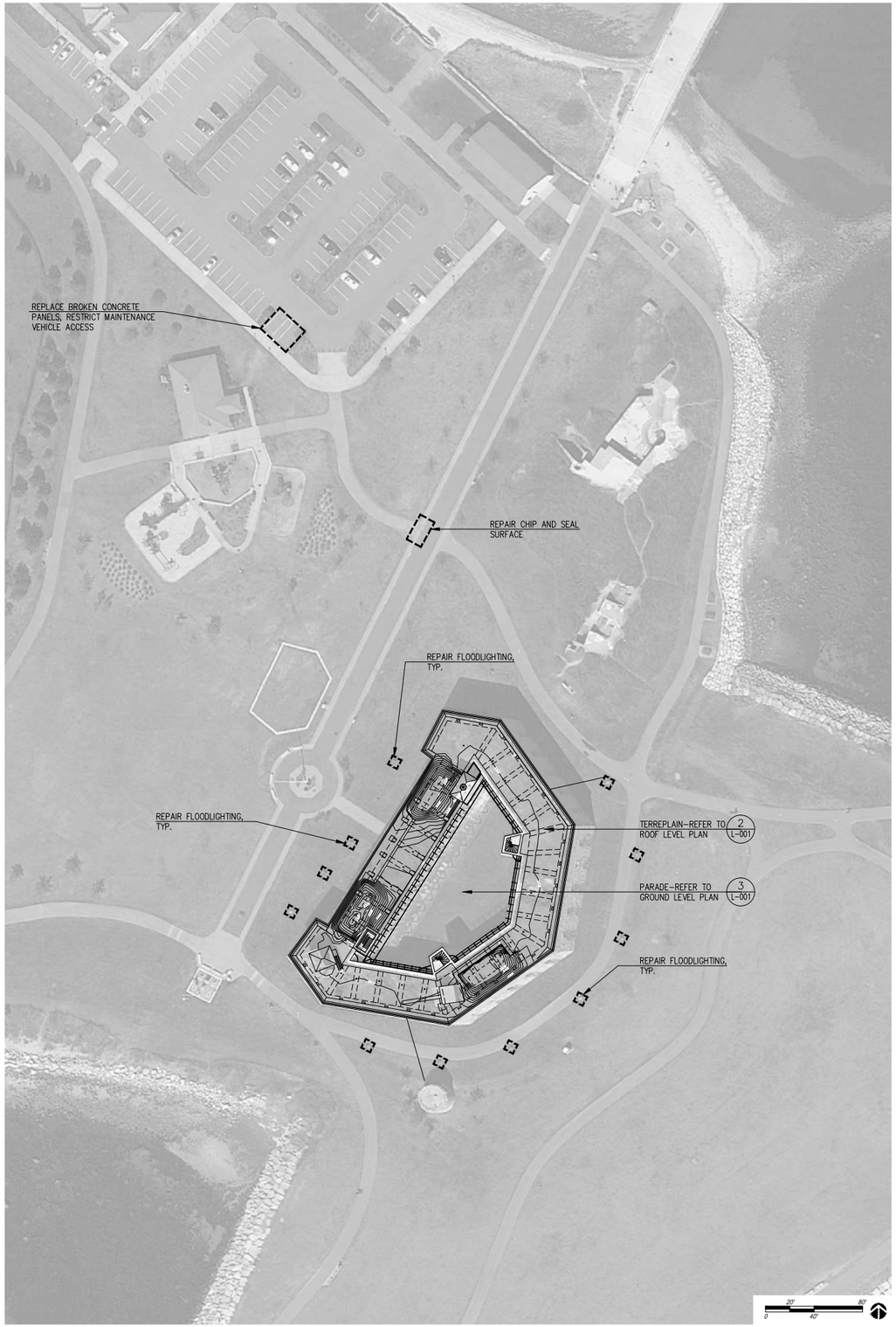
August 12, 2013
DATE OF ISSUE

DESCRIPTION

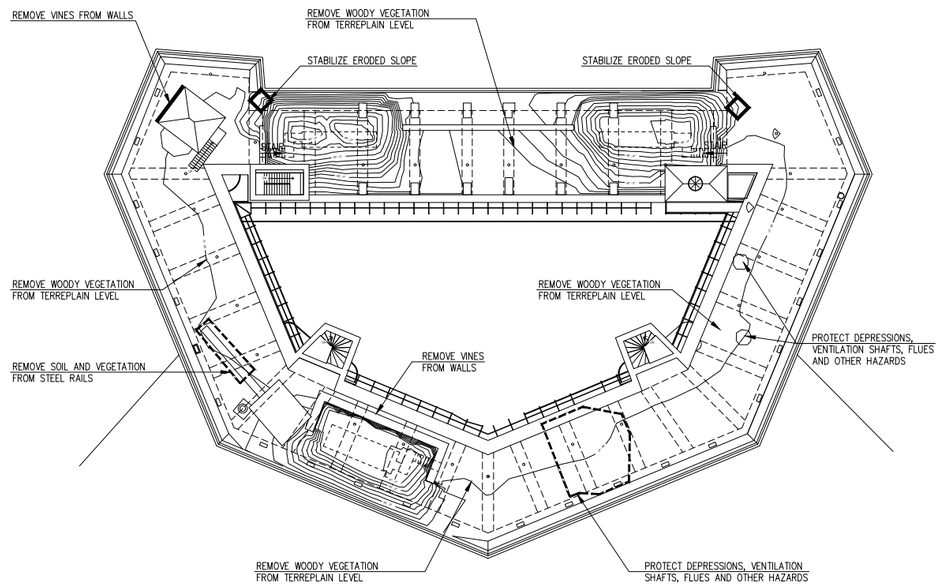
AS SHOWN	Y.L.
SCALE	DRAWN BY
3124.00	xr-site
PROJECT #	FILE NAME

DRAWING NUMBER

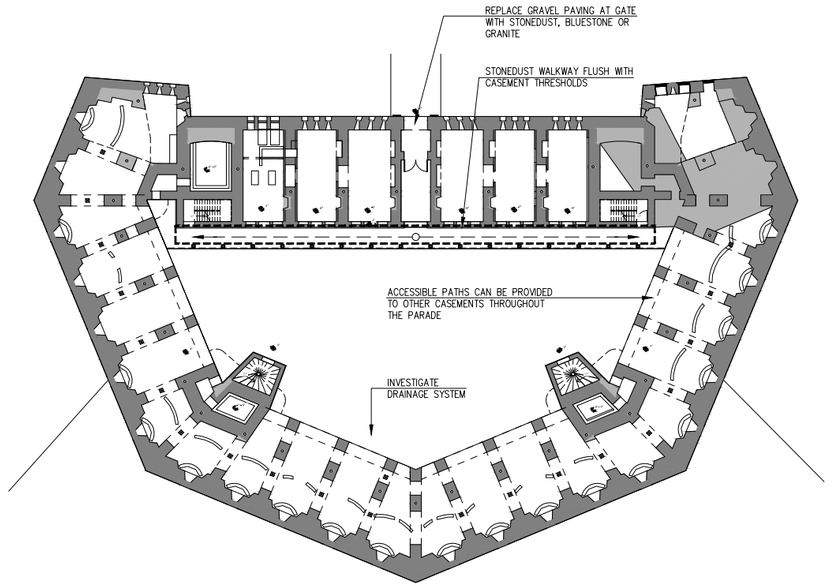
EX-001



1 SITE PLAN
SCALE: 1"=40'–0"



2 ROOF LEVEL PLAN
SCALE: 1"=20'–0"



3 GROUND LEVEL PLAN
SCALE: 1"=20'–0"

ARCHITECT
bh+a
Bargmann Hendrie + Archetype, Inc.
300 A Street
Boston, MA 02210
617 350-0450 Tel

PROJECT NAME
Fort Taber, Assessment and Feasibility Study
1000c Rodney French Blvd
New Bedford, MA 02744

CLIENT
City of New Bedford
133 William Street
New Bedford, MA 02740

PROJECT TEAM

LANDSCAPE ARCHITECTS
Kyle Zick Landscape Architecture, Inc.
36 Bromfield Street, Suite 202
Boston, MA 02108
(617) 451-1018

STRUCTURAL ENGINEERS
Structures North Engineers, Inc.
60 Washington Street, Suite 401
Salem, MA 01970
(978) 745-6817

M/E/P/FP ENGINEERS
Building Engineering Resources, Inc.
66 Main Street
North Easton, MA 02356
(508) 230-0260

COST ESTIMATING
D.J. Jones International, Inc.
3 Baldwin Green Common
Suite 202
Woburn, MA 01801-1868
(781) 932-3131

REVISIONS
1
2
3
4
5 SITE

DRAWING TITLE
Site Plan- Recommendations

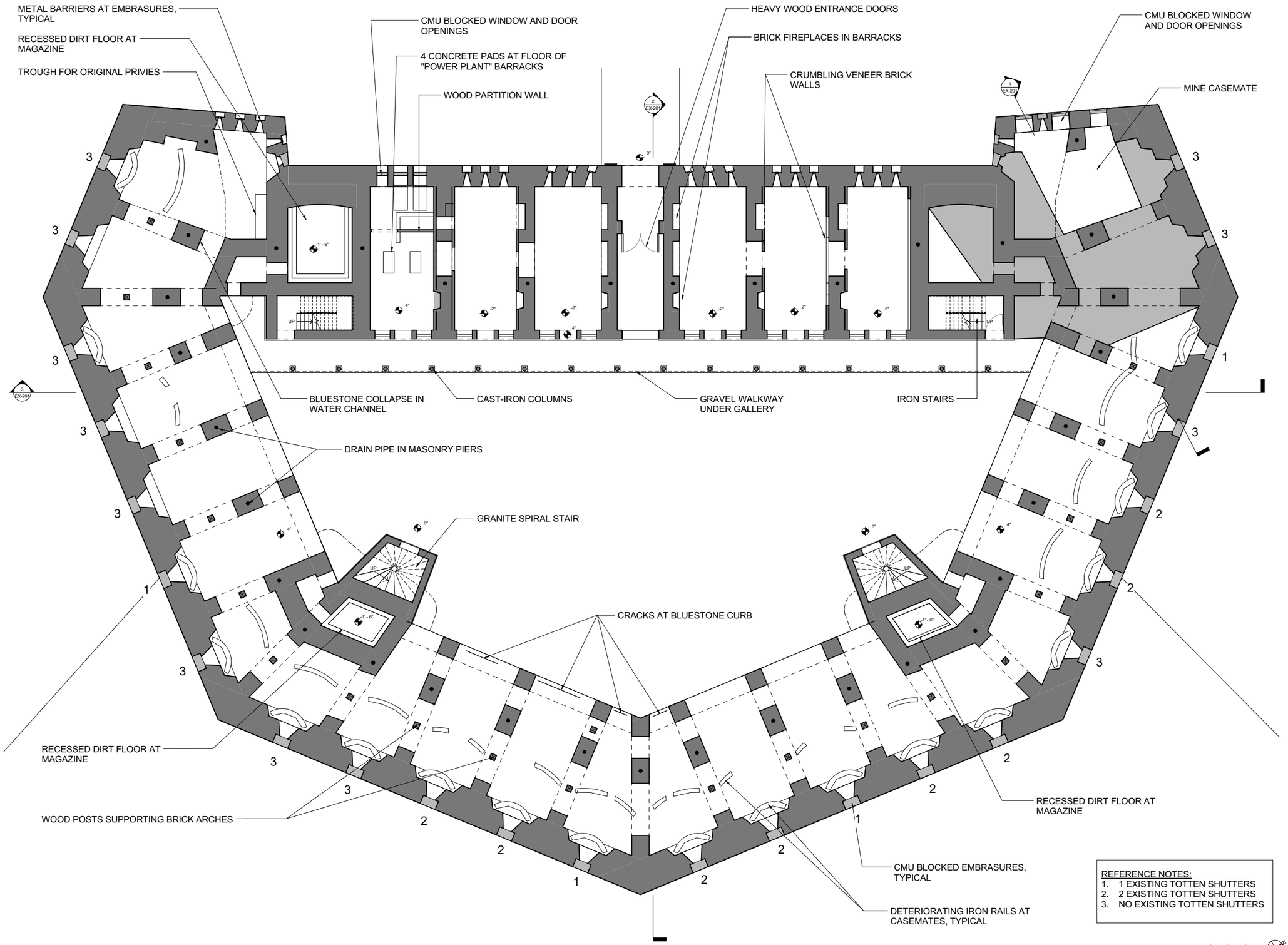
DRAWING INFORMATION

August 12, 2013
DATE OF ISSUE

DESCRIPTION

AS SHOWN	Y.L.
SCALE	DRAWN BY
3124.00	xr-site
PROJECT #	FILE NAME

DRAWING NUMBER
L-001



REFERENCE NOTES:
1. 1 EXISTING TOTTEN SHUTTERS
2. 2 EXISTING TOTTEN SHUTTERS
3. NO EXISTING TOTTEN SHUTTERS

0 4' 8'

ARCHITECT
bh+a
Bargmann Hendrie + Archetype, Inc.
300 A Street
Boston, MA 02210
617 350-0450 Tel

PROJECT NAME
Fort Taber, Assessment and Feasibility Study
1000c Rodney French Blvd
New Bedford, MA 02744

CLIENT
City of New Bedford
133 William Street
New Bedford, MA 02740

PROJECT TEAM

LANDSCAPE ARCHITECTS
Kyle Zick Landscape Architecture, Inc.
36 Bromfield Street, Suite 202
Boston, MA 02108
(617) 451-1018

STRUCTURAL ENGINEERS
Structures North Engineers, Inc.
60 Washington Street, Suite 401
Salem, MA 01970
(978) 745-6817

M/E/P/FP ENGINEERS
Building Engineering Resources, Inc.
66 Main Street
North Easton, MA 02356
(508) 230-0260

COST ESTIMATING
D.J. Jones International, Inc.
3 Baldwin Green Common
Suite 202
Woburn, MA 01801-1868
(781) 932-3131

REVISIONS
1
2
3
4
5
DATE

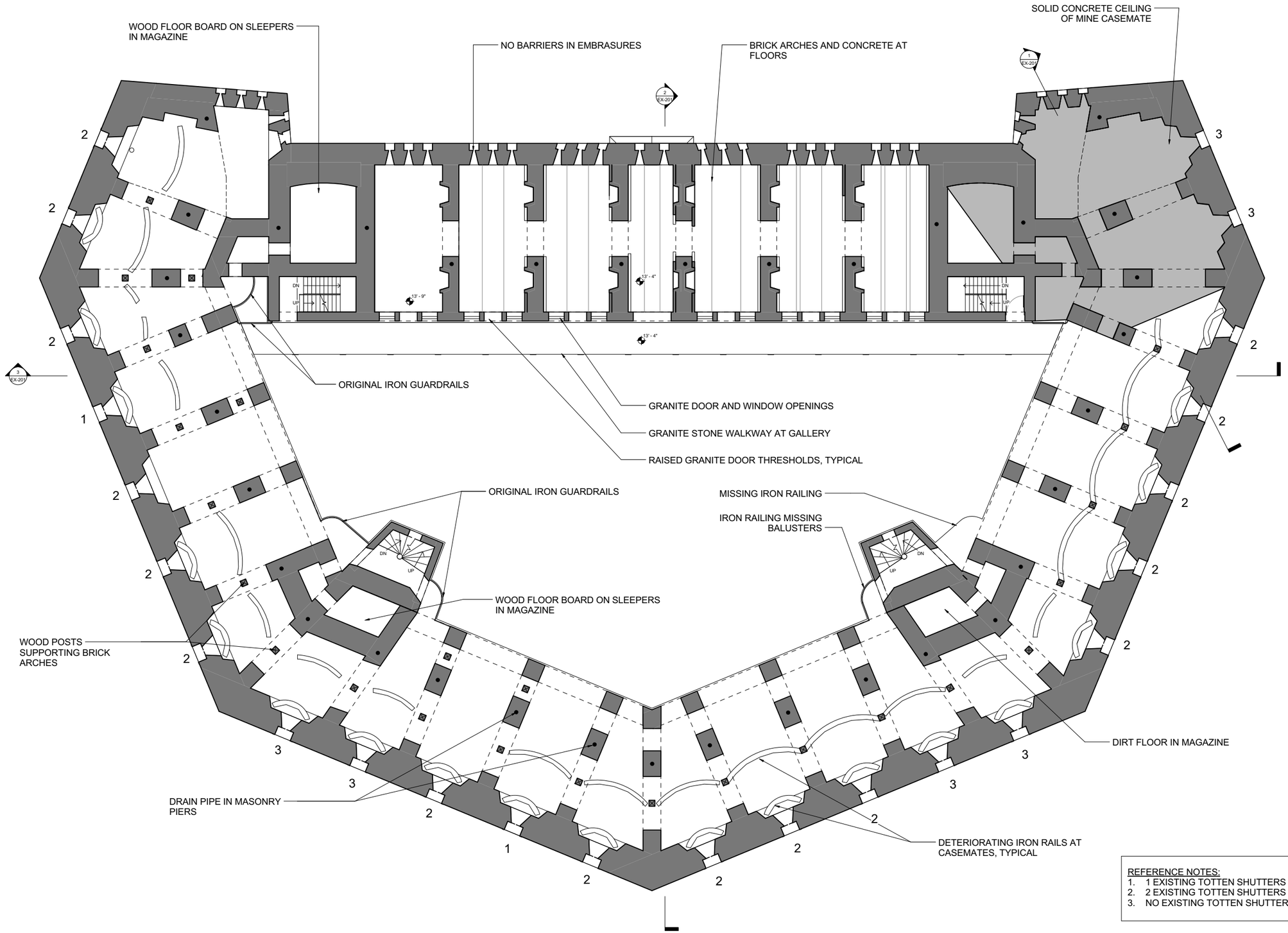
DRAWING TITLE
Existing Conditions - First Tier Plan

DRAWING INFORMATION

August 13, 2013
DATE OF ISSUE
Conditions Assessment
DESCRIPTION
Graphic scale — arc drawn by
3124.00 project # — 3124_Fort Taber.rvt file name

DRAWING NUMBER
A-101

P:\3124 New Bedford - Fort Taber\dwg\Revit\3124 Fort Taber Study.rvt
8/14/2013 5:26:16 PM arc



REFERENCE NOTES:
1. 1 EXISTING TOTTEN SHUTTERS
2. 2 EXISTING TOTTEN SHUTTERS
3. NO EXISTING TOTTEN SHUTTERS

ARCHITECT
bh+a
Bargmann Hendrie + Archetype, Inc.
300 A Street
Boston, MA 02210
617 350-0450 Tel

