National Park Service
Department of the Interior

Cape Hatteras National Seashore
Manteo, NC

Cape Hatteras Lighthouse

Historic Structure Report





The historic structure report presented here exists in two formats. A traditional, printed version is available for study at Cape Hatteras National Seashore, the Southeast Regional Office of the NPS, Denver Service Center of the NPS, and at a variety of other repositories. For more widespread access, the historic structure report also exists in a web-based format through ParkNet, the website of the National Park Service. Please visit www.nps.gov for more information.

Cape Hatteras National Seashore

Cape Hatteras Lighthouse

Historic Structure Report

February 2016

for

Cape Hatteras National Seashore
Manteo, NC

by

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Cape Hatteras National Seashore

Cape Hatteras Lighthouse

Historic Structure Report

Approved: _____

Superintendent, Cape Hatteras National Seashore Date

Recommended: _____

Chief, Cultural Resources Division, Southeast Region Date

Recommended: _____

Deputy Regional Director, Southeast Region Date

Approved: _____

Regional Director, Southeast Region Date

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Project Team

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Executive Summary

This Historic Structure Report (HSR) was produced for the Cape Hatteras National Seashore and the Southeast Regional Office to determine the best treatment and use for the Cape Hatteras Lighthouse. Use of the structure is preferred as per National Park Service policies and guidelines for Cultural Resource Management and Executive Order No. 130006: *Locating Federal Facilities on Historic Properties*. This HSR will guide future rehabilitation and repair work on the structure.

The project was conducted under a project agreement between the Historic Preservation Training Center (HPTC) and Cape Hatteras National Seashore (CAHA) entitled: "Prepare a Historic Structure Report for Cape Hatteras Lighthouse." Funding was allocated though the Southeast Regional Office (SERO); project management was also done through SERO. HPTC, CAHA, and SERO are units of the National Park Service (NPS), U.S. Department of the Interior. NPS policies and guidelines were adhered to in the production and distribution of this HSR.

A Historic Structure Report is the primary guide to treatment and use of a historic structure. It is prepared to identify and minimize the loss of character-defining features and materials and provides a basis upon which to address anticipated management objectives. This HSR aims to provide a current understanding of the historic Cape Hatteras Lighthouse and meet the following goals: provide a historical background and context for the structure; supply a current physical description and timeline for changes to the structure; identify character-defining features for the structure; document the condition of the structure; and provide treatment recommendations for the proposed use of the structure (see pp. 285-286 for Cape Hatteras Lighthouse Prioritized Treatment List).

The historical background, context, building chronology, and technical evaluations provide an understanding of the historical integrity of the structure. This information is valuable for guiding sustainable development of the Cape Hatteras Lighthouse by offering research and insight to park management. The contents are used by the park when scoping new projects. These new projects contain parameters for re-use functions and physical modifications that complement resource protection and preservation goals. This HSR informs management and directs planning and construction alternatives.

Research Conducted to Produce HSR

The following activities were conducted to gain a thorough understanding of the Cape Hatteras Lighthouse at Cape Hatteras National Seashore:

- Primary and secondary historic research into the sequence of changes and evolution of construction by the NPS:
    - Harpers Ferry Center Willow Springs, Charles Town, WV
    - Denver Service Center, Technical Information Center (eTIC), Denver, CO
    - Cape Hatteras National Seashore, Manteo, NC

- Architectural documentation, by HABS
- Condition assessments by HPTC
- Recommended treatments by HPTC
- Review of previous condition assessment/recommended treatment reports, particularly the 2014 report by Joseph K. Oppermann—Architect, P.A. and Bennett Preservation Engineering, PC.

Condition Assessment Summary

After HPTC's visit and assessment of the structure, investigation reveals modest maintenance deficiencies, resulting in an overall condition assessment rating of fair.

It should be noted that this is a high-quality and historically significant building that cannot be replicated in today's economic environment. The maintenance deficiencies described herein, while needing to be addressed, are superficial and in no way signify justification for any treatment other than full restoration of the building and continued use. Reversal of recent out-of-character modifications is easily incorporated into any design or planning work and represents a return to the sustainable management of this historic structure.

The exterior and interior retain a high level of historic integrity dating to and/or sympathetic to the original date of construction and the date of significance for this HSR (1870-1936). Major changes to the original features include:

- Removal of the exterior pedimented window hoods and brackets (1960s)
- Removal of the decorative cast-iron fence (ca. 1920s) and granite fence base (1999) surrounding the base of the lighthouse and replacement with modern vinyl fence (2000s)
- Removal of interior wood main entrance doors (between 1955 and 1986)
- Removal of interior metal gallery-level door (1992-93)
- Removal of interior lantern roller blinds
- Removal of First-Order Fresnel lens (1950s) and pedestal and clockwork (2006)

Overall Cape Hatteras Lighthouse is in **fair** condition, with a maintenance deficiency rating of **serious**, from the standpoint of NPS facility management programs (FMSS) and standards (with some features in "good" and "poor" condition and "minor" and "critical" deficiencies).

The results of these investigations at the Cape Hatteras Lighthouse provide a more fully-integrated narrative of developmental history of the extant building, including changes made over the years by former owners and the NPS. It also will educate users of the building about the integrity of the historic fabric and the character-defining features so that it may be uncovered, interpreted, and preserved for future generations.

Recommendations for Treatment and Use Summary

The recommended ultimate treatments and use for the Cape Hatteras Lighthouse, as determined through research for this HSR, are as follows:

- *Exterior Restoration* with the removal of non-sympathetic modern accretions and retention and preservation of character-defining features important to the historic design and construction of the lighthouse by the United States government in 1870.
- *Interior Rehabilitation* and preservation of character-defining features with removal of non-sympathetic modern accretions to reflect its original function. This treatment will preserve character-defining features and allow for the reversal of non-sympathetic treatments, materials, and finishes.

The treatment and use recommendations provided are meant to guide the final scope and description of the funded project and do not provide a construction or architectural program.

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Administrative Data

Project Identification

PMIS Number:	157627
Project Title:	Prepare a Historic Structure Report for Cape Hatteras Lighthouse
Project Location:	Cape Hatteras National Seashore, Manteo, NC

Name and Location Data

Preferred Structure Name:		Cape Hatteras Lighthouse
Other Structure Name:		Cape Hatteras Light Station
Structure Number:		HS-4A
LCS ID:		000113
Park:		Cape Hatteras National Seashore
Park District:		Cape Hatteras Light Station
Structure's County:		Dare
Structure's State:		North Carolina
NPS Region:		Southeast
Cluster:		Atlantic Coast
Administrative Unit:		Cape Hatteras National Seashore
GPS:	Longitude:	-75.5288369230361
	Latitude:	35.252303681786

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Cultural Resource Data

National Register of Historic Places

National Register Status:	Entered – Documented
National Register Date:	March 29, 1978
National Historic Landmark?	Yes
National Historic Landmark Date:	August 5, 1998
Significance:	The Hatteras Light Station is significant at the national level under NR Criteria A and C. The station represents the operations and architecture of the U.S. Lighthouse Service on the Outer Banks of North Carolina.
NR Information System No.:	78000266

Period of Significance

The period of significance for the Cape Hatteras Light Station National Historic Landmark District, of which the lighthouse is considered contributing, is 1870, the year the current lighthouse was lit, to 1936, the year the lighthouse was deactivated by the U.S. Coast Guard and the year it was acquired by the National Park Service.

Recommended Treatment & Use

The recommended treatment for the Cape Hatteras Lighthouse is exterior restoration and interior rehabilitation. The recommended use is to continue as an exhibit accessible by the public with the lantern leased to the U.S. Coast Guard.

Recommendations for Cataloguing & Storage of Materials Generated by HSR

All project materials will be turned over from HPTC to the Cape Hatteras National Seashore's Museum Resource Center. Electronic files and media will be transferred via the NPS ftp network site and through archival CDs mailed to DSC. Copies of materials will also be submitted to the Southeast Regional Office.

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Part 1 | Developmental History

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Historical Background and Context

The Administration of Lighthouses

The Lighthouse Act of 1789

Prior to 1789, each of the original thirteen colonies was responsible for their own navigational aids. The colonies constructed lighthouses to satisfy their own needs, particularly near large ports of trade, and worried little about other lighthouses on the Atlantic Coast.[1] The only extant colonial-era lighthouse is located at Sandy Hook, NJ, part of Gateway National Recreation Area Fort Hancock unit; it was constructed in 1764 (fig. 1).



Figure 1. The 1764 Sandy Hook Lighthouse as it looked in 1937. Photo: Library of Congress, Historic American Buildings Survey, NJ-326.

On April 8, 1789, discussions began in the House of Representatives regarding several bills, including a 'Lighthouses Bill.' After much debate on taxes for the maintenance of the lighthouses, the House passed its version of the bill on July 20 of that year. The Senate, and the first-ever special-interest group of Philadelphia merchants, debated the bill soon thereafter. The Senate's revised bill was passed on July 31. The House accepted all of the amendments, and passed the revised bill on August 3. President George Washington signed "An Act for the Establishment and Support of Light-Houses, Beacons, Buoys, and Public Piers" on August 7, 1789.[2]

The Act "provided for the acceptance of and jurisdiction over all pre-existing aids to navigation in the United States. It also arranged for the maintenance of aids and payment of keepers."[3] Due to the link with revenue and customs, both part of the Department of the Treasury, the newly established United States Light House Establishment (USLHE) was aligned under that department.[4]

[1] Holland, Jr., Francis Ross. "America's Lighthouses: An Illustrated History." Dover Publications: New York, 1972. pp. 8, 26.
[2] "The Lighthouses Act of 1789." Prepared under the direction of Walter J. Steward, Secretary of the Senate. U.S. Senate Historical Office: 1991. Accessed at https://www.uscg.mil/history/docs/1789_LH_Act.pdf on October 19, 2015.
[3] Marshall, Amy K. "Frequently Close to the Point of Peril: A history of Buoys and Tenders in U.S. Coastal Waters, 1789-1939." *A Thesis Presented to the Faculty of the Department of History, East Carolina University, in Partial Fulfillment of the Requirements for the Degree Master of Arts in Maritime History/Nautical Archaeology.* April 1997. Accessed at http://www.uscg.mil/history/weblighthouses/docs/Amy_Marshall_Thesis.pdf on October 19, 2015.
[4] Holland, Jr., "America's Lighthouses: An Illustrated History," p. 26.

Consequently, the USLHE was responsible for the twelve lighthouses which were already constructed and in operation, and the four under construction at that time. The four under construction, and therefore the first completed under direction federal government were Cape Henry, VA in 1791 (fig. 2), Tybee, GA in 1791, Portland Head, ME in 1791 (fig. 3), and Bald Head at Cape Fear River, NC in 1796. It was not until 1797 that all twelve of the previously constructed lighthouses were turned over to the federal government.[5]



Figure 2. The 1791 Cape Henry Lighthouse, right, next to its replacement, as they looked in ca. 1905. Photo: HPTC, Library of Congress, Detroit Publishing Co. No. 018400.



Figure 3. The 1791 Portland Head Light as it looked in 1965. Photo: Library of Congress, Historic American Buildings Survey, ME-123.

United States Light House Establishment

For the first several years, the lighthouses were personally managed by Treasury Secretary Alexander Hamilton. At a local level, the lighthouses were assigned to the Collector of Customs of a port.[6] In 1792, responsibility was assigned to the Commissioner of Revenue, Tench Coxe. A decade later, in 1802, the responsibility was reassigned to the Secretary of the Treasury, Albert Gallatin. In 1813, the responsibility once again returned to the Commissioner of Revenue.[7] Despite the changes, approximately forty lighthouses were constructed by the federal government between 1791 and 1820.[8]

In 1812, the federal government purchased the patent rights for a "reflecting and magnifying lantern" from ex-ship captain Winslow Lewis for $20,000. His design borrowed heavily on the Swiss Argand-style lamp and parabolic reflector. Unfortunately, Lewis also added green-tinged glass lenses to the front of the lamps which cut the range of the light drastically. Nevertheless, all of the lighthouses were outfitted in this manner by 1815. It took the federal government until 1840 to remove all of the green lenses.[9]

[5] United States Lighthouse Society. "History of the Administration of the Lighthouses in America." Accessed at http://uslhs.org/history-administration-lighthouses-america on October 19, 2015.
[6] United States Lighthouse Society, "History of the Administration of the Lighthouses in America."
[7] Holland, Jr., "America's Lighthouses: An Illustrated History," pp. 26-27.
[8] National Park Service and United States Lighthouse Society. "Historic Lighthouse Preservation Handbook." 1997. Accessed at http://www.nps.gov/maritime/nhlpa/handbook/HistoricLighthousePreservationHandbook_04_Part2.pdf on October 19, 2015.
[9] United States Lighthouse Society, "History of the Administration of the Lighthouses in America."

In 1815, Lewis began another contract which gave him "a monopoly over the provision of winter pressed Spermaceti oil for lighthouses throughout the eastern seaboard." This contract continued past 1820.[10]

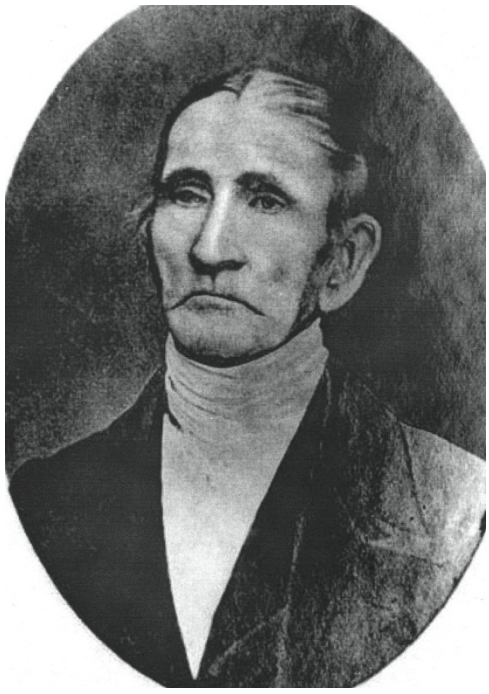


Figure 4. A portrait of Stephen Pleasonton.[12]

On August 1, 1820, the responsibility of navigational aids was once again reassigned to the Treasury Department, this time under the Fifth Auditor of the Treasury, Stephen Pleasonton (fig. 4) who became known as the "general superintendent of lights." Directly under Pleasonton were the Collectors of Customs of each port. These collectors gained the title of "superintendents of lights." The superintendents were responsible for all aspects of the lighthouses, including personnel matters, construction and/or repair of the lighthouses or related structures, and conducted annual site visits to each of the lighthouses; however the superintendents could only make minor decisions without the permission of the general superintendent. Prior to 1822, Pleasonton had to approve all expenses, large and small. Following 1822, the superintendents were permitted to spend up to $100 without Pleasonton's permission. Additionally, Pleasonton relied heavily on the superintendents to inform him of problems and carry out complaint investigations for individual lighthouses.[11]

At the beginning of Pleasonton's tenure, new construction and repairs were handled through individual contracts. As the number of light stations increased, it became impossible to adequately manage the individual contracts. Therefore, Pleasonton contracted with one supplier who would furnish supplies for all of the USLHE to keep the apparatuses at each lighthouse in complete repair. The winning bid, by Winslow Lewis, was $35.87 per lamp per year. At that time, lighthouses could have as many as 30 lamps.[13]

This was the beginning of Pleasonton's relationship with Lewis. He had faith in Lewis and relied greatly on his professional ability and experience. Lewis also had nautical experience which Pleasonton lacked. Many historians believe that because of this reliance/relationship there was little technical progress under the Pleasonton administration. Particularly damning is Pleasonton's refusal to support the installation of Fresnel lenses after their perfection in 1822. Lewis's financial interest with his own patented lenses is likely to blame.[14] The higher cost—$5,000 for a First Order Fresnel lens—may have had something to do with it as well.[15]

As sea trade increased and American ship captains began comparing Europe's lighthouses to those of the United States, complaints began to arise. I.W.P Lewis, nephew of Winslow, as well as a civil