PROJECT NAME
Fort Taber, Assessment and Feasibility Study
1000c Rodney French Blvd
New Bedford, MA 02744

CLIENT
City of New Bedford
133 William Street
New Bedford, MA 02740

PROJECT TEAM

LANDSCAPE ARCHITECTS
Kyle Zick Landscape Architecture, Inc.
36 Bromfield Street, Suite 202
Boston, MA 02108
(617) 451-1018

STRUCTURAL ENGINEERS
Structures North Engineers, Inc.
60 Washington Street, Suite 401
Salem, MA 01970
(978) 745-6817

ME/P/FP ENGINEERS
Building Engineering Resources, Inc.
66 Main Street
North Easton, MA 02356
(508) 230-0260

COST ESTIMATING
D.J. Jones International, Inc.
3 Baldwin Green Common
Suite 202
Woburn, MA 01801-1868
(781) 932-3131

REVISIONS

	DATE
1	
2	
3	
4	
5	

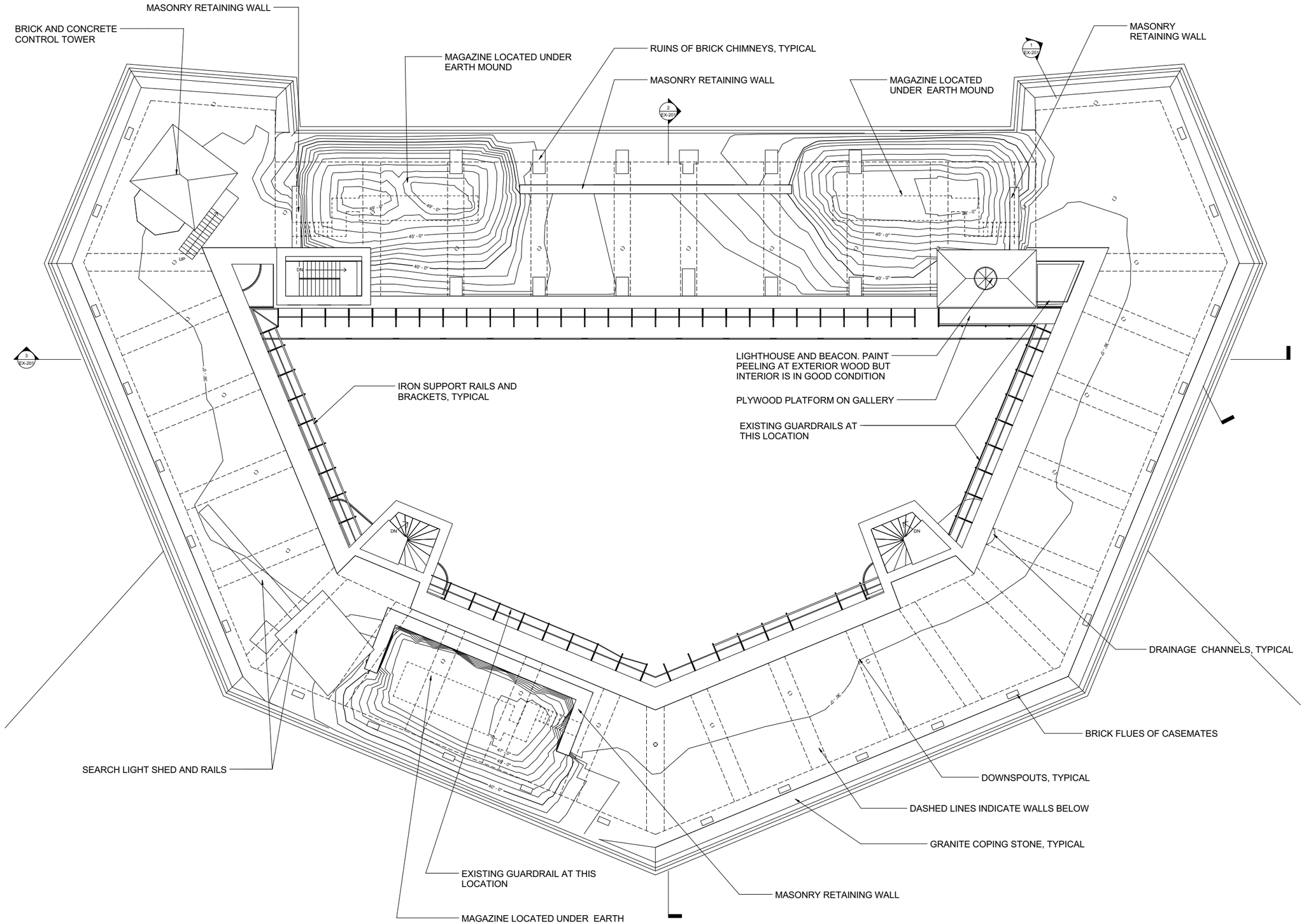
DRAWING TITLE
Existing Conditions - Second Tier Plan

DRAWING INFORMATION

August 13, 2013 — DATE OF ISSUE
Conditions Assessment — DESCRIPTION
Graphic — SCALE
arc — DRAWN BY
3124.00 — PROJECT #
3124_Fort Taber.rvt — FILE NAME

DRAWING NUMBER
A-102

P:\3124 New Bedford - Fort Taber\dwg\Revit\3124 Fort Taber Study.rvt
8/14/2013 5:26:19 PM arc



P:\3124 New Bedford - Fort Taber\dwg\Revit\3124 Fort Taber Study.rvt
8/14/2013 5:06:21 PM arc

ARCHITECT
bh+a
Bargmann Hendrie + Archetype, Inc.
300 A Street
Boston, MA 02210
617 350-0450 Tel

PROJECT NAME
Fort Taber, Assessment and Feasibility Study
1000c Rodney French Blvd
New Bedford, MA 02744

CLIENT
City of New Bedford
133 William Street
New Bedford, MA 02740

PROJECT TEAM

LANDSCAPE ARCHITECTS
Kyle Zick Landscape Architecture, Inc.
36 Bromfield Street, Suite 202
Boston, MA 02108
(617) 451-1018

STRUCTURAL ENGINEERS
Structures North Engineers, Inc.
60 Washington Street, Suite 401
Salem, MA 01970
(978) 745-6817

M/E/P/FP ENGINEERS
Building Engineering Resources, Inc.
66 Main Street
North Easton, MA 02356
(508) 230-0260

COST ESTIMATING
D.J. Jones International, Inc.
3 Baldwin Green Common
Suite 202
Woburn, MA 01801-1868
(781) 932-3131

REVISIONS

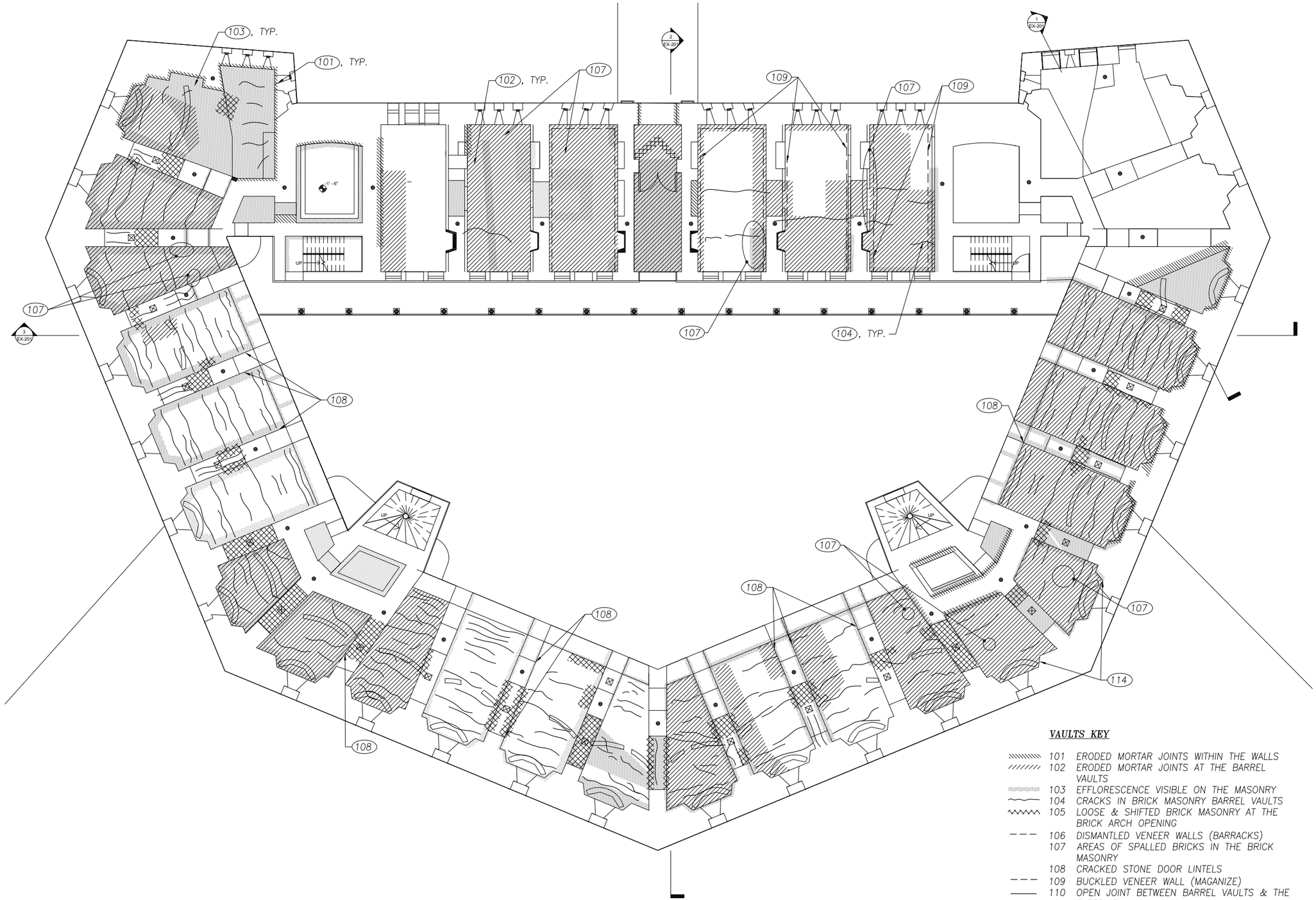
1		
2		
3		
4		
5		
		DATE

DRAWING TITLE
Existing Conditions - Terreplein

DRAWING INFORMATION

August 13, 2013
DATE OF ISSUE
Conditions Assessment
DESCRIPTION
Graphic SCALE | arc DRAWN BY
3124.00 PROJECT # | 3124_Fort Taber.rvt FILE NAME

DRAWING NUMBER
A-103



VAULTS KEY

101	ERODED MORTAR JOINTS WITHIN THE WALLS
102	ERODED MORTAR JOINTS AT THE BARREL VAULTS
103	EFFLORESCENCE VISIBLE ON THE MASONRY
104	CRACKS IN BRICK MASONRY BARREL VAULTS
105	LOOSE & SHIFTED BRICK MASONRY AT THE BRICK ARCH OPENING
106	DISMANTLED VENEER WALLS (BARRACKS)
107	AREAS OF SPALLED BRICKS IN THE BRICK MASONRY
108	CRACKED STONE DOOR LINTELS
109	BUCKLED VENEER WALL (MAGANIZE)
110	OPEN JOINT BETWEEN BARREL VAULTS & THE EXTERIOR WALL
111	CRACKS AT CANNON OPENINGS IN THE EXTERIOR WALL
112	SHIFTED CORNICE STONES
113	RUSTED DOOR LINTEL IN BARRACKS
114	CRACKED INTERIOR MASONRY UNIT

0 4' 8'

P:\3124 New Bedford - Fort Taber\dwg\Revit\3124 Fort Taber Study.rvt
6/5/2013 1:53:39 PM arc

ARCHITECT
bh+a
Bargmann Hendrie + Archetype, Inc.
300 A Street
Boston, MA 02210
617 350-0450 Tel

PROJECT NAME
Fort Taber, Assessment and Feasibility Study
1000c Rodney French Blvd
New Bedford, MA 02744

CLIENT
City of New Bedford
133 William Street
New Bedford, MA 02740

PROJECT TEAM

LANDSCAPE ARCHITECTS
Kyle Zick Landscape Architecture, Inc.
36 Bromfield Street, Suite 202
Boston, MA 02108
(617) 451-1018

STRUCTURAL ENGINEERS
Structures North Engineers, Inc.
60 Washington Street, Suite 401
Salem, MA 01970
(978) 745-6817

M/E/P/FP ENGINEERS
Building Engineering Resources, Inc.
66 Main Street
North Easton, MA 02356
(508) 230-0260

COST ESTIMATING
D.J. Jones International, Inc.
3 Baldwin Green Common
Suite 202
Woburn, MA 01801-1868
(781) 932-3131

REVISIONS

1	
2	
3	
4	
5	
	DATE

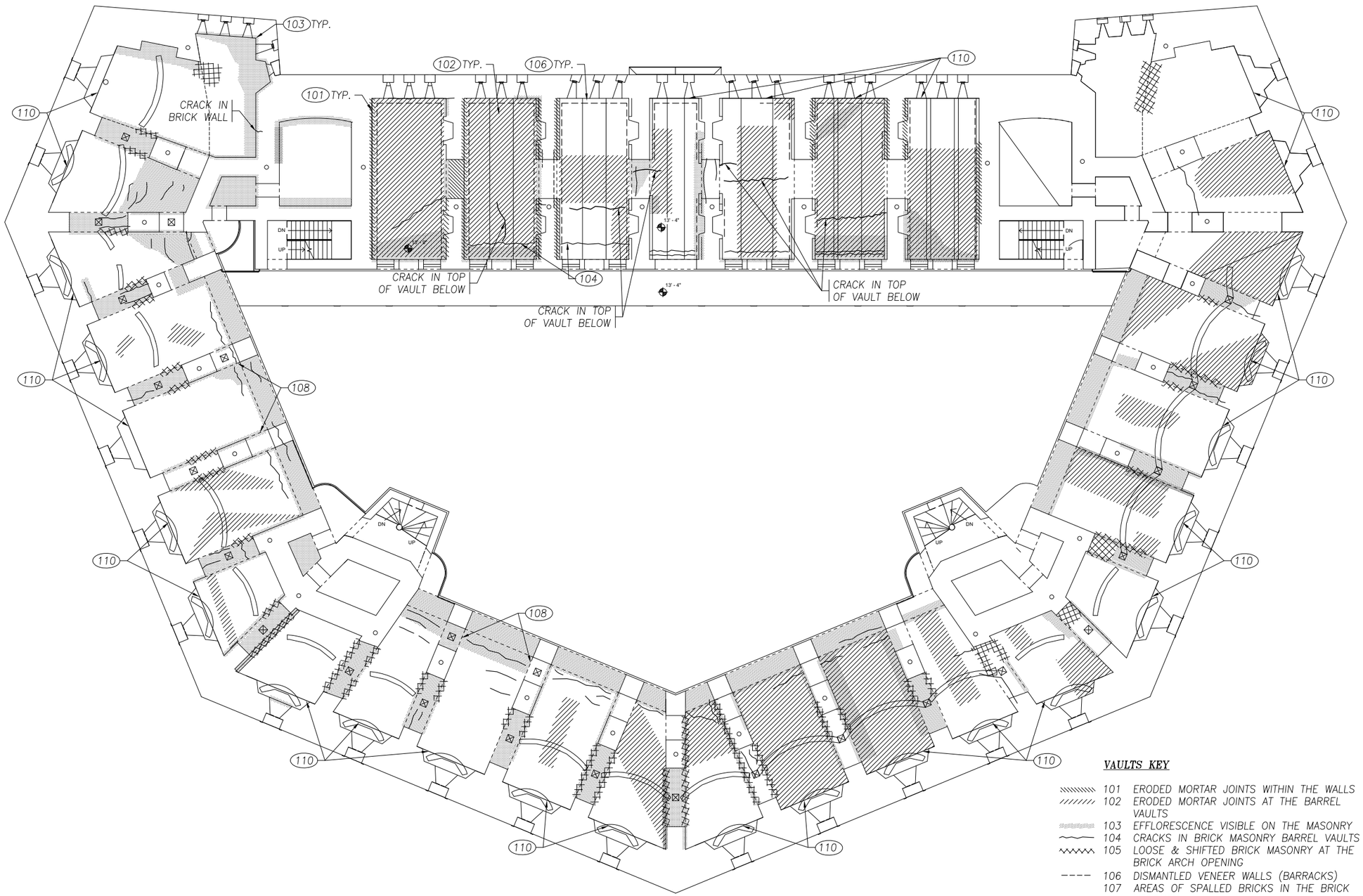
DRAWING TITLE
Existing First Floor Plan

DRAWING INFORMATION

September 17, 2013
DATE OF ISSUE
Conditions Assessment
DESCRIPTION

Graphic	arc
SCALE	DRAWN BY
3124.00	3124_Fort Taber.rvt
PROJECT #	FILE NAME

DRAWING NUMBER
EX-101



VAULTS KEY

- 101 ERODED MORTAR JOINTS WITHIN THE WALLS
- 102 ERODED MORTAR JOINTS AT THE BARREL VAULTS
- 103 EFFLORESCENCE VISIBLE ON THE MASONRY
- 104 CRACKS IN BRICK MASONRY BARREL VAULTS
- 105 LOOSE & SHIFTED BRICK MASONRY AT THE BRICK ARCH OPENING
- 106 DISMANTLED VENEER WALLS (BARRACKS)
- 107 AREAS OF SPALLED BRICKS IN THE BRICK MASONRY
- 108 CRACKED STONE DOOR LINTELS
- 109 BUCKLED VENEER WALL (MAGANIZE)
- 110 OPEN JOINT BETWEEN BARREL VAULTS & THE EXTERIOR WALL
- 111 CRACKS AT CANNON OPENINGS IN THE EXTERIOR WALL
- 112 SHIFTED CORNICE STONES
- 113 RUSTED DOOR LINTEL IN BARRACKS
- 114 CRACKED INTERIOR MASONRY UNIT

0 4' 8'

P:\3124 New Bedford - Fort Taber\dwg\Revit\3124 Fort Taber Study.rvt
6/6/2013 1:53:43 PM arc

ARCHITECT
bh+a
Bargmann Hendrie + Archetype, Inc.
300 A Street
Boston, MA 02210
617 350-0450 Tel

PROJECT NAME
Fort Taber, Assessment and Feasibility Study
1000c Rodney French Blvd
New Bedford, MA 02744