[10] Marshall, "Frequently Close to the Point of Peril: A history of Buoys and Tenders in U.S. Coastal Waters, 1789-1939."
[11] Holland, Jr., "America's Lighthouses: An Illustrated History," p. 27.
[12] U.S. Government - Extracted from PDF version of Keeping the Seal in Good Hands poster, part of a U.S. Diplomacy Center (State Department) exhibition on the 225th anniversary of the Great Seal. Licensed under Public Domain via Commons - https://commons.wikimedia.org/wiki/File:StephenPleasonton.jpg#/media/File:StephenPleasonton.jpg October 19, 2015.
[13] United States Lighthouse Society, "History of the Administration of the Lighthouses in America."
[14] Holland, Jr., "America's Lighthouses: An Illustrated History," p. 27.
[15] Marshall, "Frequently Close to the Point of Peril: A history of Buoys and Tenders in U.S. Coastal Waters, 1789-1939."

engineer and lighthouse inspector, was extremely critical of his uncle, accusing Winslow of gross negligence and plagiarism. In addition, Edmund and George W. Blunt, publishers of the *American Coast Pilot,* corresponded frequently with Pleasonton about the terrible state of the country's aids to navigation.[16] The Blunt brothers also wrote to the Secretary of the Treasury in 1830 stating that the appropriated money was not being used adequately. When they received no response, they wrote to Congress in 1837 stating the USLHE was badly managed, the lighthouses were inadequately constructed, and Lewis's lamps were useless.[17]

Congress responded the same year by authorizing an appropriation for the construction of a large number of new lighthouses and other navigational aids, contingent upon a study by the newly formed Board of Navy Commissioners. The Department of the Navy detailed twenty-two officers for the study who would report directly to Congress. The study determined that thirty-one of the proposed new lighthouses were not needed, that the current USLHE was the most economical agency and adequately successful, and that a new office, known as The Auditor of the Department of State and General Superintendent of the Lighthouse Establishment, should take the place of the Fifth Auditor. The last recommendation was never realized.[18]

As a result of the study, Congress passed an act on June 7, 1838 which divided the Atlantic Coast into six districts (the Great Lakes were divided into two). The extant superintendents were replaced with a naval officer, one for each of the new districts. The officer would be required to report on the condition of the aids to navigation in his own district and choose and acquire sites for new aids. The resulting reports varied in quality and thoroughness. Some reports were extremely detailed, while others lacked specifics. Overall, the officers found the lighthouses varied from very bad to very good condition and, overwhelmingly, the most consistently noted defect centered on the quality of the light. Unfortunately, the combined report did little to spur Congress into action and the aids continued to operate as they had for another decade.[19]

Also in 1838, Congress asked the Commerce Committee to conduct a comparison test of the Fresnel lenses being used in Europe to the existing reflector lamps found in American lighthouses. Senator John Davis, head of the committee, was assigned to oversee the test at Sandy Hook, NJ. Captain Matthew C. Perry was sent to Europe to investigate the lighthouses of Britain and France. While there, he purchased a First Order fixed lens and a Second Order revolving lens. He met Léonor Fresnel, younger brother of deceased lens developer Augustin-Jean Fresnel, and placed an order with Henry Lepaute. Having gone behind Pleasonton's back to order the Fresnel lenses, Pleasonton stalled when asked to authorize payment. After other additional issues, the lenses were finally installed in December 1840 at the twin towers of the Navesink Highlands, a bluff overlooking New York Harbor and close to the originally planned Sandy Hook location. The test was deemed a success by all those who used the lighthouses for navigation. However, Pleasonton was not impressed by the outcome, particularly its price tag, and still remained in control of the USLHE.[20]

In 1842, the House of Representatives Commerce Committee investigated better regulations for the USLHE and the idea that it be realigned under the Corps of Topographic Engineers. The

[16] United States Lighthouse Society, "History of the Administration of the Lighthouses in America."
[17] Levitt, Theresa. "A Short, Bright Flash." W.W. Norton & Company: New York, 2013. pp. 139-140.
[18] United States Lighthouse Society, "History of the Administration of the Lighthouses in America."
[19] Holland, Jr., "America's Lighthouses: An Illustrated History," pp. 28-30.
[20] Levitt, "A Short, Bright Flash," pp. 140-144.

Committee submitted their report in May. The same day they submitted their report, I.W.P. Lewis was appointed to inspect seventy lighthouses in Maine, New Hampshire, and Massachusetts (one-third of all the lighthouses in the country at the time). His report, submitted to Congress in February 1843, condemned the extant USLHE and recommended that engineers be in charge of lighthouse operations. Ultimately the report did little to change anything and I.W.P. moved to France for two years to study their lenses, of his own volition.[21]

When I.W.P. returned to the United States in 1845, he made it his mission to integrate Fresnel lenses into U.S. lighthouses. Using sample lenses, he rallied the support of the Merchants and Underwriters Associations in Boston and New York, as well as two Harvard physics professors, all of whom wrote to the Secretary of the Treasury Robert J. Walker.[22]

In 1845, Secretary Walker sent Lieutenant Thornton A. Jenkins of the Coast Survey and naval officer Richard Bache to Europe to study the far-advanced lighthouse establishments there. They submitted a report in June 1846. It recommended that the USLHE be reorganized "by the appointment of an engineer and optician and number of District Superintendents under the Secretary of the Treasury." The engineer would complete the drawings and specifications for all construction work and inspect all of the lighthouses once a year. The coast would be divided into ten districts overseen by Navy officers who would inspect all of their district's lighthouses monthly. Congress again took no immediate action.[23]

In 1847, Congress removed the responsibility for the construction of new light stations from the Fifth Auditor and transferred it to the Corps of Topographical Engineers, another suggestion by I.W.P. [24]

Finally, on March 3, 1851, Congress approved *An Act Making Appropriations for Light House, Light Boats, Buoys, &c.* The act required the Secretary of Treasury to create the United States Lighthouse Board, consisting of two high-ranking naval officers, two army engineering officers, a civilian "of high scientific attainment," and a junior navy officer as secretary. On May 21 of the same year, Secretary Thomas Corwin appointed Commodore William B. Shubrick (president of the board), Commander Samuel F. Du Pont, Brevet Brigadier General Joseph G. Totten, Lieutenant Colonel James Kearney, Professor Alexander D. Bache, and Lieutenant Thornton A. Jenkins respectively. The board was asked to "look into every aspect of the lighthouse establishment, including methods of lighting, all phases of construction, management of the system, effectiveness of the lights, procuring of supplies, the way the lighthouses were operated, and efficiency and economy of operation." The board completed their assignment and submitted a 760-page report which included forty plates.[25] A summary:

> The report detailed construction of towers and dwellings, instructions as to how keepers were to perform their duties, ability and fidelity of the inspectors, mode of procuring and furnishing oil and other stores to the light stations, methods of testing supplies and types of reports to be placed into the new system. The report recommended that Fresnel lenses be placed in all of [the] lighthouses and that they be classed by Order, like the French (1st Order being the largest and

[21] United States Lighthouse Society, "History of the Administration of the Lighthouses in America."
Levitt, "A Short, Bright Flash," pp. 144-146.
[22] Levitt, "A Short, Bright Flash," p. 147.
[23] Marshall, "Frequently Close to the Point of Peril: A history of Buoys and Tenders in U.S. Coastal Waters, 1789-1939."
United States Lighthouse Society, "History of the Administration of the Lighthouses in America."
[24] Marshall, "Frequently Close to the Point of Peril: A history of Buoys and Tenders in U.S. Coastal Waters, 1789-1939."
[25] Holland, Jr., "America's Lighthouses: An Illustrated History," pp. 33-34.

6th the smallest). Every aspect of construction, inspection and administration was laid out in fine detail. The report also recognized Mr. Pleasonton, who had administered the lighthouse service for over 30 years, a period in which the number of lighthouses had grown from 25 to well over 300. They said "great credit is due to the zeal and faithfulness of the General Superintendent and to the spirit of economy which he has shown,) which spirit, perhaps, accounted for the "lack of zeal exhibited for the adoption of modern improvements;" and went on to say that, really, it was too much to expect that one person had the ability to manage such a vast organization and to stay on top of all the new developments, as well as ensure that all aspects of the service were running smoothly.[26]

On October 9, 1852, Congress created the nine-member United States Light-House Board (USLHB), who took up their duties immediately upon organization. The board members included all of the original members as well as the addition of physicist Joseph Henry and Captain E.L.F. Hardcastle. The Secretary of the Treasury was president *ex officio* and Shubrick was the chairman (fig. 5).[27]

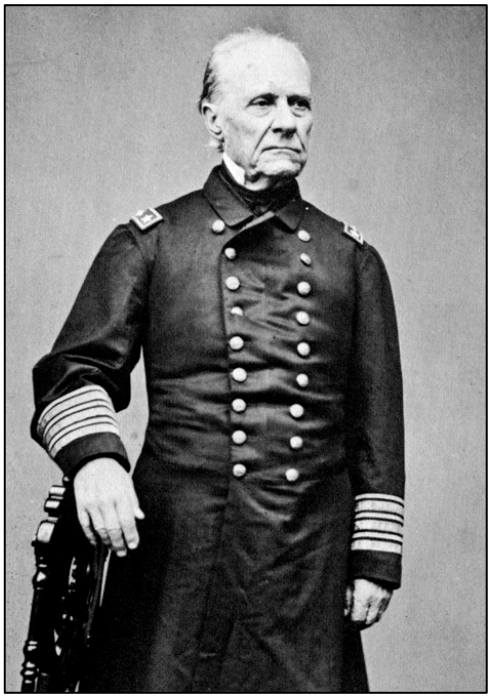


Figure 5. Commodore William B. Shubrick in a photograph taken during the Civil War, which was after his leadership with the USLHB. Photo: Library of Congress, LC-DIG-cwpb-05306.

Despite his faults and unwavering obstruction of technological progress, whether knowingly or unknowingly, Pleasonton thriftily expanded the number of navigational aids in the United States from fifty-five lighthouses and a few buoys at the beginning of his tenure to 325 lighthouses and lightships and many other buoys, daymarks, range lights, etc.[28]

United States Light-House Board

The USLHB took up their duties immediately upon organization. The country was divided into twelve new lighthouse districts. A centralized work and supply depot was located at Staten Island, NY initially, but a district depot was eventually added for each district (fig. 6).[29]

First District:	Coasts of Maine and New Hampshire. Depot at Portland, ME.
Second District:	Coast of Massachusetts. Depot at Boston Harbor.
Third District:	Coasts of Rhode Island, Connecticut, and New York, the Narragansett and New York Bays, the Providence and Hudson Rivers, the Whitehall Narrows, and Lake Champlain. Depots located at Staten Island, NY and New London, CT.
Fourth District:	Navesink Highlands of New Jersey south to Metomkin Inlet, VA, including all bays. Depot in Christiana, DE.
Fifth District:	Metomkin Inlet, VA south to New River, NC, including the sounds of North Carolina, the Chesapeake Bay, and the James and Potomac Rivers (fig. 8). Depots at Lazaretto Point in Baltimore, MD (fig. 7), Portsmouth, VA, and Washington, NC.
Sixth District:	New River Inlet, NC south to Cape Canaveral, FL. Depot at Charleston, SC.
Seventh District:	Cape Canaveral south to Cedar Keys, FL.

[26] United States Lighthouse Society, "History of the Administration of the Lighthouses in America."
[27] Holland, Jr., "America's Lighthouses: An Illustrated History," p. 35.
[28] United States Lighthouse Society, "History of the Administration of the Lighthouses in America."
[29] Holland, Jr., "America's Lighthouses: An Illustrated History," p. 36.

Eighth District:	Cedar Keys, FL through the coasts of Alabama, Mississippi, Louisiana, and Texas. Depots at Mobile Bay, AL and Southwest Pass, LA.
Ninth District:	Unknown.
Tenth District:	American shores of Lake Erie, Lake Ontario, and the St. Lawrence River.
Eleventh District:	American shores of Lake St. Clair, Lake Huron, Lake Michigan, and Lake Superior. Depot in Detroit, MI.
Twelfth District:	Pacific coast. Depot at San Francisco, CA.[32]

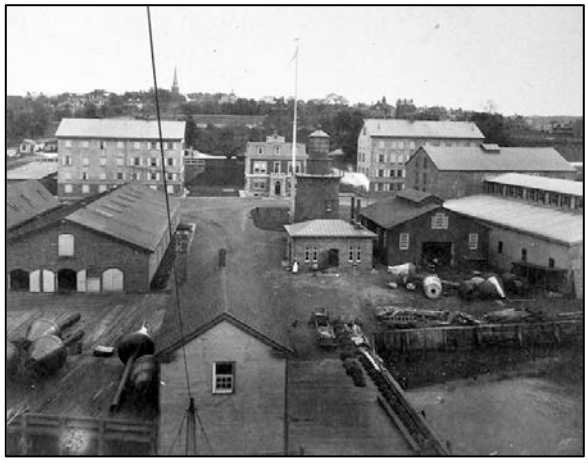


Figure 6. The General Lighthouse Depot located at Staten Island, NY, in ca. 1885. Photo: National Archives.[30]

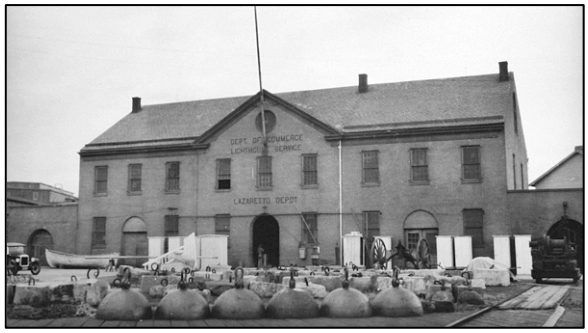


Figure 7. The Fifth District Lighthouse Depot located at Lazaretto Point in Baltimore, MD. Date unknown. Photo: Source unknown.[31]

An inspector—an Army or Navy officer—was placed in charge of each district and had the responsibility of building lighthouse; keeping the lighthouses in repair; and purchasing, installation, and repairing the illuminating apparatuses. Within a few years, the board realized that the inspectors needed assistance, and assigned an engineer to each district. The inspector, still a Navy officer, was the general superintendent of the lighthouses in his district and was responsible for disbursing funds for salaries and supplies and ensuring the keepers performed their duties adequately. He also inspected each light station every three months and reported on its condition and if any repairs were needed. The engineer, an Army officer, was responsible for the construction of new light stations and the repair of old ones. The local collectors of customs, the original superintendents of lights, were retained for some time, but they had reduced responsibilities, which were mostly financial and administrative.[33]

In addition, the board divided its function among five committees in order to direct correspondence pertaining to the subjects to those committees. The committees included: Finance, Engineering, Light Vessels (and Buoys), Lighting, and Experiments. The board could then concentrate its efforts more broadly.[34]

THE USLHB took immediate steps to replace all of the extant, unsuitable lenses and reflector systems in the lighthouses with Fresnel lenses. The first step was to determine which lenses would go where. The Cape Hatteras Lighthouse was at the top of the list. Alexander A. Bartlett was sent to

[30] Accessed at http://lighthousehistory.info/2014/08/06/national-lighthouse-museum-opens-on-staten-island/ on October 21, 2015.
[31] Accessed at http://www.lighthousefriends.com/lazaretto_depot.jpg on October 21, 2015.
[32] United States Light-House Board. *Annual Report of the Light-House Board of the United States to the Secretary of the Treasury for the Fiscal Year Ended June 30, 1872.* Washington: Government Printing Office, 1872. Accessed at https://books.google.com/books?id=0Dw5AQAAMAAJ&pg=PA2#v=onepage&q&f=false on October 21, 2015.
United States Light-House Board. *Annual Report of the Light-House Board of the United States to the Secretary of the Treasury for the Fiscal Year Ended June 30, 1874.* Washington: Government Printing Office, 1874. Accessed at https://books.google.com/books?id=pZdIAQAAIAAJ&pg=PP12#v=onepage&q&f=true on October 21, 2015.
[33] Holland, Jr., "America's Lighthouses: An Illustrated History," p. 36.
[34] Marshall, "Frequently Close to the Point of Peril: A history of Buoys and Tenders in U.S. Coastal Waters, 1789-1939."