CLIENT
City of New Bedford
133 William Street
New Bedford, MA 02740

PROJECT TEAM

LANDSCAPE ARCHITECTS
Kyle Zick Landscape Architecture, Inc.
36 Bromfield Street, Suite 202
Boston, MA 02108
(617) 451-1018

STRUCTURAL ENGINEERS
Structures North Engineers, Inc.
60 Washington Street, Suite 401
Salem, MA 01970
(978) 745-6817

M/E/P/FP ENGINEERS
Building Engineering Resources, Inc.
66 Main Street
North Easton, MA 02356
(508) 230-0260

COST ESTIMATING
D.J. Jones International, Inc.
3 Baldwin Green Common
Suite 202
Woburn, MA 01801-1868
(781) 932-3131

REVISIONS

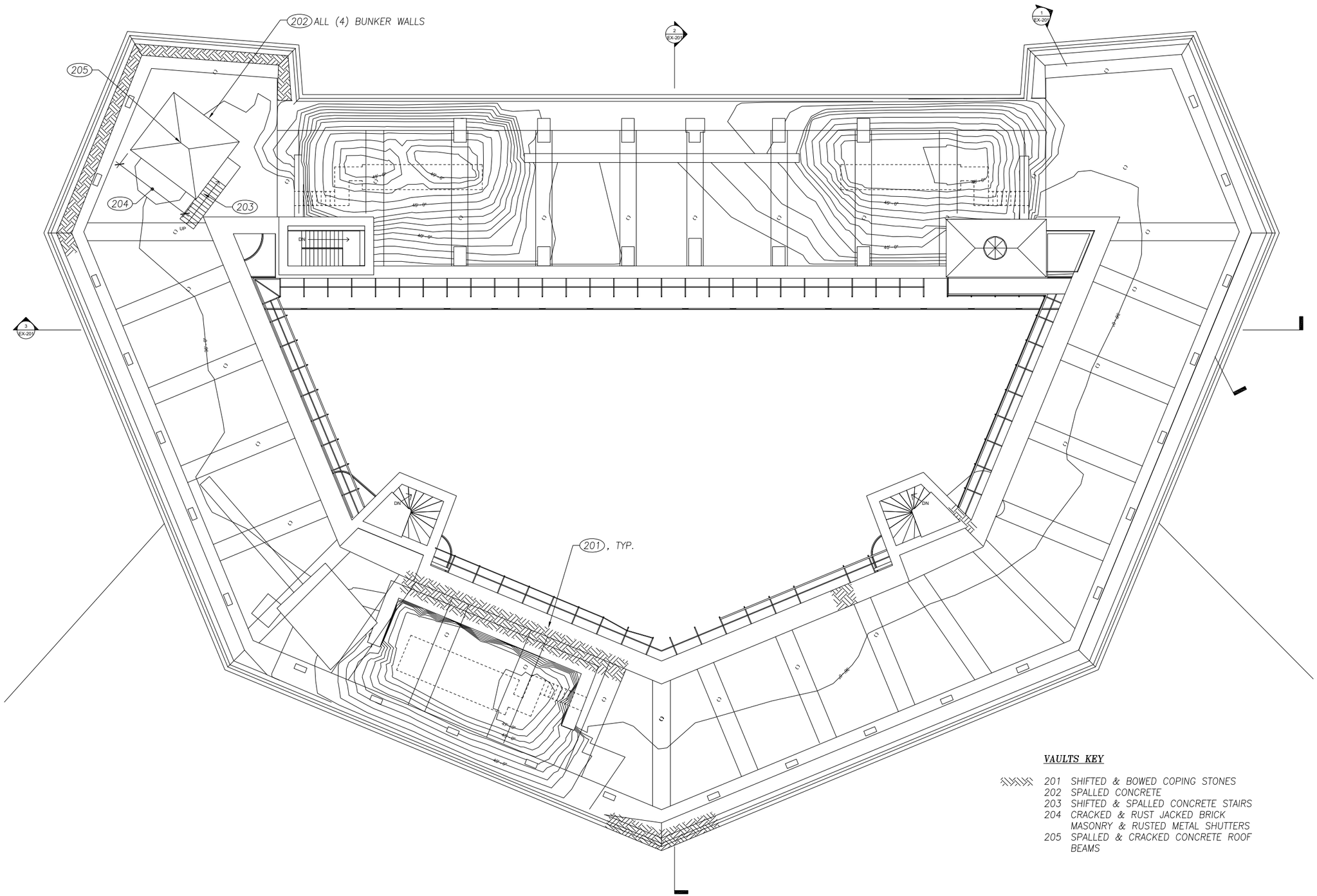
	DATE
1	
2	
3	
4	
5	

DRAWING TITLE
Existing Second Floor Plan

DRAWING INFORMATION

September 17, 2013	
DATE OF ISSUE	
Conditions Assessment	
DESCRIPTION	
Graphic	arc
SCALE	DRAWN BY
3124.00	3124_Fort Taber.rvt
PROJECT #	FILE NAME

DRAWING NUMBER
EX-102



VAULTS KEY

201 SHIFTED & BOWED COPING STONES
202 SPALLED CONCRETE
203 SHIFTED & SPALLED CONCRETE STAIRS
204 CRACKED & RUST JACKED BRICK MASONRY & RUSTED METAL SHUTTERS
205 SPALLED & CRACKED CONCRETE ROOF BEAMS

0 4' 8'

ARCHITECT

bh+a

Bargmann Hendrie + Archetype, Inc.
300 A Street
Boston, MA 02210
617 350-0450 Tel

PROJECT NAME

Fort Taber, Assessment and Feasibility Study

1000c Rodney French Blvd
New Bedford, MA 02744

CLIENT

City of New Bedford

133 William Street
New Bedford, MA 02740

PROJECT TEAM

LANDSCAPE ARCHITECTS
Kyle Zick Landscape Architecture, Inc.
36 Bromfield Street, Suite 202
Boston, MA 02108
(617) 451-1018

STRUCTURAL ENGINEERS
Structures North Engineers, Inc.
60 Washington Street, Suite 401
Salem, MA 01970
(978) 745-6817

M/E/P/FP ENGINEERS
Building Engineering Resources, Inc.
66 Main Street
North Easton, MA 02356
(508) 230-0260

COST ESTIMATING
D.J. Jones International, Inc.
3 Baldwin Green Common
Suite 202
Woburn, MA 01801-1868
(781) 932-3131

REVISIONS

		DATE
1		
2		
3		
4		
5		

DRAWING TITLE

Existing Roof Plan

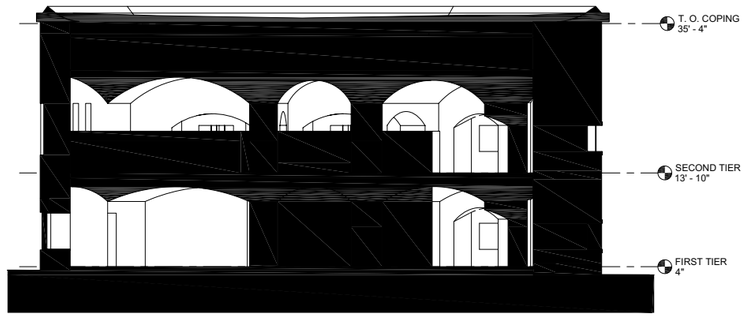
DRAWING INFORMATION

September 17, 2013	DATE OF ISSUE
Conditions Assessment	DESCRIPTION
Graphic	SCALE
arc	DRAWN BY
3124.00	PROJECT #
3124_Fort Taber.rvt	FILE NAME

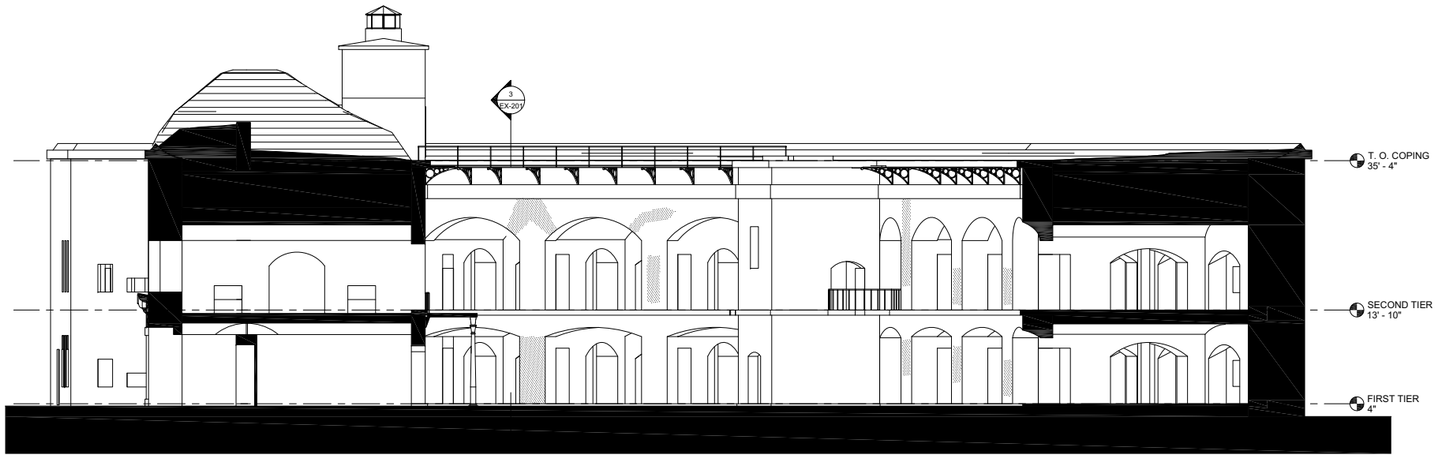
DRAWING NUMBER

EX-103

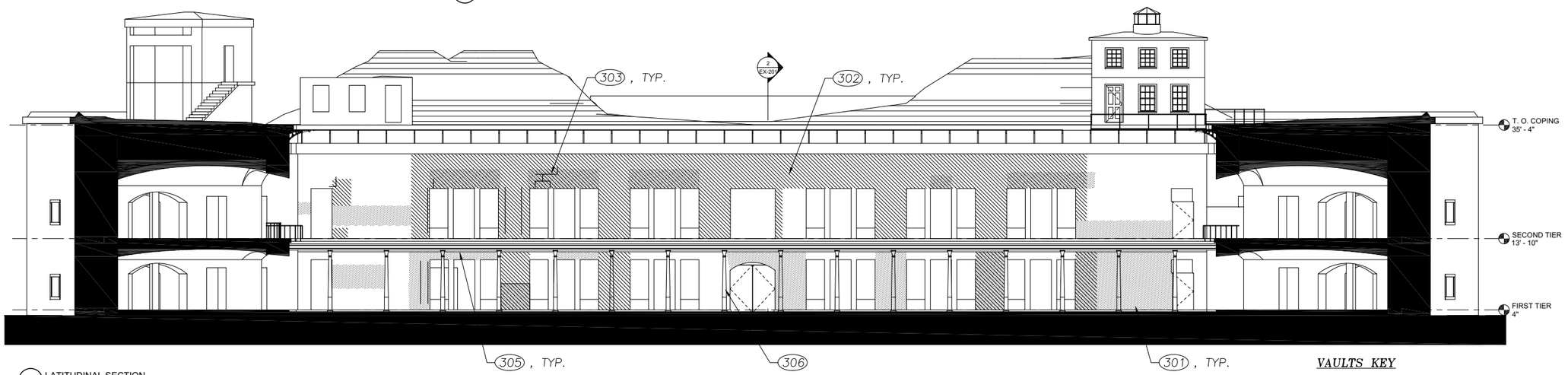
P:\3124 New Bedford - Fort Taber\dwg\Revit\3124 Fort Taber Study.rvt
6/5/2013 1:53:46 PM arc



1 MINE CASEMATE SECTION



2 LONGITUDINAL SECTION



3 LATITUDINAL SECTION

VAULTS KEY

301 EFFLORESCENCE
302 ERODED MORTAR JOINTS
303 WIDENED MORTAR JOINTS
305 RUSTED IRON BEAM SOFFITS
306 DAMAGED IRON COLUMN

P:\3124 New Bedford - Fort Taber\dwg\Revit\3124 Fort Taber Study.rvt
6/5/2013 1:53:49 PM arc

ARCHITECT

bh+a

Bargmann Hendrie + Archetype, Inc.
300 A Street
Boston, MA 02210
617 350-0450 Tel

PROJECT NAME

Fort Taber, Assessment and Feasibility Study

1000c Rodney French Blvd
New Bedford, MA 02744

CLIENT

City of New Bedford

133 William Street
New Bedford, MA 02740

PROJECT TEAM

LANDSCAPE ARCHITECTS
Kyle Zick Landscape Architecture, Inc.
36 Bromfield Street, Suite 202
Boston, MA 02108
(617) 451-1018

STRUCTURAL ENGINEERS
Structures North Engineers, Inc.
60 Washington Street, Suite 401
Salem, MA 01970
(978) 745-6817

M/E/P/FP ENGINEERS
Building Engineering Resources, Inc.
66 Main Street
North Easton, MA 02356
(508) 230-0260

COST ESTIMATING
D.J. Jones International, Inc.
3 Baldwin Green Common
Suite 202
Woburn, MA 01801-1868
(781) 932-3131

REVISIONS

1
2
3
4
5
DATE

DRAWING TITLE

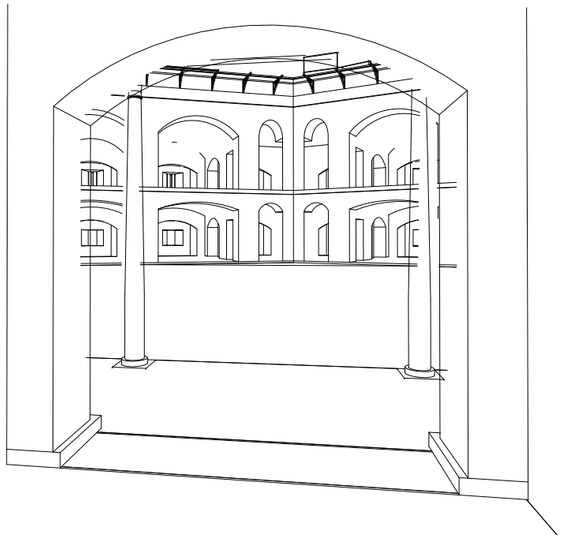
Existing Sections

DRAWING INFORMATION

September 17, 2013
DATE OF ISSUE
Conditions Assessment
DESCRIPTION
Graphic | arc
SCALE | DRAWN BY
3124.00 | 3124_Fort Taber.rvt
PROJECT # | FILE NAME

DRAWING NUMBER

EX-201



1 VIEW THROUGH ENTRANCE

2 VIEW OF PARADE GROUND

VAULTS KEY

301 EFFLORESCENCE

3 VIEW AT SECOND FLOOR GALLERY

4 VIEW OF FIRST FLOOR GALLERY

ARCHITECT

bh+a

Bargmann Hendrie + Archetype, Inc.
300 A Street
Boston, MA 02210
617 350-0450 Tel

PROJECT NAME

Fort Taber, Assessment and Feasibility Study

1000c Rodney French Blvd
New Bedford, MA 02744

CLIENT

City of New Bedford

133 William Street
New Bedford, MA 02740

PROJECT TEAM

LANDSCAPE ARCHITECTS
Kyle Zick Landscape Architecture, Inc.
36 Bromfield Street, Suite 202
Boston, MA 02108
(617) 451-1018

STRUCTURAL ENGINEERS
Structures North Engineers, Inc.
60 Washington Street, Suite 401
Salem, MA 01970
(978) 745-6817

M/E/P/FP ENGINEERS
Building Engineering Resources, Inc.
66 Main Street
North Easton, MA 02356
(508) 230-0260

COST ESTIMATING
D.J. Jones International, Inc.
3 Baldwin Green Common
Suite 202
Woburn, MA 01801-1868
(781) 932-3131

REVISIONS

	DATE
1	
2	
3	
4	
5	

DRAWING TITLE

Existing Perspectives

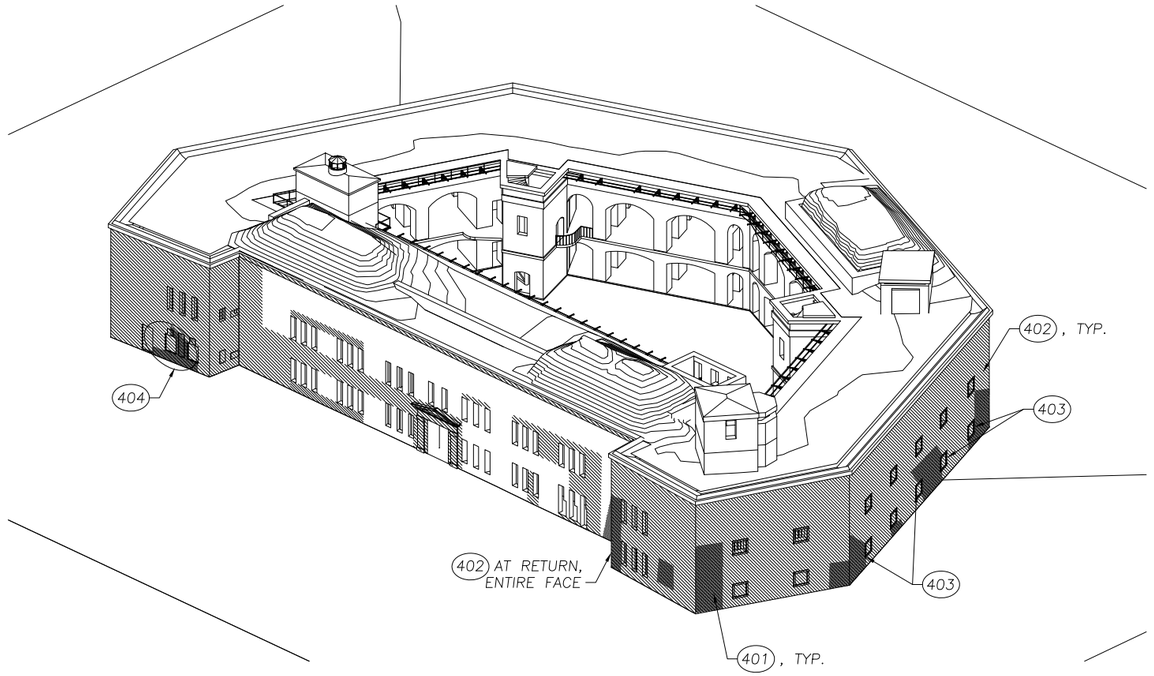
DRAWING INFORMATION

September 17, 2013	DATE OF ISSUE
Conditions Assessment	DESCRIPTION
N.T.S.	SCALE
ARC	DRAWN BY
3124.00	PROJECT #
3124_Fort Taber.rvt	FILE NAME