France as a special agent to mend relations with the lens makers, which had gone sour due to complications with Pleasonton, and order new lenses. Eight lenses would be sent to California, the ninth would be used at Cape Hatteras, after a short stint on display at the Exhibition of the Industry of All Nations in New York in 1853 (see Chronology of Development and Use section for more information). All further lens orders for the United States would be split between Lepaute and Sautter. The Board in turn prioritized which lighthouses received new lenses first.[35] By 1859, Fresnel lenses had been installed in all American lighthouses.[36] This accomplishment prompted Board President Commodore Shubrick and Board Secretary Thornton Jenkins to leave the USLHB.[37]

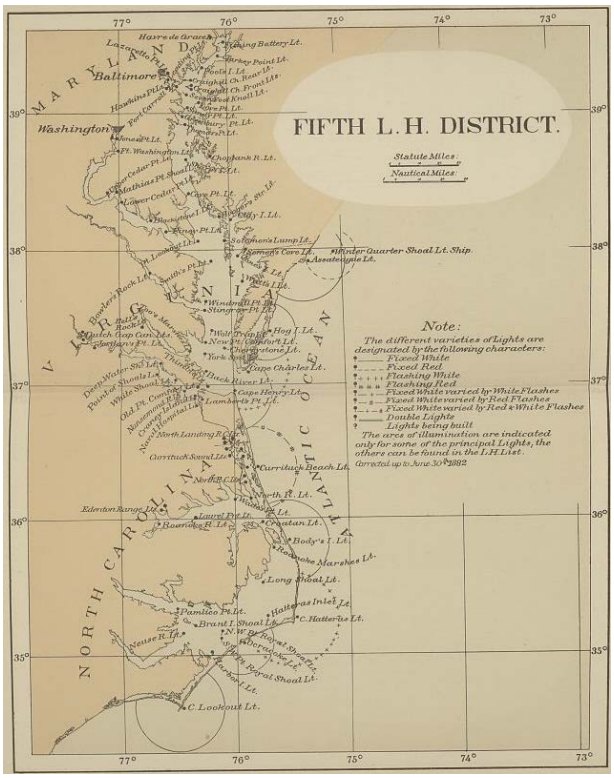


Figure 8. A map of the Fifth Light-House District from 1882, by the USLHB. Map: Library of Congress Catalog No. 2005688354.

Prior to the Civil War, the USLHB was nearing its heyday. The lens modernization was nearing completion; inefficient lightships had been replaced by screw-pile lighthouses; and where possible, new taller first-order lighthouses had been constructed with only about six yet to be constructed.[38]

The Civil War began on April 12, 1861. Seven days later, President Abraham Lincoln enacted a blockade of the Southern coast in order to hinder the Confederacy from importing "arms, munitions, iron plating for armored ships, ship engines and machinery, rail iron, railroad locomotives and cars, boots, cloth, niter, and other manufactured goods" and exporting cotton, their chief source of revenue, to northern states and Europe. In response, the Confederacy extinguished all the lights in its lighthouses by April 24. This caused the blockade to flounder early on as the Union scrambled to assemble a fleet and the Confederates, familiar with the hidden hazards of the coast, slipped easily through the blockade.[39]

A Confederate States Lighthouse Bureau (CSLB) was developed and headed by Raphael Semmes, the man who had succeeded Shubrick at the USLHB. The CSLB was short-lived, with Semmes' only legitimate action being the organization of the Confederacy into four lighthouse districts. Semmes held office April 4-18, before returning to active service. The Board would continue on through the end of the war only administratively.[40]

[35] Levitt, "A Short, Bright Flash," pp. 164-171.
[36] United States Lighthouse Society. "History of the Administration of the Lighthouses in America."
[37] Levitt, "A Short, Bright Flash," p. 183.
[38] Cipra, David. "The Confederate States Lighthouse Bureau." United States Lighthouse Society. Accessed at http://uslhs.org/confederate-states-lighthouse-bureau-david-cipra on October 21, 2015.
[39] Levitt, "A Short, Bright Flash," p. 183.
[40] Cipra, "The Confederate States Lighthouse Bureau."

The following is a summary of the result of the Civil War on southern lighthouses:

> Lighthouses in the southern states suffered badly during the Civil War. A great many were partially or totally destroyed. In some cases the Confederates removed the lenses from the towers, hiding them until after the war was over. Nearly all the lightships in the Chesapeake were taken or sunk to obstruct various channels. Some 164 lighthouses were, in one way or another, placed out of commission during the hostilities. The management of the service also suffered as naval and army offers were reassigned to the military duties. The board tried to cooperate with the naval forces by relighting as many towers as was possible.[41]

After the war ended, the USLHB started the process of reestablishing the 164 lighthouses which had been darkened or destroyed by the Confederates. This included finding lenses which had been removed and hidden during the war.[42]

Attempts were made at reorganizing the USLHB during the latter half of the nineteenth century. In 1862, a bill was introduced in the Senate which would transfer the Board to the Department of the Navy. Admiral Shubrick made it quite clear that idea was unfounded and the bill failed. Between 1882 and 1885 an attempt was made to combine the USLHB, the Life Saving Service and the Coast Survey into one entity in the Department of the Navy. This too was thwarted.[43]

The number of lighthouse districts expanded as more navigational aids were added and land was developed. Congress expanded the USLHB's jurisdiction over the Mississippi, Ohio, and Missouri Rivers in 1874, which included two new districts for a total of fourteen. And in 1886, the number of lighthouse districts was increased to sixteen (fig. 9).[44]

The Board continued under the Department of the Treasury until 1903. At that time it was transferred to the Department of Commerce.[45]

Another reorganization occurred in June 1910 when the United States Light House Service, also known as the Bureau of Lighthouses, was formed under the Department of Commerce. Congress believed a pyramid organizational structure would be more efficient than the extant nine-member USLHB. Additionally, they believed that having military officers serve as district inspectors and engineers caused a "loss of continuity." A civilian inspector could provide continuity if able to serve for many years.[46]

Although some historians disagree on the exact cause of the reorganization, it is easily recognized that the United States Light-House Board had accomplished a significant amount of work. Between 1852 and 1910, the total number of lighted aids had increased from 335 to nearly four thousand (including minor lights and light buoys); the number of fog signals had increased from forty-nine to 457; and the number of buoys had increased from one thousand to 5,300.[47]

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[41] United States Lighthouse Society, "History of the Administration of the Lighthouses in America."
[42] Levitt, "A Short, Bright Flash," pp. 210-213.
[43] United States Lighthouse Society, "History of the Administration of the Lighthouses in America."
[44] Ibid.
[45] Marshall, "Frequently Close to the Point of Peril: A history of Buoys and Tenders in U.S. Coastal Waters, 1789-1939."
[46] United States Lighthouse Society, "History of the Administration of the Lighthouses in America."
[47] Marshall, "Frequently Close to the Point of Peril: A history of Buoys and Tenders in U.S. Coastal Waters, 1789-1939." Holland, Jr., "America's Lighthouses: An Illustrated History." p. 36.