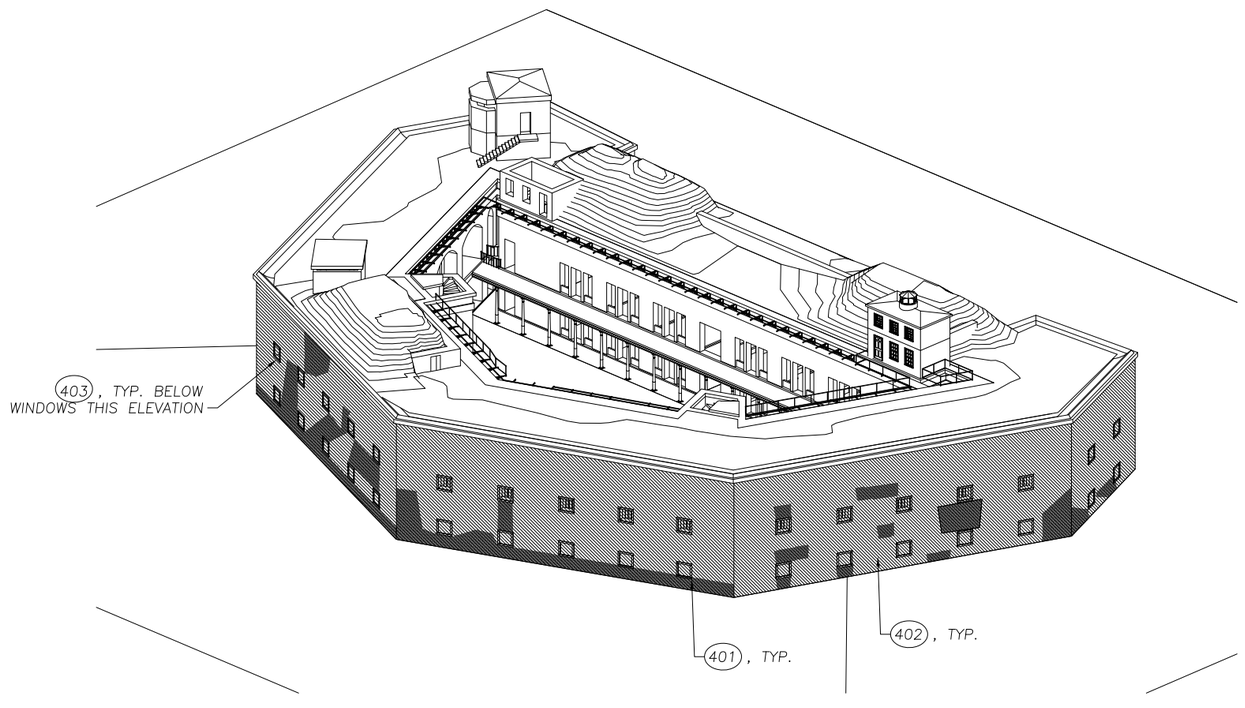
DRAWING NUMBER

EX-202

P:\3124 New Bedford - Fort Taber\dwg\Revit\3124 Fort Taber Study.rvt
6/5/2013 1:53:55 PM ARC



1 BIRD'S EYE FROM NORTHWEST



2 BIRD'S EYE FROM SOUTHEAST

VAULTS KEY

401 EFFLORESCENCE
402 ERODED MORTAR JOINTS
403 CRACKED STONES & RUSTED METAL EMBEDMENTS
404 SPALLED CONCRETE INFILL

ARCHITECT

bh+a

Bargmann Hendrie + Archetype, Inc.
300 A Street
Boston, MA 02210
617 350-0450 Tel

PROJECT NAME

Fort Taber, Assessment and Feasibility Study

1000c Rodney French Blvd
New Bedford, MA 02744

CLIENT

City of New Bedford

133 William Street
New Bedford, MA 02740

PROJECT TEAM

LANDSCAPE ARCHITECTS
Kyle Zick Landscape Architecture, Inc.
36 Bromfield Street, Suite 202
Boston, MA 02108
(617) 451-1018

STRUCTURAL ENGINEERS
Structures North Engineers, Inc.
60 Washington Street, Suite 401
Salem, MA 01970
(978) 745-6817

M/E/P/FP ENGINEERS
Building Engineering Resources, Inc.
66 Main Street
North Easton, MA 02356
(508) 230-0260

COST ESTIMATING
D.J. Jones International, Inc.
3 Baldwin Green Common
Suite 202
Woburn, MA 01801-1868
(781) 932-3131

REVISIONS

1		
2		
3		
4		
5		
		DATE

DRAWING TITLE

Existing Bird's Eye Views

DRAWING INFORMATION

September 17, 2013
DATE OF ISSUE
Conditions Assessment
DESCRIPTION

N.T.S.	
SCALE	
3124.00	3124_Fort Taber.rvt
PROJECT #	FILE NAME
	arc
	DRAWN BY

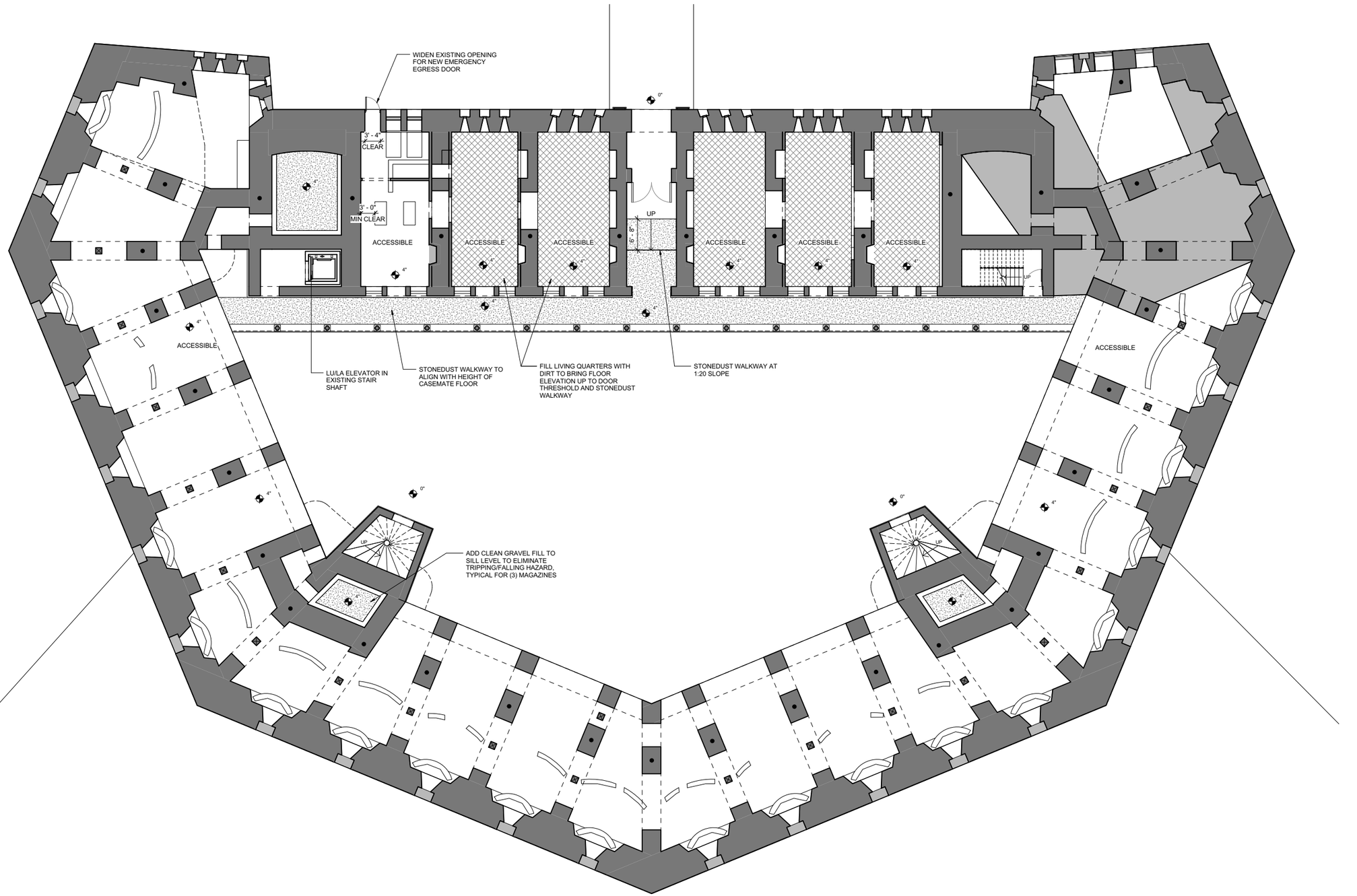
DRAWING NUMBER

EX-203

Z:\CADD\Projects\2013\13078 Fort Taber\Struct\3124 Fort Taber Study-5\sheet EX-203 ExistingBirdEyeViews.dwg 9/23/2013 4:08:29 PM, lbeham, Bluebeam PDF10 Printer HighRes.pc3

P:\3124 New Bedford - Fort Taber\dwg\Revit\3124 Fort Taber Study.rvt

6/5/2013 1:54:04 PM arc



1 FIRST TIER PLAN - OPTION A - LU/LA ELEVATOR

0 4' 8'

P:\3124 New Bedford - Fort Taber\dwg\Revit\3124 Fort Taber Study.rvt
8/14/2013 9:56:37 AM ARC

ARCHITECT

bh+a

Bargmann Hendrie + Archetype, Inc.
300 A Street
Boston, MA 02210
617 350-0450 Tel

PROJECT NAME

Fort Taber, Assessment and Feasibility Study

1000c Rodney French Blvd
New Bedford, MA 02744

CLIENT

City of New Bedford

133 William Street
New Bedford, MA 02740

PROJECT TEAM

LANDSCAPE ARCHITECTS
Kyle Zick Landscape Architecture, Inc.
36 Bromfield Street, Suite 202
Boston, MA 02108
(617) 451-1018

STRUCTURAL ENGINEERS
Structures North Engineers, Inc.
60 Washington Street, Suite 401
Salem, MA 01970
(978) 745-6817

M/E/P/FP ENGINEERS
Building Engineering Resources, Inc.
66 Main Street
North Easton, MA 02356
(508) 230-0260

COST ESTIMATING
D.J. Jones International, Inc.
3 Baldwin Green Common
Suite 202
Woburn, MA 01801-1868
(781) 932-3131

REVISIONS

1		
2		
3		
4		
5		
		DATE

DRAWING TITLE

Accessibility Option A - First Tier Plan

DRAWING INFORMATION

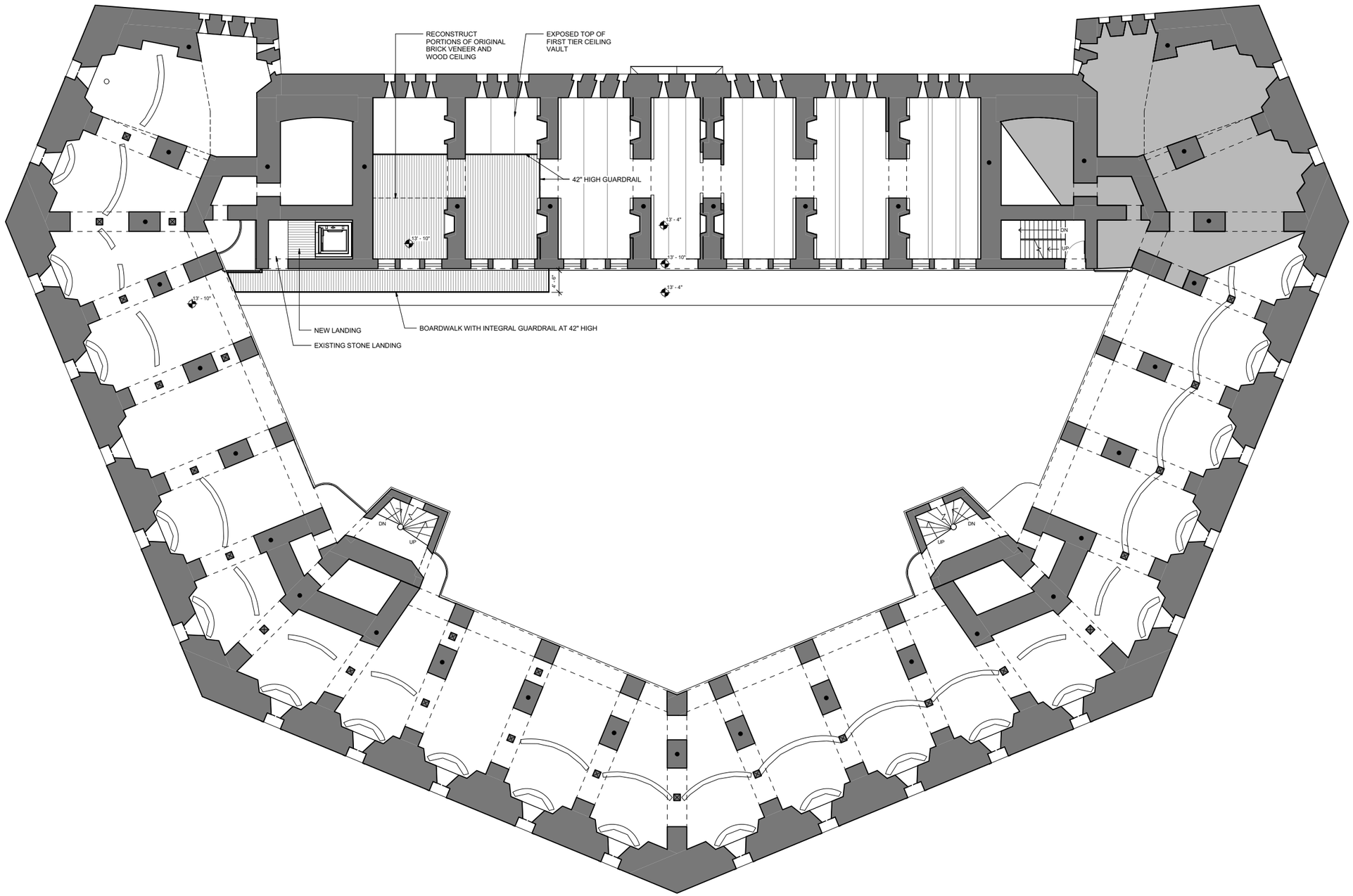
May 31, 2013
DATE OF ISSUE

Conditions Assessment
DESCRIPTION

Graphic	ARC
SCALE	DRAWN BY
3124.00	3124_Fort Taber.rvt
PROJECT #	FILE NAME

DRAWING NUMBER

A-101a



1 SECOND TIER PLAN - OPTION A - LU/LA

0 4' 8'

P:\3124 New Bedford - Fort Taber\Dwg\Revit\3124 Fort Taber Study.rvt
8/14/2013 8:56:52 AM ARC

ARCHITECT

bh+a

Bargmann Hendrie + Archetype, Inc.
300 A Street
Boston, MA 02210
617 350-0450 Tel

PROJECT NAME

Fort Taber, Assessment and Feasibility Study

1000c Rodney French Blvd
New Bedford, MA 02744

CLIENT

City of New Bedford

133 William Street
New Bedford, MA 02740

PROJECT TEAM

LANDSCAPE ARCHITECTS
Kyle Zick Landscape Architecture, Inc.
36 Bromfield Street, Suite 202
Boston, MA 02108
(617) 451-1018

STRUCTURAL ENGINEERS
Structures North Engineers, Inc.
60 Washington Street, Suite 401
Salem, MA 01970
(978) 745-6817

M/E/P/FP ENGINEERS
Building Engineering Resources, Inc.
66 Main Street
North Easton, MA 02356
(508) 230-0260

COST ESTIMATING
D.J. Jones International, Inc.
3 Baldwin Green Common
Suite 202
Woburn, MA 01801-1868
(781) 932-3131

REVISIONS

1
2
3
4
5
DATE

DRAWING TITLE

Accessibility Option A - Second Tier Plan

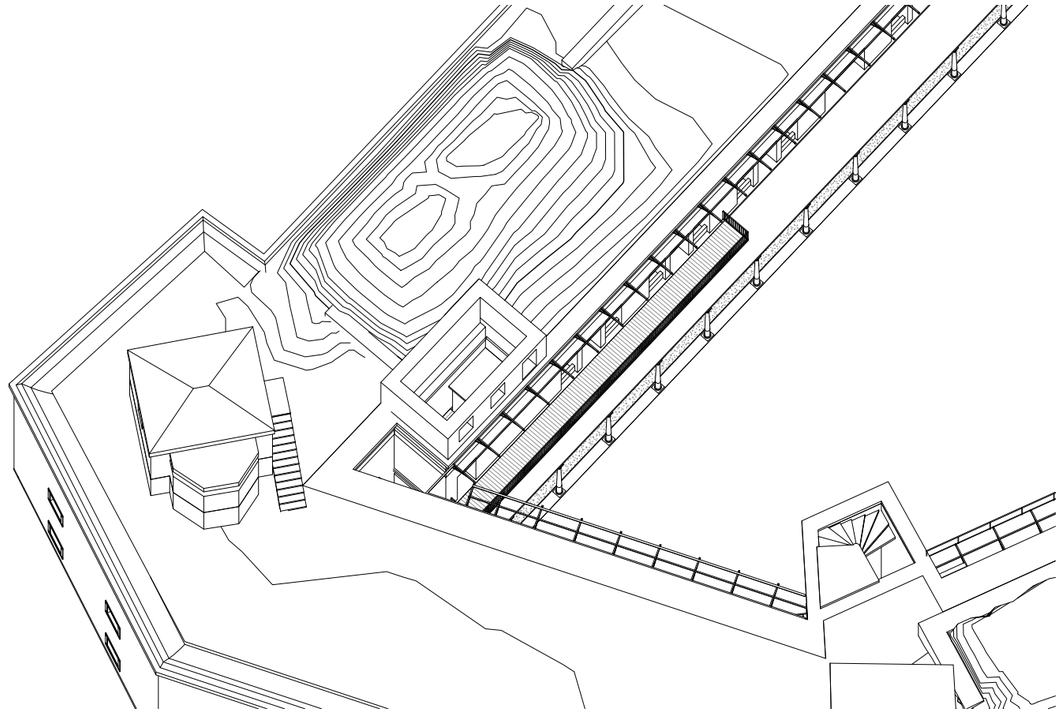
DRAWING INFORMATION

May 31, 2013
DATE OF ISSUE
Conditions Assessment
DESCRIPTION

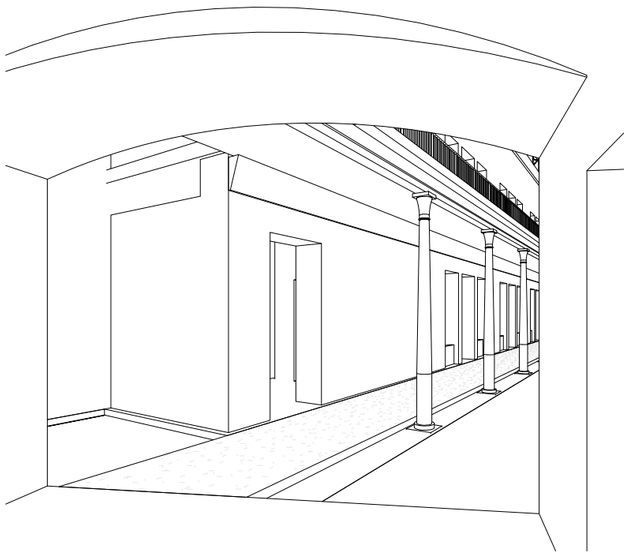
Graphic	ARC
SCALE	DRAWN BY
3124.00	3124_Fort Taber.rvt
PROJECT #	FILE NAME