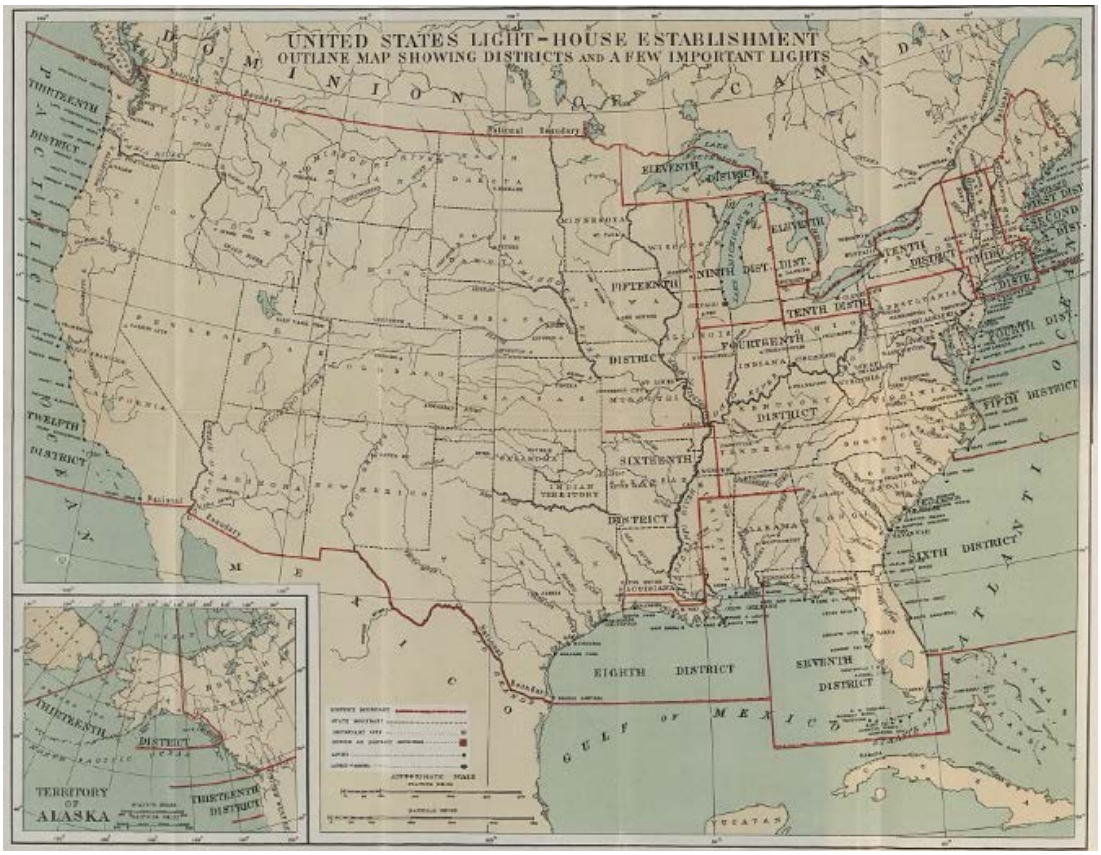


Figure 9. An 1896 map showing the division of the lighthouse districts at that time. Map: Library of Congress Catalog No. 2006678401.

United States Light House Service

George R. Putman was chosen to head the new bureau as the "Commissioner of Lighthouses." A non-military man, he had spent his professional career with the U.S. Coast and Geodetic Survey. At the same time, the USLHS established new districts in Puerto Rico, Alaska, and Hawaii (eighteen total districts). Each of the districts was managed by a single District Inspector (changed to District Superintendent in 1918). Each district also had an assistant, clerk, and engineer.[49]

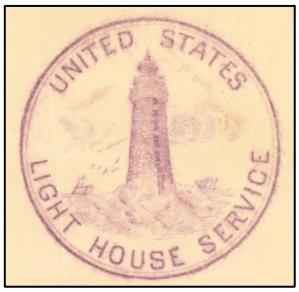


Figure 10. The seal of the USLHS. Photo: United States Coast Guard.[48]

As the United States prepared to enter World War I, arrangements were made to transfer the Light House Service to the War Department and the Navy. An April 1, 1917 executive order mandated that thirty tenders and the people associated with them be transferred to the War Department, as well as fifteen tenders, twenty-one light stations, four light vessels and the people associated with them be transferred to the Navy. The Navy required that USLHS personnel at light stations report any submarine and surface vessel sightings on a continual basis.[50]

[48] Accessed at http://www.uscg.mil/history/gifs/USLHSseal.jpg on October 21, 2015.
[49] United States Lighthouse Society, "History of the Administration of the Lighthouses in America."
[50] Marshall, "Frequently Close to the Point of Peril: A history of Buoys and Tenders in U.S. Coastal Waters, 1789-1939."

Putman retired on May 31, 1935. During his highly successful tenure, the number of navigational aids more than doubled and the number of employees decreased by nearly twenty percent due to the adoption of automatic navigational aids and other technological advancements. These advancements included the introduction of radio beacons, the use of electric buoys, and the application of electricity to fog signals. In addition, Putnam was instrumental in having a retirement system for USLHS field and lightship employees enacted by Congress in 1918.[51]

Putnam was replaced by H.D. King, a former district superintendent, who would serve as Commissioner until the Presidential Reorganization Act of 1939.[52] The USLHS was transferred to and consolidated with the United States Coast Guard (USCG), again under the Department of the Treasury on July 1, 1939.[53]

United States Coast Guard Management

After the reorganization, former USLHS employees were given the choice to either remain in civilian status or transfer to a military position in the USCG, with no loss of pay.[54] Keepers who transferred were given petty officer rank. Those who remained in civilian status were eligible for the draft in the ensuing World War II.[55]

Automation of the light stations was in full swing during the 1960s. During the 1970s, all but one civilian keeper had retired and most of the light stations were unmanned. Soon after 1989, all light stations were unmanned.[56] Despite automation and the departure from the traditional use of the lighthouses, historians agree that the Coast Guard has maintained the light stations effectively and efficiently.

Lighthouse Lights

The history of lighthouse lights can be traced back to Alexandria, Egypt and the lighthouse built there in 280 BC. Its light was an open flame. This report will fast forward to a more modern era and the introduction of lamps which coincides with the development of the lighthouse establishment in the United States.

Early Lamps

Early lamps used solid, circular wicks or flat wicks, which caused smoke to dirty the interior of the lantern glass. In 1790, a new lamp was introduced which had a pan of oil with four wicks protruding from it (first placed at the Boston Light). Because of acrid fumes which burned a keeper's eyes and nose, keepers could not stay in the lantern room for long. Unfortunately these lamps would be used until 1812 when they were replaced by Winslow Lewis' lamps.[57]

[51] Holland, Jr., "America's Lighthouses: An Illustrated History." p. 38.
[52] United States Lighthouse Society, "History of the Administration of the Lighthouses in America."
[53] Holland, Jr., "America's Lighthouses: An Illustrated History." p. 38.
[54] Ibid.
[55] United States Lighthouse Society, "History of the Administration of the Lighthouses in America."
[56] Ibid.
[57] Holland, Jr., "America's Lighthouses: An Illustrated History." pp. 13-14.

Meanwhile in Switzerland, Francois Pierre Ami Argand invented a lamp which had a hollow cylindrical wick (fig. 11). Because oxygen could pass along the inside and outside of the wick, the flame burned more intensely, brighter (one wick was equivalent to seven candles), and smokeless. England began installing Argand lamps, outfitted with fifteen- to twenty-inch parabolic reflectors, in their lighthouses in 1789.[58]

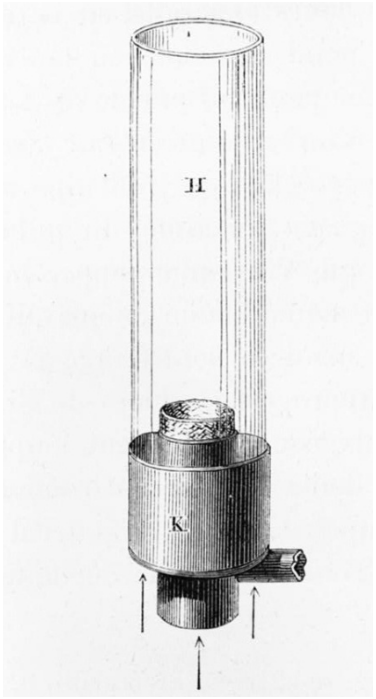


Figure 11. Argand's lamp included a hollow wick. Photo: Library of Congress, LC-USZ62-110395.

Winslow Lewis' Parabolic Reflector

In 1810, after several years of independent research and experimentation, Winslow Lewis revealed his version of the Argand lamp with parabolic reflector which he claimed was superior to and used half as much oil as the older four-wick pan lamps. After he patented his design, he offered to sell the patent to the United States government. Henry Dearborn, the collector of customs in Boston, after seeing a demonstration of the Lewis lamp, urged Secretary of the Treasury Albert Gallatin to purchase the patent. In 1812, Congress appropriated $60,000 to pay Lewis for his patent. The appropriation also called for Lewis to outfit the nation's forty-nine lighthouses with his lamps and maintain them for seven years.[60]

Lewis completed forty of the lighthouses prior to the beginning of the War of 1812. The remaining nine were completed by the fall of 1815. Upon installation, Lewis also fitted a glass lens to the front of each lamp (fig. 12). The lens had a greenish tint which diminished the light. It would take until 1840 to remove all of the defective "green" lenses. Lewis' installed reflectors were also a problem. Intended to be parabolic, most were reported not to be; in addition, they were so thin so as to be easily warped from regular use and cleaning.[61] Despite these issues, the Lewis lamps would stay in federal lighthouses through at least 1852 when Congress mandated that the U.S. Light-House Establishment be replaced by the U.S. Light-House Service and significant reforms occurred.

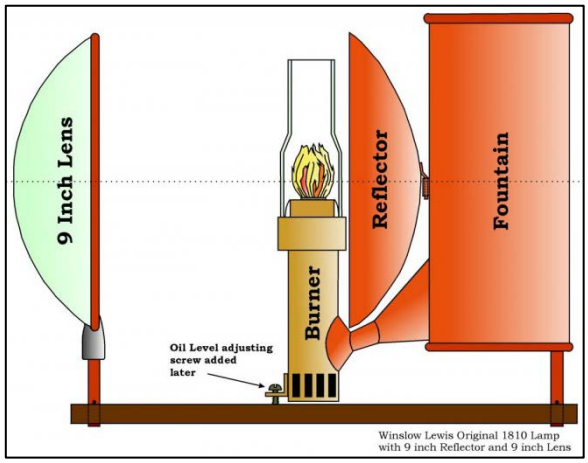


Figure 12. A diagram showing Winslow Lewis's parabolic reflector, Argand-style lamp, and glass lens. Source: U.S. Lighthouse Society.[59]

Historians disagree and hold their own hypotheses on the reason why Winslow Lewis held so much sway with the leadership at the USLHE, particularly Fifth Auditor Stephen Pleasonton. What is clear, unlike Lewis' lenses, is that this relationship deterred the integration

[58] Holland, Jr., "America's Lighthouses: An Illustrated History." p. 14.
[59] Accessed at http://uslhs.org/american-lighthouse-lamp-identification-document on October 21, 2015.
[60] Holland, Jr., "America's Lighthouses: An Illustrated History." pp. 14-15.
[61] Ibid, pp. 15-16.

of significant technological advances to lighthouses in the United States, particularly the use of Fresnel lenses.

The Fresnel Lens

From an early age, Augustin-Jean Fresnel, born in France in 1788, was an experimenter and labelled a genius by childhood friends (fig. 13). After graduation from the *Ecole nationale des ponts et chausses* (National School of Bridges and Highways) in 1809, he became an engineer for France. His interest in optics began when he met Francois Arago, a French mathematician and physicist who worked for the *Academie des sciences*. After the meeting, Fresnel began experiments on optics, wave theory, and diffraction, and made significant discoveries. These discoveries won Arago's support, and an inside route to the *Academie,* resulting in Fresnel winning the Grand Prize in diffraction from the *Academie* in 1819. As a result of his success, Fresnel was assigned to the *Commission des phares,* or the French Lighthouse Commission. [64]



Figure 13. Monsieur Fresnel.[62]

Fresnel's first big innovation soon followed. He quickly determined that the reflectors used in lighthouses should be removed for several reasons: mirrors were never perfectly reflective, a parabolic form was hard to perfect, a reflector required a hole through it for the lamp, and half of the light source was lost by absorption. Alternatively, Fresnel placed a lens in front of a single light source. Refraction caused all the light from a source to be directed into a beam. The main problem was that in order to get enough light, the lenses would have to be composed of angled, prism glass (fig. 14). This type of glass would be hard to come by and was Fresnel's first step in building a large prototype. It would take him over a year to construct a sufficient prototype, but in 1821, Fresnel unveiled his dioptric lens for display. That night, witnesses could not deny that the new lens caused a much brighter light that was far superior to the former technology. [65]

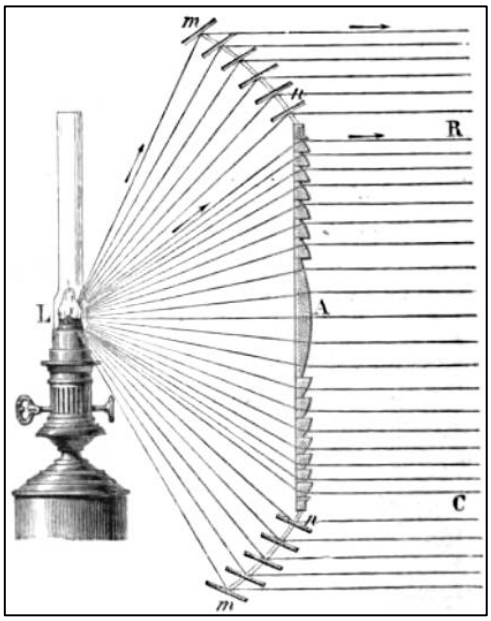


Figure 14. Fresnel placed a dioptric lens in front of a light source which refracted the light into beams.[63]

The Lighthouse Commission chose the lighthouse at

[62] Accessed at https://en.wikipedia.org/wiki/Augustin-Jean_Fresnel#/media/File:Augustin_Fresnel.jpg on October 22, 2015.
[63] Ganot, Adolphe. "Natural Philosophy for General Readers and Young Persons. New York: Appleton & Co., 1872, p. 328. Accessed at https://en.wikipedia.org/wiki/Fresnel_lens#/media/File:Fresnel_lighthouse_lens_diagram.png on October 22, 2015.
[64] Levitt, "A Short, Bright Flash," pp. 21-47.
[65] Ibid, pp. 49-66.

Cordouan to be the first to receive a Fresnel lens. For this, Fresnel completed a second prototype, one with annular glass that rotated (fig. 15). An official test of the dioptric apparatus was done in 1822, and installation in the lighthouse was completed the next year.[66]

After this, Fresnel continued to experiment and test new ideas, including the development of the catadioptric apparatus (fig. 16). This apparatus retained the refracting dioptric lenses of his second prototype and added reflecting catoptric lenses (prisms). Together the lenses used every portion of the radiating light source. By 1827, eight employees worked in Fresnel's workshop, with their main goal to develop the perfect catadioptric lens. Glass production remained the key problem.[67]

In July 1827, Fresnel died of tuberculosis, at the age of thirty nine. Prior to his death, Augustin had his brother, Leonor, transferred to the Lighthouse Commission. After Augustin's death, Leonor was appointed to his brother's former position as Secretary of the *Commission des phares*. Leonor would continue to honor his brother's memory, ambition, and desires for the next twenty years.[68]

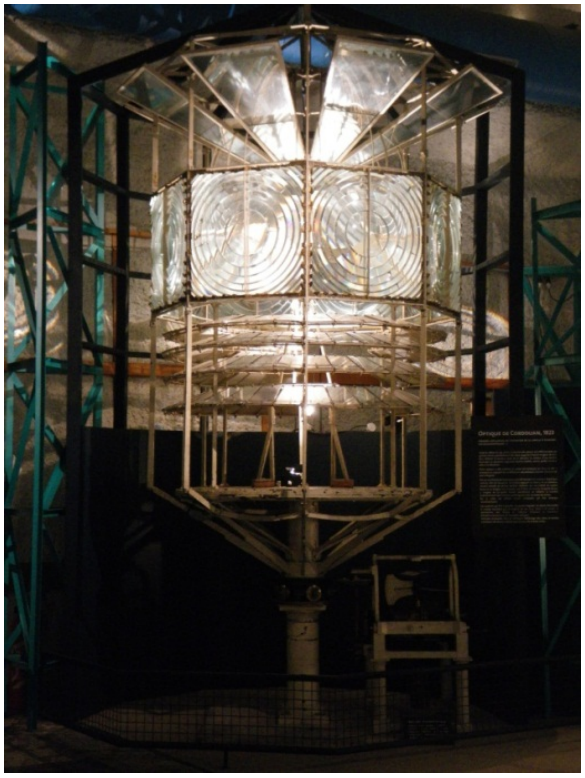


Figure 15. The first Fresnel lens used at Cordouan Lighthouse. Photo: *Musee des Phares et Balises de Ouessant, Phare du Creac'h*.[69]