DRAWING NUMBER

A-102a



1 OPTION A - BIRD'S EYE VIEW



2 OPTION A - VIEW LOOKING NORTH AT BOARDWALK AND LU/LA ELEVATOR

3 OPTION A - VIEW LOOKING WEST AT BOARDWALK

P:\3124 New Bedford - Fort Taber\dwg\Revit\3124 Fort Taber Study.rvt
8/14/2013 8:57:06 AM ARC

ARCHITECT

bh+a

Bargmann Hendrie + Archetype, Inc.
300 A Street
Boston, MA 02210
617 350-0450 Tel

PROJECT NAME

Fort Taber, Assessment and Feasibility Study

1000c Rodney French Blvd
New Bedford, MA 02744

CLIENT

City of New Bedford

133 William Street
New Bedford, MA 02740

PROJECT TEAM

LANDSCAPE ARCHITECTS
Kyle Zick Landscape Architecture, Inc.
36 Bromfield Street, Suite 202
Boston, MA 02108
(617) 451-1018

STRUCTURAL ENGINEERS
Structures North Engineers, Inc.
60 Washington Street, Suite 401
Salem, MA 01970
(978) 745-6817

M/E/P/FP ENGINEERS
Building Engineering Resources, Inc.
66 Main Street
North Easton, MA 02356
(508) 230-0260

COST ESTIMATING
D.J. Jones International, Inc.
3 Baldwin Green Common
Suite 202
Woburn, MA 01801-1868
(781) 932-3131

REVISIONS

1
2
3
4
5
DATE

DRAWING TITLE

Accessibility Option A - Perspectives

DRAWING INFORMATION

May 31, 2013
DATE OF ISSUE

Conditions Assessment
DESCRIPTION

N.T.S.
SCALE

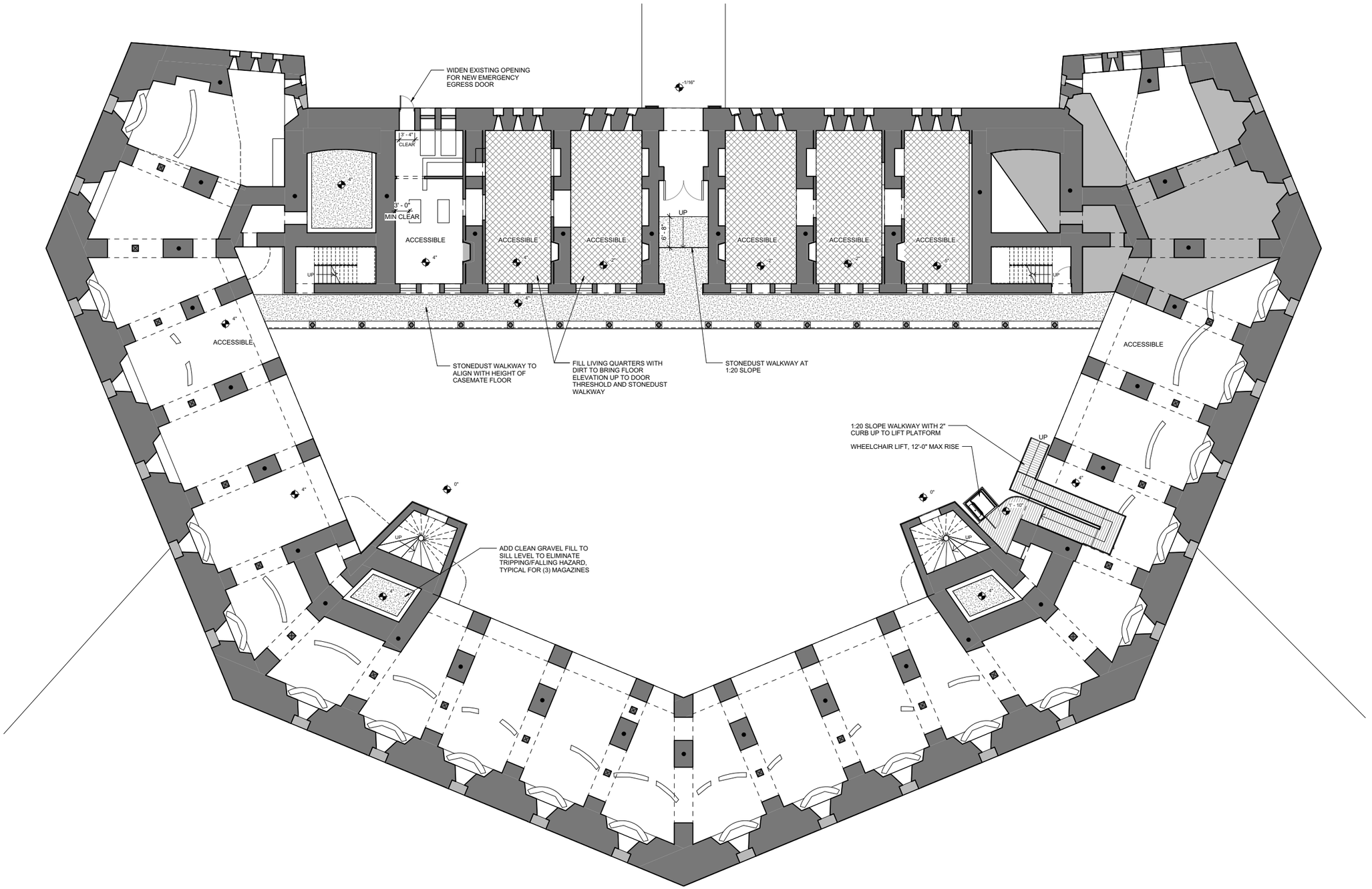
ARC
DRAWN BY

3124.00
PROJECT #

3124_Fort Taber.rvt
FILE NAME

DRAWING NUMBER

A-103a



1 FIRST TIER PLAN - OPTION B - LIFT WITH WALKWAY

0 4' 8'

P:\3124 New Bedford - Fort Taber\dwg\Revit\3124 Fort Taber Study.rvt
8/14/2013 8:56:45 AM ARC

ARCHITECT

bh+a

Bargmann Hendrie + Archetype, Inc.
300 A Street
Boston, MA 02210
617 350-0450 Tel

PROJECT NAME

Fort Taber, Assessment and Feasibility Study

1000c Rodney French Blvd
New Bedford, MA 02744

CLIENT

City of New Bedford

133 William Street
New Bedford, MA 02740

PROJECT TEAM

LANDSCAPE ARCHITECTS
Kyle Zick Landscape Architecture, Inc.
36 Bromfield Street, Suite 202
Boston, MA 02108
(617) 451-1018

STRUCTURAL ENGINEERS
Structures North Engineers, Inc.
60 Washington Street, Suite 401
Salem, MA 01970
(978) 745-6817

M/E/P/FP ENGINEERS
Building Engineering Resources, Inc.
66 Main Street
North Easton, MA 02356
(508) 230-0260

COST ESTIMATING
D.J. Jones International, Inc.
3 Baldwin Green Common
Suite 202
Woburn, MA 01801-1868
(781) 932-3131

REVISIONS

1
2
3
4
5
DATE

DRAWING TITLE

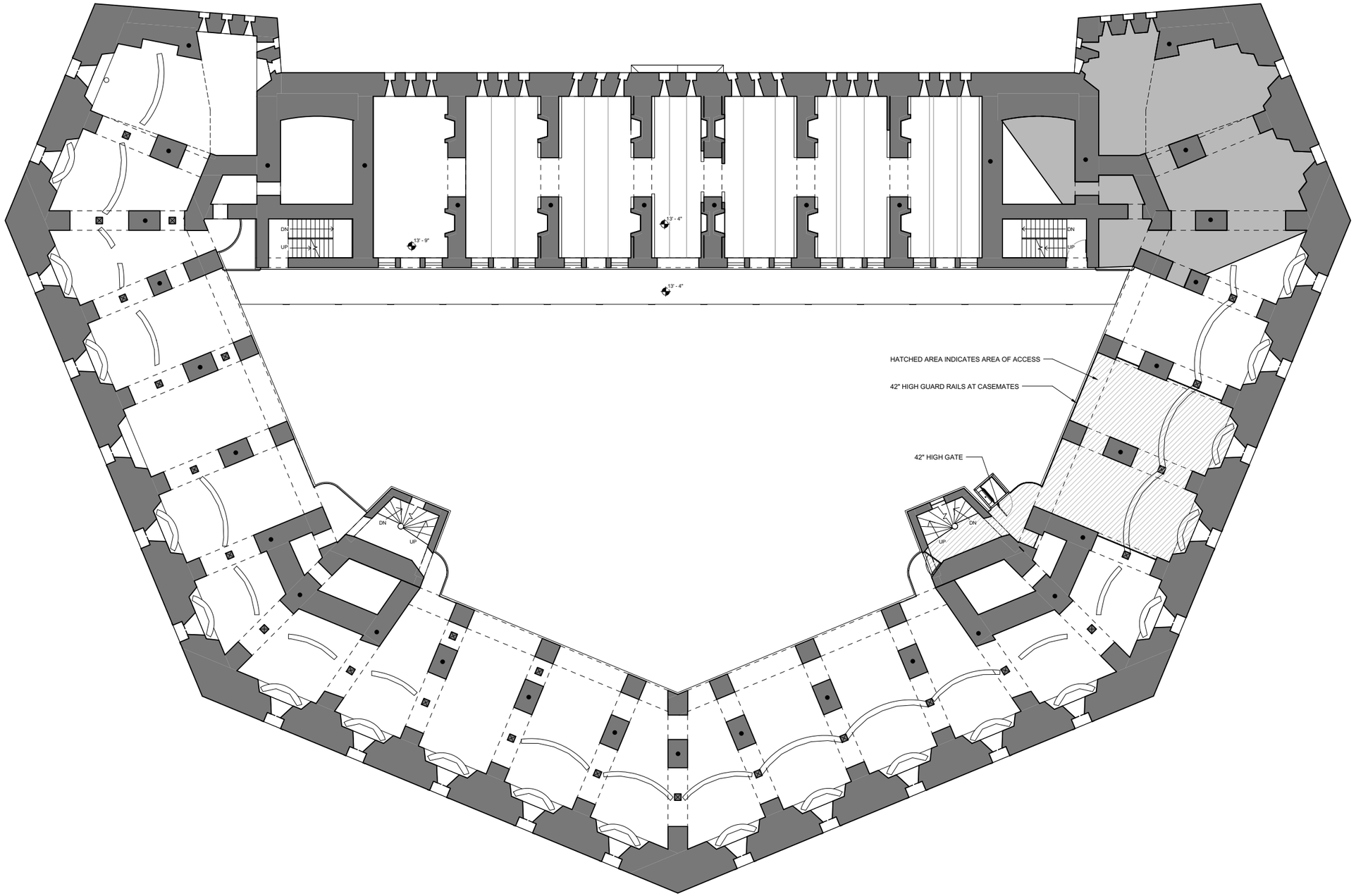
Accessibility Option B - First Tier Plan

DRAWING INFORMATION

May 31, 2013
DATE OF ISSUE
Conditions Assessment
DESCRIPTION
Graphic SCALE
ARC DRAWN BY
3124.00 PROJECT #
3124_Fort Taber.rvt FILE NAME

DRAWING NUMBER

A-101b



1 SECOND TIER PLAN - OPTION 2- LIFT WITH WALKWAY

0 4' 8'

P:\3124 New Bedford - Fort Taber\dwg\Revit\3124 Fort Taber Study.rvt
8/14/2013 9:56:59 AM ARC

ARCHITECT

bh+a

Bargmann Hendrie + Archetype, Inc.
300 A Street
Boston, MA 02210
617 350-0450 Tel

PROJECT NAME

Fort Taber, Assessment and Feasibility Study

1000c Rodney French Blvd
New Bedford, MA 02744

CLIENT

City of New Bedford

133 William Street
New Bedford, MA 02740

PROJECT TEAM

LANDSCAPE ARCHITECTS
Kyle Zick Landscape Architecture, Inc.
36 Bromfield Street, Suite 202
Boston, MA 02108
(617) 451-1018

STRUCTURAL ENGINEERS
Structures North Engineers, Inc.
60 Washington Street, Suite 401
Salem, MA 01970
(978) 745-6817

M/E/P/FP ENGINEERS
Building Engineering Resources, Inc.
66 Main Street
North Easton, MA 02356
(508) 230-0260

COST ESTIMATING
D.J. Jones International, Inc.
3 Baldwin Green Common
Suite 202
Woburn, MA 01801-1868
(781) 932-3131

REVISIONS

1	
2	
3	
4	
5	
	DATE

DRAWING TITLE

Accessibility Option B - Second Tier Plan

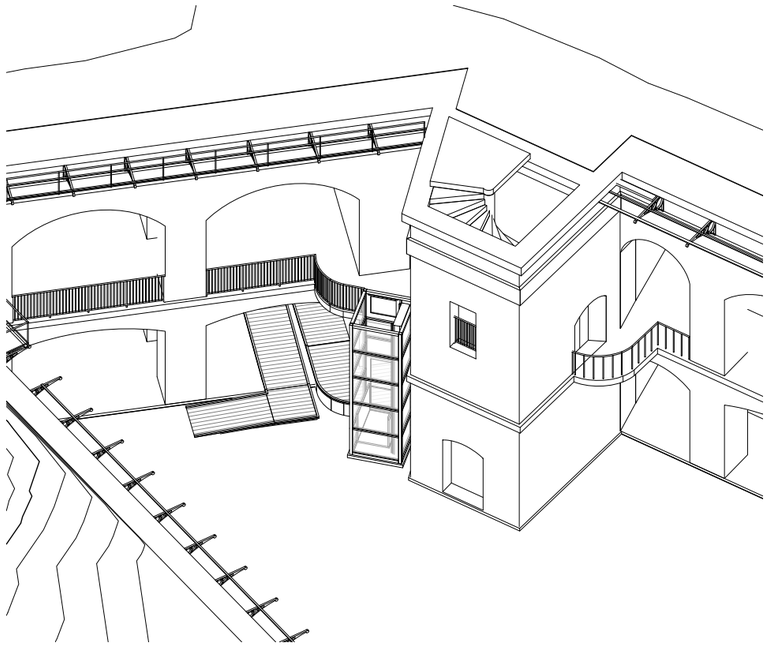
DRAWING INFORMATION

May 31, 2013
DATE OF ISSUE
Conditions Assessment
DESCRIPTION

Graphic	ARC
SCALE	DRAWN BY
3124.00	3124_Fort Taber.rvt
PROJECT #	FILE NAME

DRAWING NUMBER

A-102b



1 OPTION B - BIRD'S EYE VIEW

2 OPTION B - VIEW OF WHEELCHAIR LIFT FROM GALLERY

3 OPTION B - VIEW OF WHEELCHAIR LIFT FROM SALLY PORT

P:\3124 New Bedford - Fort Taber\dwg\Revit\3124 Fort Taber Study.rvt
8/14/2013 9:57:11 AM ARC

ARCHITECT

bh+a

Bargmann Hendrie + Archetype, Inc.
300 A Street
Boston, MA 02210
617 350-0450 Tel

PROJECT NAME

Fort Taber, Assessment and Feasibility Study

1000c Rodney French Blvd
New Bedford, MA 02744

CLIENT

City of New Bedford

133 William Street
New Bedford, MA 02740

PROJECT TEAM

LANDSCAPE ARCHITECTS
Kyle Zick Landscape Architecture, Inc.
36 Bromfield Street, Suite 202
Boston, MA 02108
(617) 451-1018

STRUCTURAL ENGINEERS
Structures North Engineers, Inc.
60 Washington Street, Suite 401
Salem, MA 01970
(978) 745-6817

M/E/P/FP ENGINEERS
Building Engineering Resources, Inc.
66 Main Street
North Easton, MA 02356
(508) 230-0260

COST ESTIMATING
D.J. Jones International, Inc.
3 Baldwin Green Common
Suite 202
Woburn, MA 01801-1868
(781) 932-3131

REVISIONS

1		
2		
3		
4		
5		
		DATE

DRAWING TITLE

Accessibility Option B - Perspectives

DRAWING INFORMATION

May 31, 2013
DATE OF ISSUE

Conditions Assessment
DESCRIPTION

N.T.S.	ARC
SCALE	DRAWN BY
3124.00	3124_Fort Taber.rvt
PROJECT #	FILE NAME

DRAWING NUMBER

A-103b

F. Appendix

4. Bibliography

Begel, Judith. "Historical Analysis Municipal Wastewater Treatment, Clarks Cove, New Bedford MA." US EPA, United States Environmental Protection Agency. USA GOV. http://www.epa.gov/region1/superfund/sites/newbedford/25743.pdf. (Accessed August 9th, 2013).

Bromley,Bob. Curator at Fort Taber/ Fort Rodman Military Museum. Phone interview. August 12, 2013.

D'Entremont, Jeremy. "Clark's Point Lighthouse, New Bedford, Massachusetts." Clark's Point Lighthouse, New Bedford, Massachusetts. Blandchard, Young & Co. http://lighthouse.cc/clarkspoint. (Accessed May 10, 2013).

D'Entremont, Jeremy. "History of Clark's Point Lighthouse, New Bedford." New England Lighthouses. http://lighthouse.cc/clarkspoint/history.html. (Accessed August 12th, 2013).

Dolphin, Debbie. Clark's Point Light Station. New England Lighthouse wallpapers. http://home.comcast.net/~debee2/mass/ClarksPoint.html. (Accessed August 12th, 2013).

"Fort Map & Gun Batteries." Fort Taber/ Fort Rodman Historical Association. New Bedford Internet. http://forttaber.org/fort-map-gun-batteries/. (Accessed June 3, 2013).

Fort Taber / Fort Rodman Historical Association, Inc. "Fort Taber / Fort Rodman Historical Association." Fort Taber Fort Rodman Historical Association Inc. New Bedford Internet. http://forttaber.org/ (Accessed May 20, 2013).

"New Bedford History / Lighthouse History." City of New Bedford Official Website. http://www.newbedford-ma.gov/Tourism/OurHistory/LighthouseHistory.html (Accessed August 12th, 2013).

"Preserving Fort Jefferson, NPS Restoration Bulletin." Dry Tortugas National Park. National Park Service. www.nps.gove/drto (Accessed August 11th, 2013).

Silvia, Mike. "New Bedford Guide | Your Guide to New Bedford and South Coast, MA." New Bedford Guide. http://www.newbedfordguide.com (Accessed August 11th, 2013).

Ron Labelle. Commissioner, City of New Bedford Department of Public Infrastructure. Interview. July 31, 2013.

[Note: this page deliberately left blank.]

Fort Taber / Fort Rodman
New Bedford, Massachusetts

Terreplein and Rampart Waterproofing Recommendations

Final Report

Prepared by

Bargmann Hendrie + Archetype, Inc.
Boston, Massachusetts

for

City of New Bedford, Massachusetts

November 2014

Terreplein and Rampart Waterproofing Recommendations

The Need

Fort Rodman's historic brick and granite structure is deteriorating at an accelerating rate, due to large amounts of water seeping through the terreplein (the earthen landforms between and behind the parapets and ramparts atop the Fort) and infiltrating masonry arches and vaults below. Massachusetts Historical Commission (MHC), the City of New Bedford and the BH+A A/E team agree that controlling this infiltration by providing a waterproof membrane to prevent further seepage through the roof structure to the masonry vaults below, and by directing terreplein storm water runoff to restored drain conduits and channels, remains a top priority. Based upon prior success at Fort Adams and other forts and upon the particular conditions at Fort Rodman, a two-pronged solution is proposed below.

Our knowledge of the actual, as-built construction of Fort Rodman is limited, especially given that surviving construction drawings are incomplete and inconsistent; for example, the early drawings depicted the earthen terreplein higher than it was actually constructed. Also, a third tier of casemates was planned but never constructed. In any case, Fort Rodman was built and enlarged in a number of stages, complicating our understanding of internal construction details and our ability to make definitive assessments regarding failed drainage systems.

Investigations

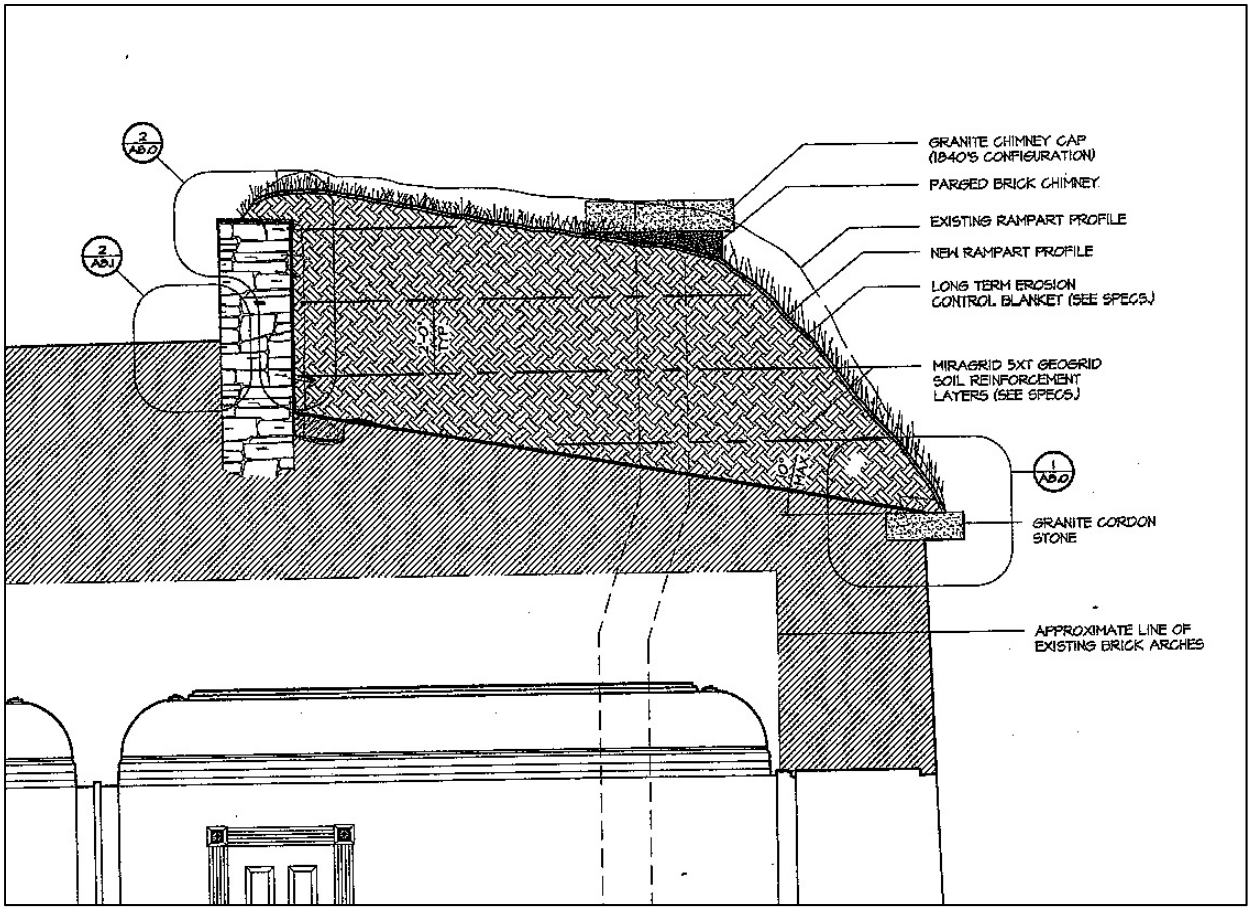
Based on historical research and extensive fieldwork at Fort Rodman, a pilot project to investigate structural conditions, waterproofing and drainage systems was designed by BH+A and Structures North Consulting Engineers. Slated to be undertaken by City of New Bedford facilities personnel, the project was cancelled by the City due to the higher-than-expected cost of shoring and equipment rental and the complexity of shifting soil loads safely. The BH+A team was subsequently asked to consider other approaches that might involve less earth-moving and reduced cost. The following recommendations are intended to guide a future design-bid-build construction effort.

BH+A revisited a number of coastal fortification repair and preservation reports, comparative analyses and guides previously reviewed and facilitated a November 5, 2014 conference call with Anne Louro, City of New Bedford Preservation Planner, and with Arnold Robinson, Fort Adams Trust board member and the former project manager at Newport Collaborative Architects, Inc. Upon further reflection (and following consultation with landscape architect Kyle Zick, ASLA), we determined that a number of relatively shallow and lightweight "extensive green roof" systems might be suitable for the terreplein; see below.

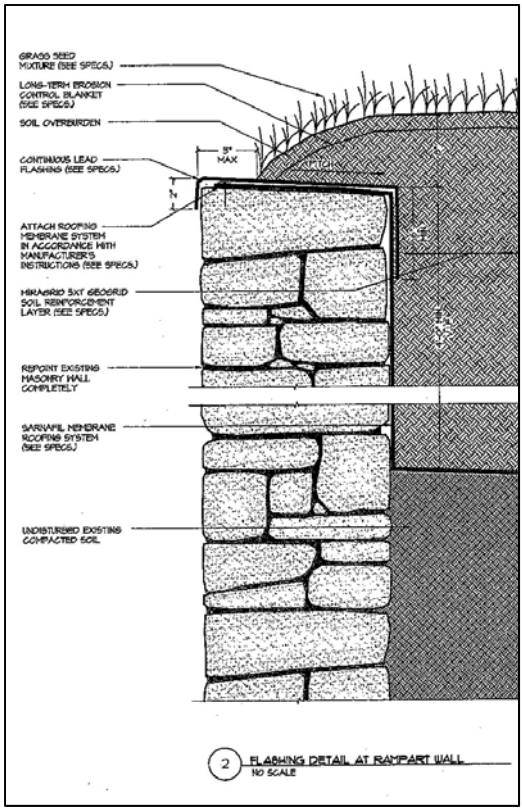
Fort Adams State Park, Newport, Rhode Island

As an alternative to total excavation of the fill surmounting the deteriorated casemate vaults, magazines and other features, limited excavation and installation of a green roof system similar to the Sika "Sarnafil" system installed as a pilot project at Fort Adams State Park has been suggested by the City of New Bedford and MHC. Designed by Newport Collaborative Architects, Inc. ("Newport Collaborative"), the Terreplein and Rampart Repairs project at Fort Adams included a combination of soil reinforcement and erosion control components, drainage panels, roofing membranes, concealed and semi-exposed flashing assemblies and an external roof drainage system, and the executed project also incorporated masonry repointing and chimney repair/reconstruction.

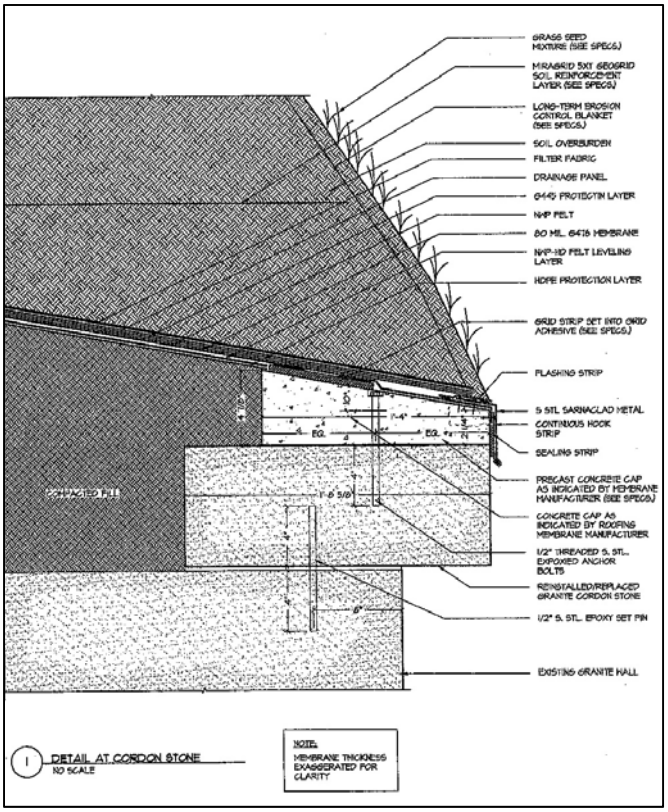
The waterproofing effort at Fort Adams focused in part on the sloping earthen rampart atop the northeast demi bastion. By all accounts, the Sarnafil solution worked well at the rampart, where they were able maintain a positive pitch such that the drainage layer "daylights" atop new flashing capping the cordon stone on the exterior wall and atop the masonry parapet wall facing inward. The Newport Collaborative details show as many as 4 geogrid layers spaced 2'-0" apart. The Fort Adams terreplein itself is separate, paved and theoretically impermeable.



Construction documents prepared by Newport Collaborative in June 2004 illustrate the proposed Sarnafil system to drain steeply sloping rampart atop at the northeast demi bastion at Fort Adams. Unlike at Fort Rodman, the extant Fort Adams terreplein in this area is a paved hardscape.



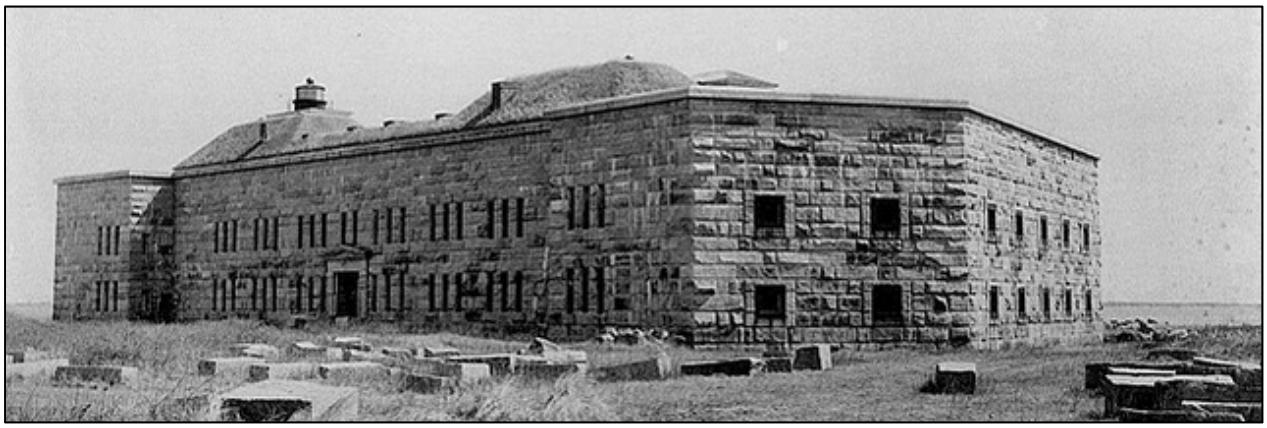
At the stone masonry retaining wall dividing the Fort Adams rampart from the paved terreplein, continuous lead flashing was wrapped over the stone coping, exposing an unobtrusive drip edge.



At the cordon stone cornice, the Sarnafil system specified by Newport Collaborative required the addition of a precast concrete cap epoxy-anchored to the cordon stones.

Fort Rodman Historic Appearance

Fort Rodman is not as large in plan or as extensive as Fort Adams, but the forts share some design characteristics and, in any case, both suffered from years of moisture damage and deferred maintenance.



This ca. 1880 photograph of Fort Rodman illustrates meticulously sculpted pyramidal landforms covering the magazines; the rampart berms are divided by an orderly row of vents and chimneys.

This ca. 1906 photograph of Fort Rodman from the northwest shows the ramparts rising from a nearly-flat terreplein.

Fort Rodman today; although the ramparts are eroded and overgrown, the essential form survives.

View of northwest ramparts from the edge of the parade walls. A comprehensive drainage system flashed to "daylight" over the existing coping would prevent further water infiltration down into the casemates below.

View of northwest (right) and south (center left) ramparts, from terreplein.

The southern rampart surmounts a barrel-vaulted brick magazine; the granite parapet wall faces a *banquette* paved with a single row of irregular stones.

Stone pavers at *banquette*.

Parapet wall and coping need repointing.

View of southern rampart and terreplein, from lighthouse.

Terreplein overview; note the minimal change in elevation from interior to exterior.

Terreplein, looking south from the lighthouse area; note the minimal change in elevation of the grassy terreplein. A new drainage membrane would need to "daylight" above the level of the repointed parade wall coping stones.

View of gallery brackets from parade.

View of parade wall coping soffits from below; open vertical joints need repointing.

Extant iron brackets supported a wood-planked gallery. A new drainage gutter system could be installed atop the brackets and integrated with a reconstructed wood-plank gallery deck.

Gallery support system, viewed from terreplein level.

In some areas, fill atop the cordon stones has eroded away, exposed the dressed stone masonry to wind and rain.

Restoration of the original exterior slope of the terreplein is recommended.

Conclusions

Based upon our review of available documents and recent conversations, the BH+A team concludes that two different types of green roof systems can be tailored to Fort Rodman's 1) steeply sloped rampart areas and 2) nearly-flat terreplein area, with minimal changes in exterior appearance. Both solutions require details allowing excess stormwater drainage to "daylight" at the edges in order to avoid further structural deterioration and damage to the casemates below. The proposed terreplein intervention requires replacing the existing grasses and uppermost turf with an integrated "sedum carpet" system.

Proposed Terreplein and Rampart Waterproofing System

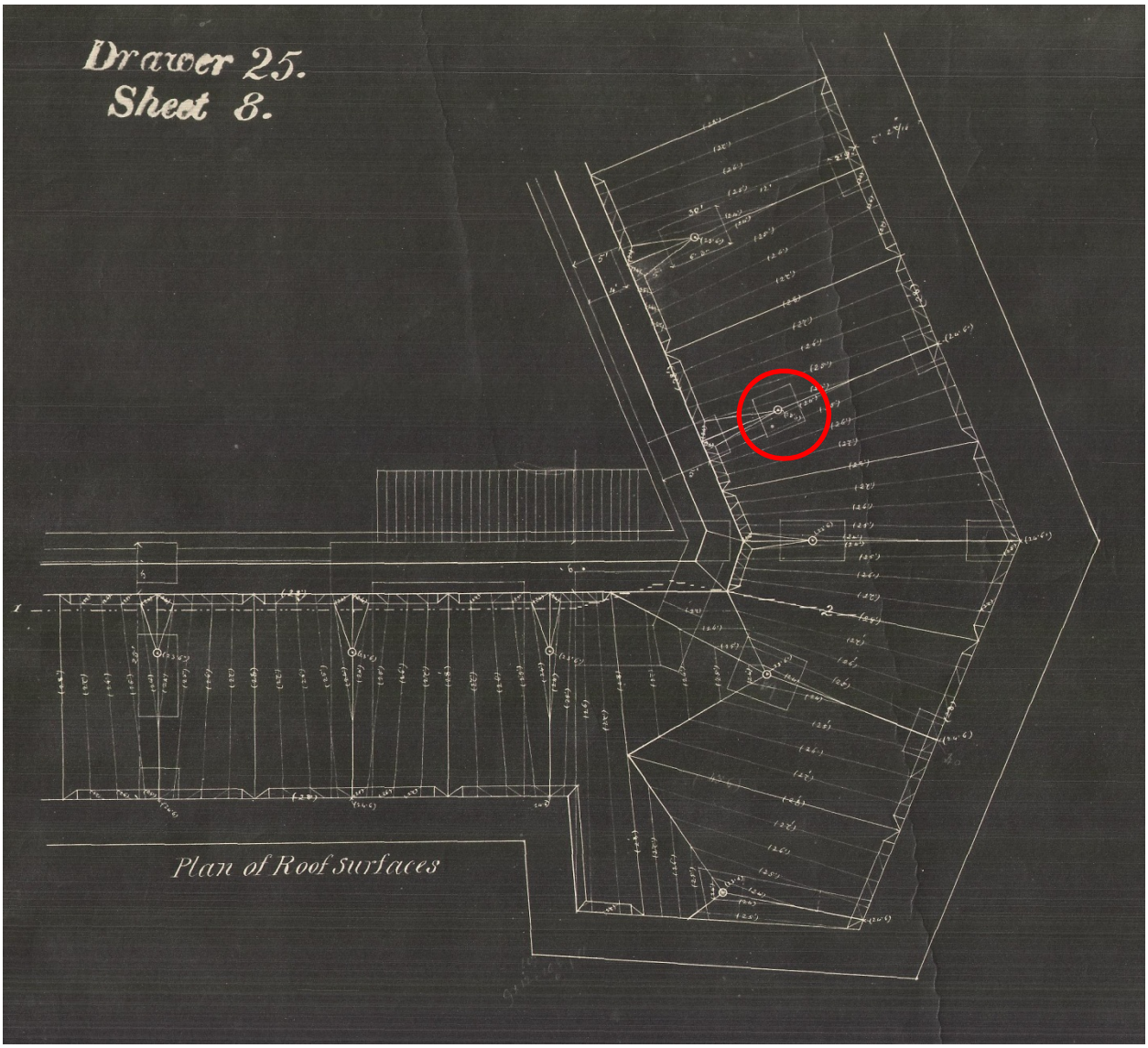
Major design features of the proposed dual system include:

1. Sika Sarnafil-type green roof system, supplemented by geogrid-type soil reinforcement at three earthen ramparts.
2. Remove existing stone paving at banquette, install fluid-applied or membrane waterproofing flashed into adjacent drainage membranes, and re-set pavers in crushed-stone base.
3. Vegetated roof with sedum, growing medium and drainage layer at slightly-crowned terreplein; "daylights" at exterior cordon and interior coping stones; provide metal cap flashing bedded in sealant and secured to copings via non-ferrous anchors drilled into mortar joints.
4. Repointing (with optional lead weather caps) at skyward-facing joints in cordon and coping stones.
5. Applied metal gutter and downspout system atop parade walls carries internal drainage down to cleaned and renewed underground drainage system.

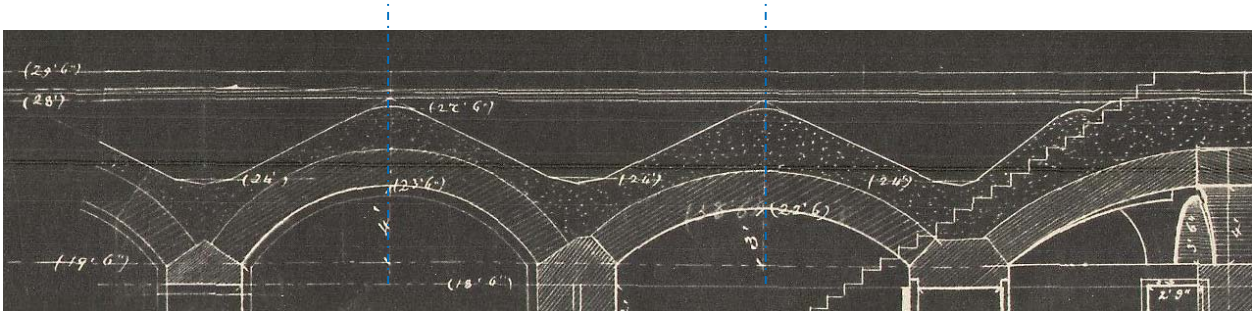
The proposed drainage solution relies in part of carrying roof drainage down to grade via conventional gutters and rain leaders; accordingly, repair and restoration of existing underground drains is strongly recommended.

This existing underground drainage channel fed by vertical drains deep in the heart of the granite casemate piers has become undermined by flooding and/or scour.

The brick-lined horizontal drain channel running beneath a casemate pier has been exposed to view by a collapsed adjacent stone paver.



This historic "Plan of Roof Surfaces" (Drawer 25, Sheet 8) indicates subterranean pitches to internal drains; a typical drain location is circled in red on the plan.



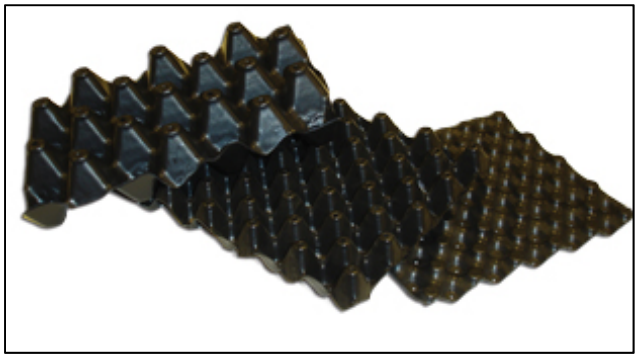
This part section showing fill over the casemate vaults (Drawer 25, Sheet 8) probably does *not* depict the actual, as-built conditions.

Extensive Green Roofs

"Extensive" green roofs are relatively lightweight and have a shallow build-up height. Suitable plants include types of moss, various Sedum species, herbs and some grasses. After establishment of the vegetation, recommended maintenance is limited to one or two inspections a year. The growing media for a typical "sedum carpet" green roof system is as shallow as 2½ inches, with a build-up height (above the drainage layers, etc.) of less than 4 inches.

As an added environmental and educational benefit, green roofs can increase biodiversity and attract particular fauna and flora; these so-called biodiverse green roofs reproduce natural habitats and provide food, nesting opportunities or resting places for spiders, beetles, butterflies, birds, etc.

Extensive green roof systems require an integrated series of layers and components.

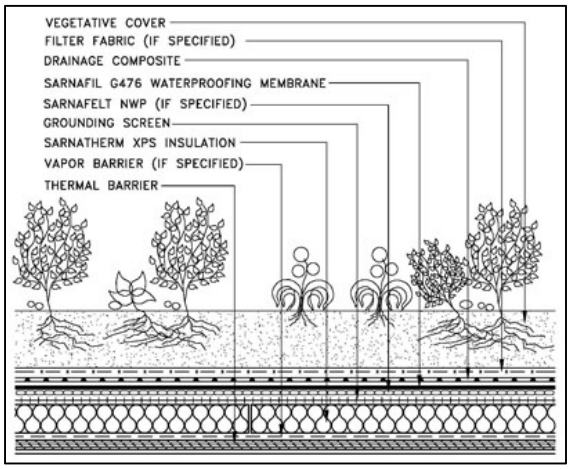


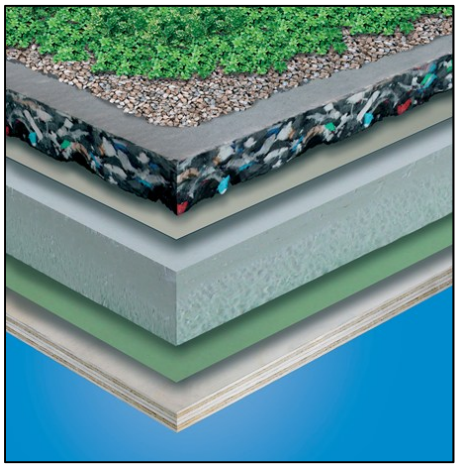
A typical drainage element.

The typical visual appearance of a sedum plant mix.

Fort Rodman Ramparts: Sarnafil-type Green Roof System

Fort Rodman has three ramparts – all erected over vaulted brick magazines and surmounted by vegetated soil – that appear to be appropriate candidates for a similar Sarnafil-type membrane system. The exterior and interior slopes appear capable of providing the positive pitch required for proper management and drainage of excess stormwater. Accordingly, excavation of approximately 5 feet of soil is recommended, leaving an outward-sloping plane of undisturbed fill as a base for a new composite drainage system. As at Fort Adams, installation of a horizontal "Miragrid 5XT" (or equivalent) geogrid soil reinforcement system throughout the replaced soil overburden is recommended, at an approximately 2-foot layer spacing.

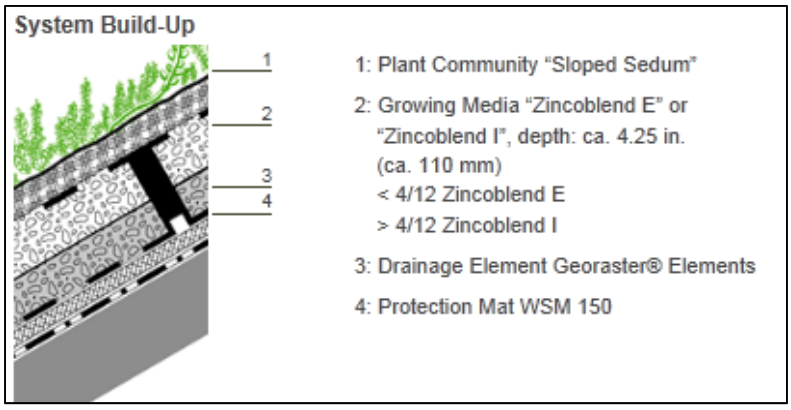




A conventional Sika Sarnafil green roof detail includes rigid insulation, but a series of protection layers was used at the Fort Adams earthen rampart.

ZinCo "Georaster" System

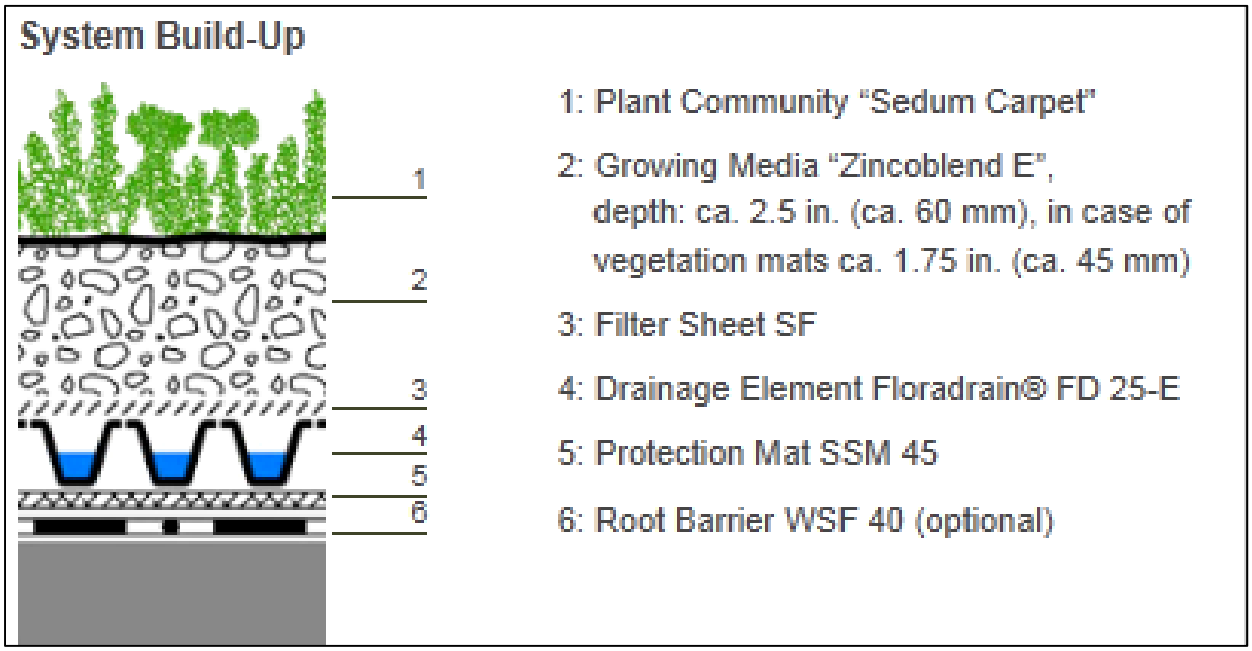
Alternatively, a "sloped sedum" green system equal to those manufactured by ZinCo "Georaster" could installed. Integrating a protection layers, root-resistant sloped systems are designed to resist shear transfer. "Georaster" elements manufactured of recycled polyethylene (HDPE) interlock without tools to create a stable structure that is infilled with a growing medium. The build-up height of this system is approximately 5 inches.



ZinCo "Sloped Sedum" System Diagram

Fort Rodman Terreplein: Extensive Green Roof

Unlike the steeply-sloped ramparts, Fort Rodman's grassy terreplein areas slope very gently towards the interior parade, with little if any crown. Implementing a Sarnafil-type solution with deeply-placed filter fabric, drainage panels, etc. would result in a "bathtub" with no positive pitch and no way to "daylight" stormwater runoff other than to core through the exterior and/or parade walls for drain outlets and scuppers. Conversely, adding a significant amount of soil to create a positive drainage pitch would add weight to the soil overburden and significantly alter the historic appearance. A variety of extensive green roof systems are manufactured by Sika, Hydrotech, ZinCo, Henry Company and others.



The ZinCo "Sedum Carpet" System incorporates a three-dimensional drainage element similar to the Sika Sarnafil "drainage composite" layer.

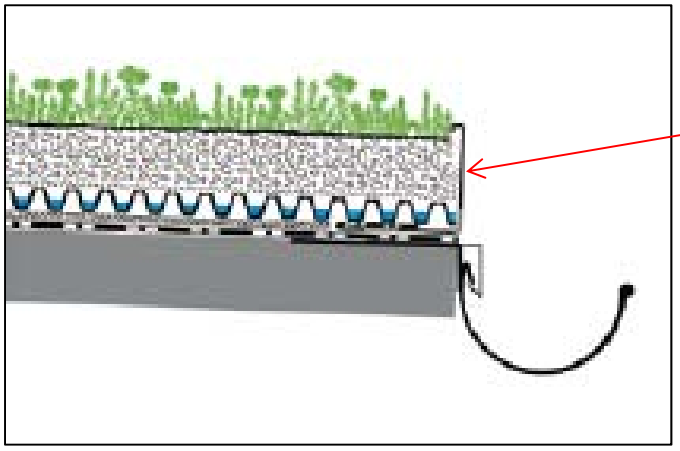
Estimated Installation Cost

Green roof systems have evolved over recent years such that installed costs on buildings average from $15.00 to $20.00 per square foot. Adapting the green roof system to the sloping and near-flat rampart and terreplein areas might cost $25.00 per square foot (plus extended crane rental costs as needed), allowing for preservation of historic fabric and for access complexities. The preliminary estimate of construction costs below is intended for capital planning and budgeting purposes.

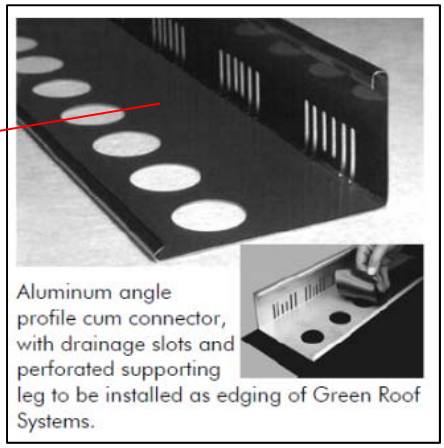
PROPOSED REPAIR AND WATERPROOFING WORK				**November 12, 2014**
#	Uniformat category	Work Item	Estimated Net Cost	Subtotals by Category
B		Shell		$740,000
	B 10 Superstructure	B 1020 Roof Construction: Provide Sarnafil-type and extensive green roof systems, complete; allow 16,400 sf terreplein + 8,000 sf ramparts = 24,400 sf @ $25.00/sf.	$610,000	
	B 20 Exterior Enclosure	B 2010 Exterior Walls: Rake and repoint granite parade wall coping stones and exterior cordon stones; assume add lead weather cap at skyward facing joints.	$50,000	
	B 20 Exterior Enclosure	B 2010 Exterior Walls: Rake and repoint granite parapet walls at ramparts as required..	$10,000	
	B 20 Exterior Enclosure	B 2010 Exterior Balcony Railings: Repair, restore and reconstruct galleries with salvaged and new materials; allow 400 lf @ $175/lf (includes iron bracket repair/renewal/replacement).	$70,000	
D		Services		$33,520
	D 20 Plumbing	D 2040 Rainwater Drainage: Provide custom copper gutters; allow 420 lf @ $40/lf.	$16,800	
		D 2040 Rainwater Drainage: Provide copper downspouts, conductors and rain leaders; alllow 280 lf @ $24/lf.	$6,720	
		D 2040 Rainwater Drainage: Provide miscellaneous metal and flexible flashing for gutters.	$10,000	
F		Special Construction and Demolition		$35,000
	F 20 Selective Building Demolition	F 2010 Building Elements Demolition: Miscellaneous salvage for reinstallation and selective demolition for	$35,000	
G		Sitework		$135,000
	G 10 Site Preparation	G 1030 Earthwork: In ccoordination with new green roof systems, resculpt/reconstruct historic rampart massing.	$25,000	
	G 20 Site Improvements	G 2050 Landscaping: In coordination with new green roof system, cut back plant growth, landscape "in between"	$50,000	
	G 30 Site Mechanical Utilities	G 3030 Storm Sewer: Clean, repair and reconstruct existing underground storm drainage system.	$60,000	
Subtotal Construction Cost				$943,520
General Requirements (including crane rental, access, temporary worker protection)			22.50%	$212,292
Escalation to mid-point of construction (2Q2015)			5.00%	$57,791
Building Permit fee (assume waived by City of New Bedford)			0.00%	$0
Design Contingency			5.00%	$60,680
Construction Contingency			15.00%	$191,142
Total Construction Cost (Preliminary Estimate for Budget Purposes)				$1,465,425

Roof Drainage: Gutters

At the Fort Rodman parade wall coping, a new metal gutter system is proposed to receive and channel interior stormwater runoff down to cleaned and restored underground drainage channels. ZinCo USA, Inc. manufacturers an "eaves profile" designed to border a green roof "build-up" without hindering water runoff; see below diagrams.

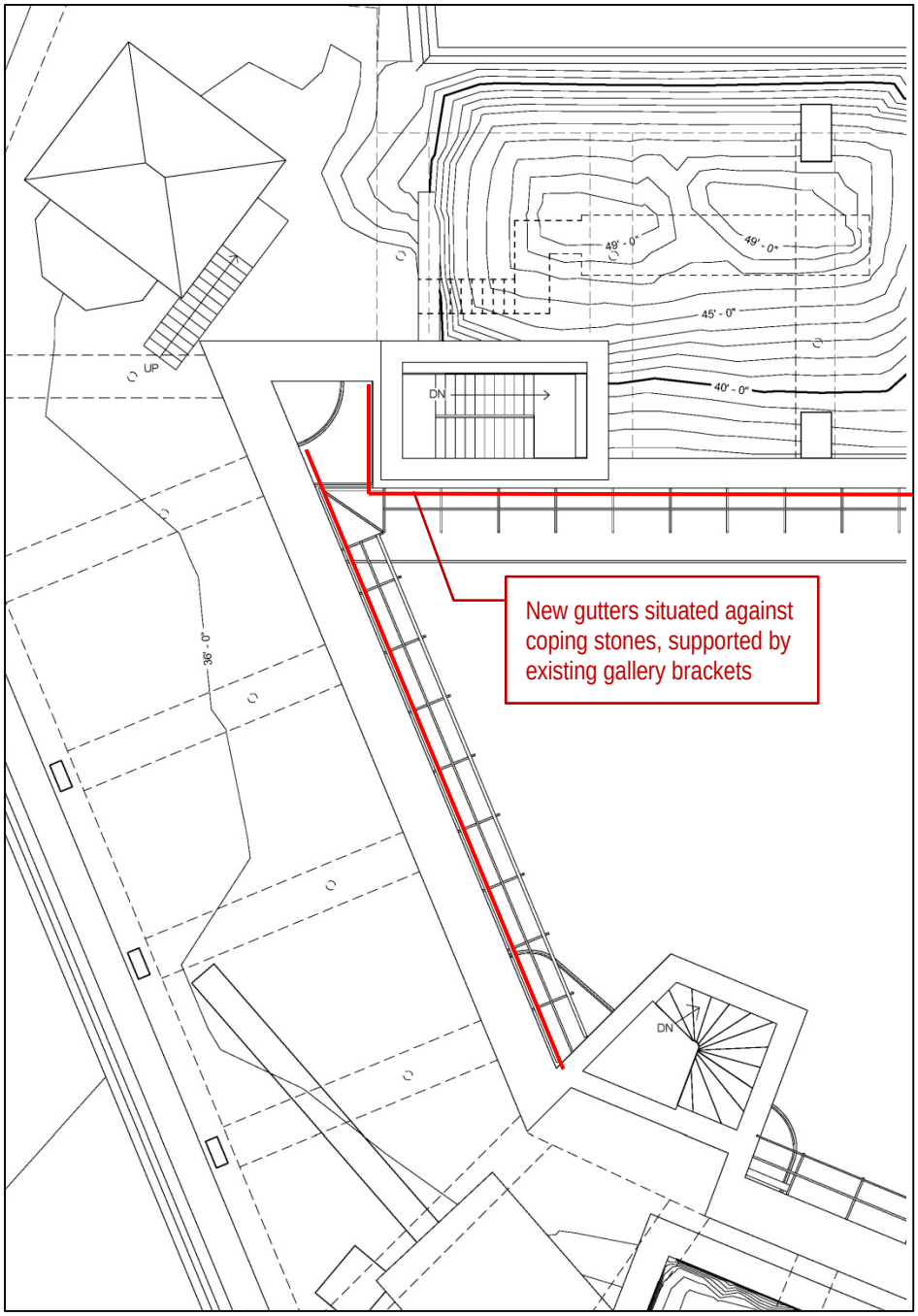


ZinCo eaves gutter detail

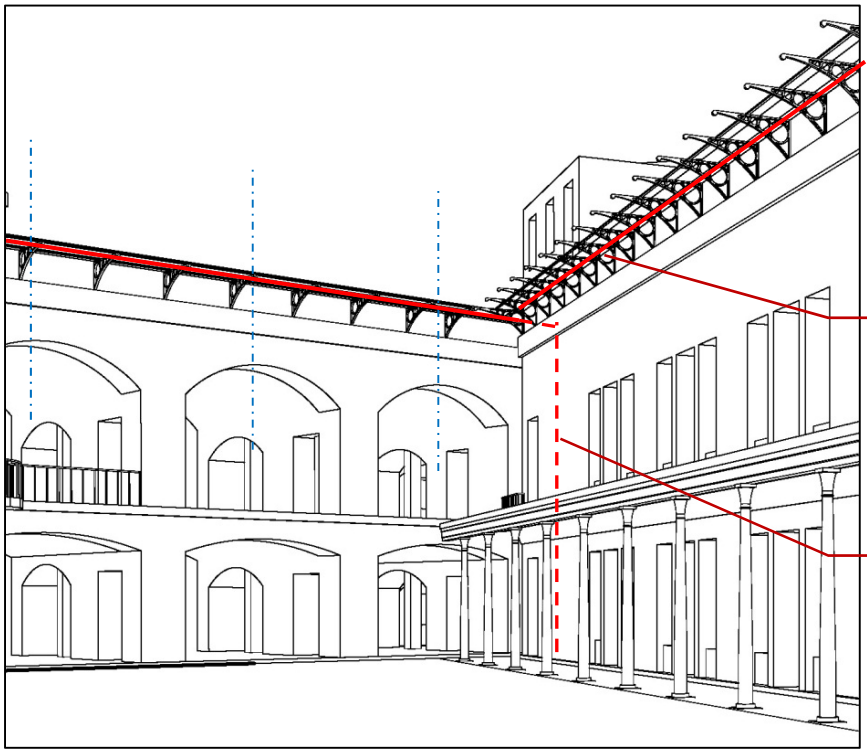


ZinCo eaves profile product; note vertical drainage slots.

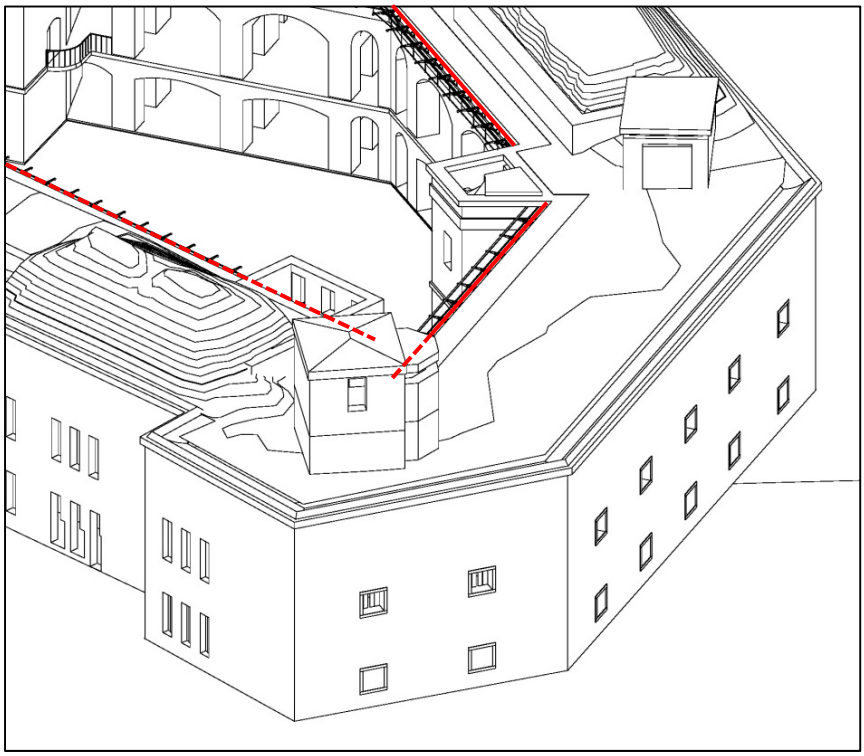
View west across parade at terreplein level; the existing iron gallery brackets could be repurposed to support (and camouflage) a new gutter system atop the interior (parade) wall.



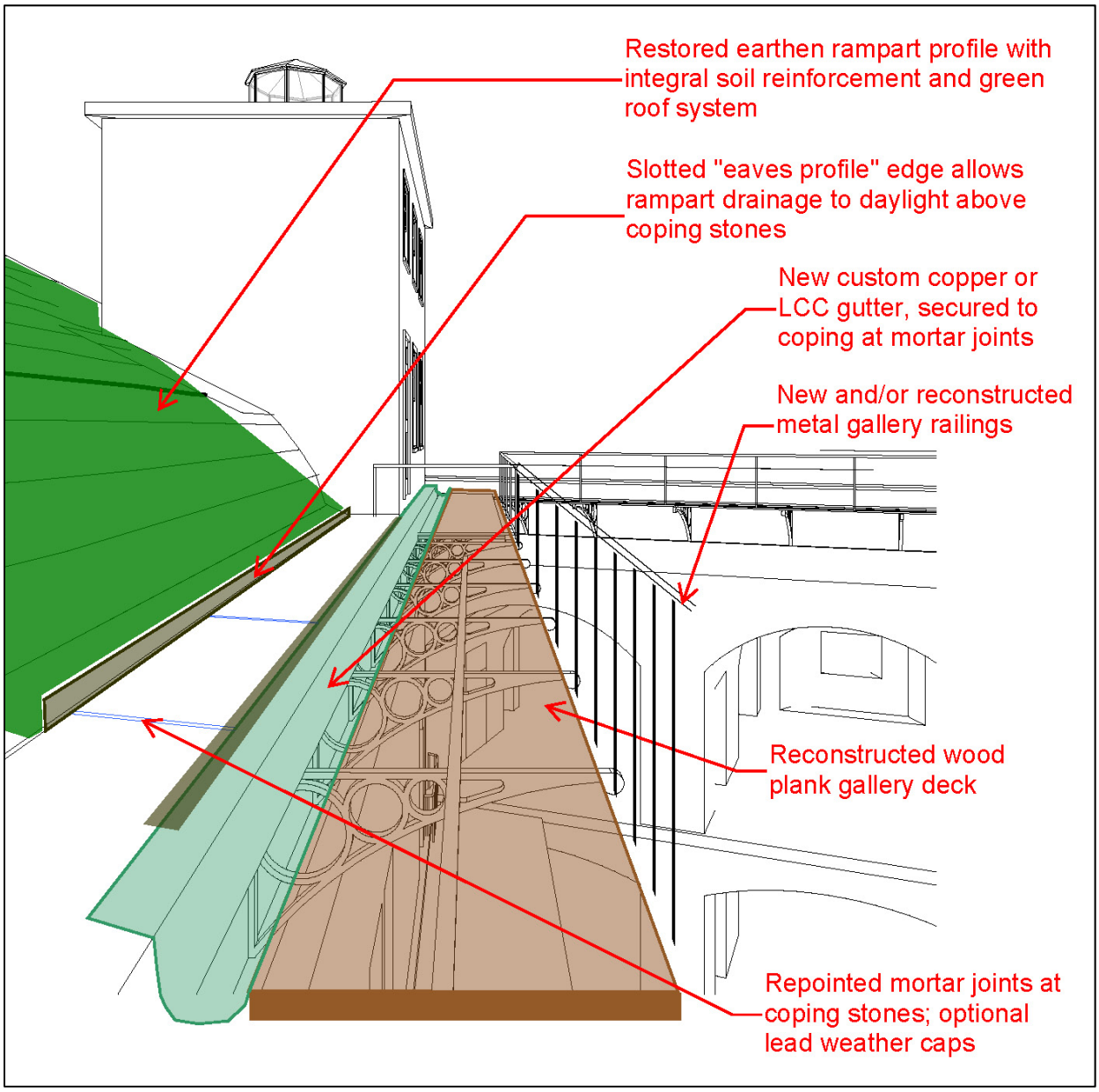
Partial roof plan indicates a proposed gutter layout at the southwestern end of the fort.



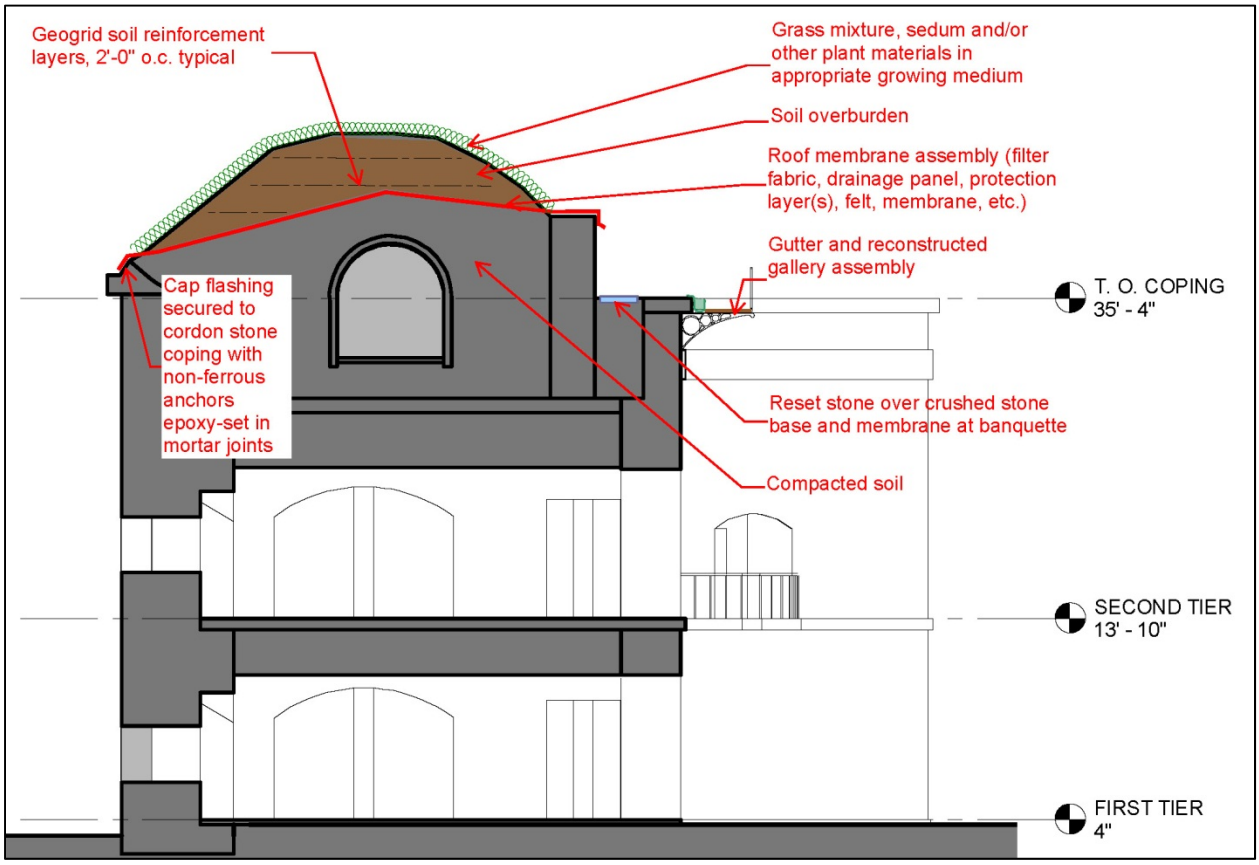
Proposed gutter system.



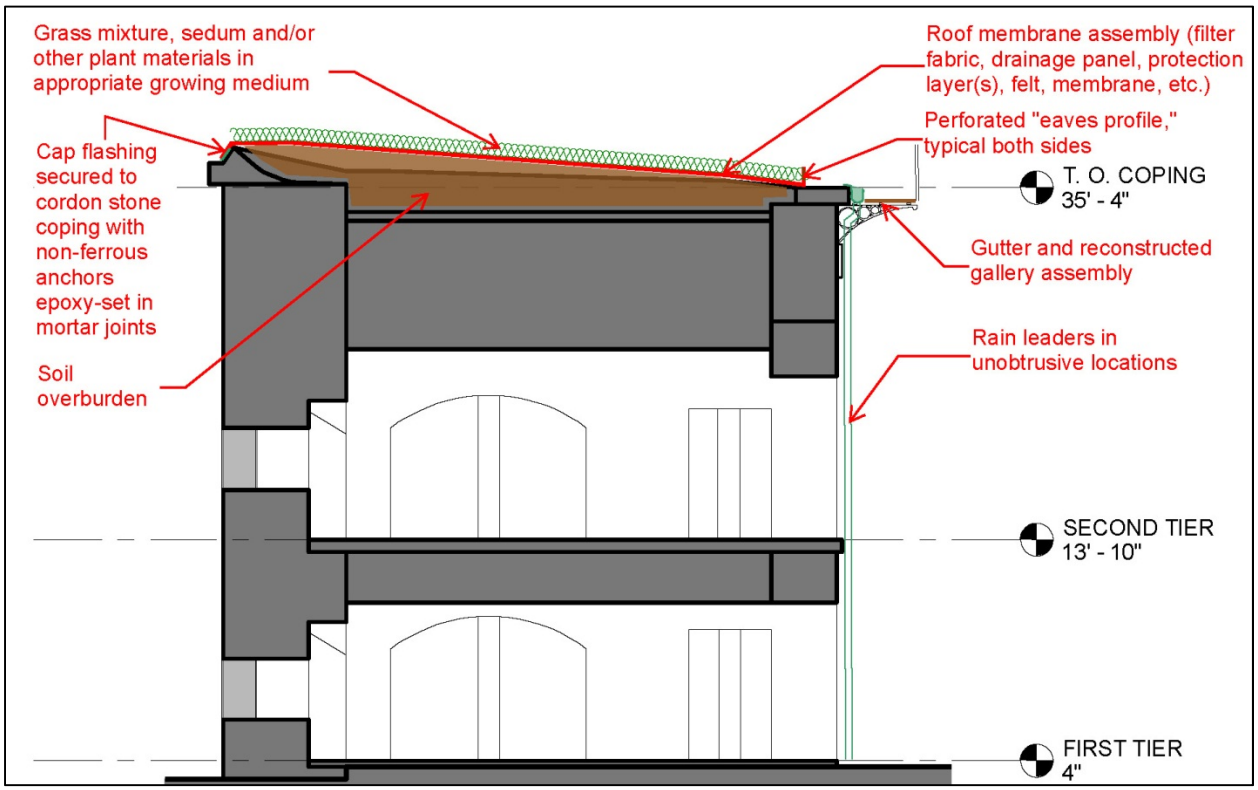
Proposed gutter locations (partial)



Proposed drainage solution at Fort Rodman northwestern ramparts combines a soil reinforcement and green roof system with coping stone repointing and with properly-flashed new gutters and a reconstructed wood-plank gallery and metal railing assembly.



Proposed green roof system at rampart areas, using Sika "Sarnafil," ZinCo "Sloped Sedum" or other integrated vegetated roof system with buried drainage and protection layers.



Proposed green roof system at Fort Rodman terreplein areas, using ZinCo “Sedum Carpet” or other shallow and lightweight vegetated roof system with buried drainage and protection layers.