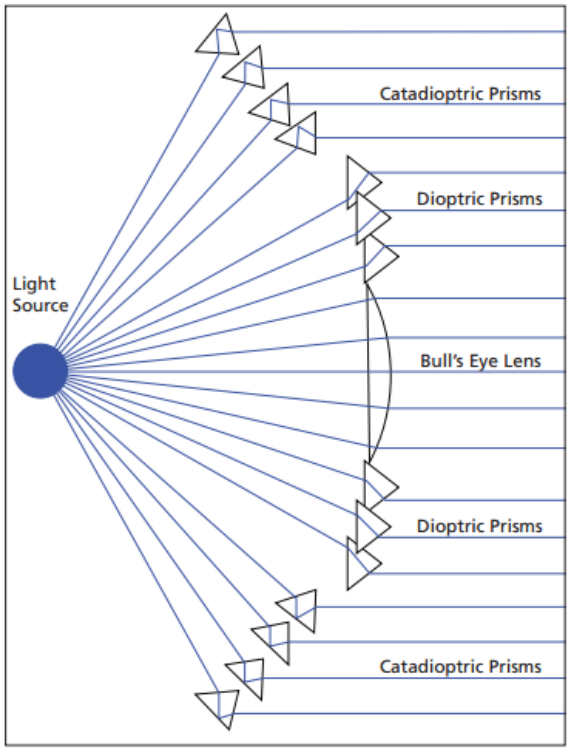


Figure 16. A rendering of how a Fresnel lens works. Fresnel developed the technology to bend light from the source into perfectly parallel beams through prisms. Dioptric prisms bent the light once. Catadioptic prisms bent the light twice. Drawing: NPS, "The Historic Point Reyes Lighthouse."[70]

[66] Ibid, pp. 67-77.
[67] Ibid, pp. 80-95.
[68] Ibid, pp. 97-99.
[69] Accessed at http://www.cordouan.culture.fr/accessible/en/uc/04_02_04-Cordouan's%20first%20lens on October 22, 2015.
[70] Accessed at http://www.nps.gov/pore/planyourvisit/upload/brochure_lighthouse.pdf on August 26, 2015.

Despite his life being cut short, Augustin Fresnel was able to completely revolutionize lighthouse lens technology. Soon after his death, his lenses spread throughout the world, particularly once the glass prisms required to make a perfect catadioptric lens could be made using steam power.

Fresnel had devised seven orders, or sizes, of lenses for lighthouses, depending upon the amount of light that was needed (figs. 17-18). First-Order lenses were used in the largest seacoast lighthouses; the smallest Sixth-Order lenses were used in harbors.[72]

In 1838, Pleasonton relented to Congress when they sent Commodore Perry to Europe to procure two Fresnel lenses (a first-order fixed lens, and a second-order revolving lens) for experimentation purposes. The lenses were installed at the twin towers at the Navesink Highlands in New Jersey in 1840 and proved to be far superior to the lighthouses which had Lewis lamps. Still, Pleasonton was not convinced. It would take two more acts of Congress to install two more Fresnel lenses in American lighthouses during Pleasonton's tenure. These were the 1850 Sankaty Head Light Station on Nantucket Island, MA and the 1850 Brandywine lighthouse in Delaware Bay.[73]

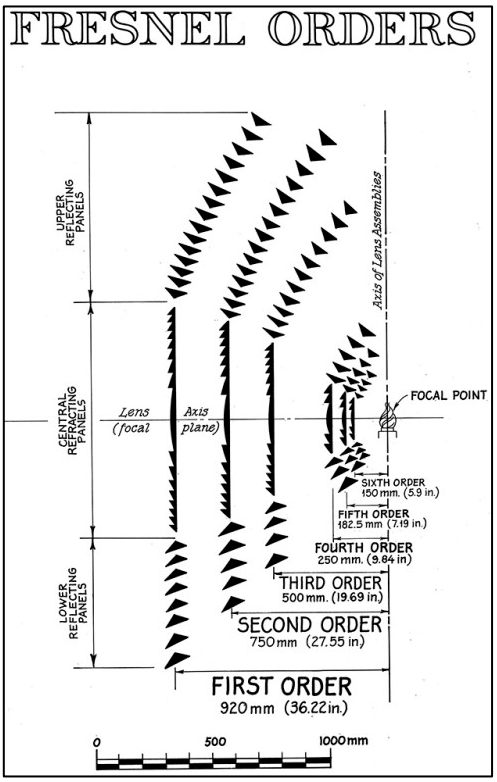


Figure 17. The six Fresnel lens sizes. The dioptric lens is labeled as the central refracting panels. The catoptric lenses are labeled as the upper and lower reflecting panels. Table: Spring Point Ledge Lighthouse.[71]

COMPARATIVE TABLE OF LENS ORDERS

ORIGINAL FRESNEL ORDERS			OIL CONSUMPTION PER HOUR		RELATIVE BRIGHTNESS (6TH ORDER=1)	MODERN LENS ORDERS (U.S.A.)	FOCAL LENGTH		HEIGHT OF COMPONENTS								APPROXIMATE WEIGHT OF ASSEMBLED LENS		USE
ORDER		Nº OF LAMP WICKS							LOWER REFLECTOR		CENTRAL REFRACTOR		UPPER REFLECTOR		TOTAL				
			gm.	oz.			mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm	in.	kg.	lbs.	
1ST		4	750	26.25	17.69	1ST	920	36.22	539	21.22	980	38.58	1001	39.40	2590	101.97	5800	12,800	LARGEST SEACOAST LIGHTS
2ND		3	500	17.5	11.54	2ND	750	27.55	378	14.88	854	33.62	810	31.89	2069	81.46	1600	3,530	GREAT LAKES LIGHTHOUSES, SEACOASTS ISLANDS, SOUNDS
3RD	LARGE	2	200	7	3.85	3RD	500	19.69	278	10.94	660	25.98	593	23.35	1576	62.05	900	1,985	SEACOAST, SOUNDS RIVER ENTRY, BAYS, CHANNELS, RANGE LIGHTS
	SMALL	1	150	5.25	2.31	4TH	250	9.84	144	5.67	300	11.81	358	14.09	722	28.43	200 TO 300	440 TO 660	SHOALS, REEFS, HARBOR LIGHTS, ISLANDS IN RIVERS AND HARBORS
4TH	LARGE	2	90	3.15	1.23	5TH	182.5	7.19	105	4.13	226	8.90	196	7.72	541	21.30	120 TO 200	265 TO 440	BREAKWATERS RIVER LIGHTS CHANNEL, SMALL ISLANDS IN SOUNDS.
	SMALL	1	90	3.15	1	6TH	150	5.9	84	3.31	180	7.09	157	6.18	433	17.05	100	220	PIER OR BREAKWATER LIGHTS IN HARBORS.

Figure 18. A comparison of Fresnel lens orders. See Figure 16 for source information.

[71] Accessed at http://springpointlight.org/explore/lenses/ on October 22, 2015.
[72] Holland, Jr., "America's Lighthouses: An Illustrated History," p. 18.
[73] Ibid, p. 18.

In 1851, Congress asked an interim board to investigate all aspects of the extant USLHE and the board made several recommendations. Regarding lighthouse lenses, the board, found the extant system to be "of a description now nearly obsolete throughout all maritime countries, where the best apparatus of that description was employed, prior to the introduction of the Fresnel lens, as substitutes." They recommended that Fresnel lenses be used as they were "greatly superior to any other mode of light-house illumination, and in point of economy is nearly four times as advantageous as the best system of reflectors and Argand lamps." After this report, Congress made the interim board the permanent United States Light-House Board and stipulated that Fresnel lenses be used in all new lighthouses and any lighthouses where new apparatuses were needed.[74]

[74] Ibid, p. 19.

Chronology of Development and Use

The First Lighthouse

On March 28, 1792, the United States Senate directed Secretary of the Treasury Alexander Hamilton "to inquire into the expediency…of erecting a light house at Occracok [sic] island, or elsewhere, near the entrances of Occracok [sic] Inlet, & an estimate of the probable expense…."[1]

Hamilton then instructed Tench Coxe, "the Commissioner of Revenue (who is charged with the immediate care of that branch of the Treasury business which respects Light House Establishments) to make the proper inquiries concerning the subject of it." Because Hamilton had,

> …for a long time entertained an opinion that a Lighthouse on some part of Cape Hatteras would be an establishment of very general utility to the navigation of the united states, [Hamilton] judged it a fit occasion to unite with an examination of the scene indicated by the order an examination of the situations on the Cape adapted to a Light House and of such other circumstances as were necessary to be attended to in forming a judgment of the practicability and expediency of erecting and maintaining a Light House on the Cape. And accordingly [Hamilton] charged the Commissioner with the collateral inquiry likewise.[2]

On February 20, 1794, Hamilton submitted the "Report Relative to a Lighthouse on Cape Hatteras" to the President of the Senate which included a letter from the Commissioner of Revenue (Coxe) and an estimate for the erection of a lighthouse at Cape Hatteras, of which Hamilton supported.[3]

On May 13, 1794, the following act was approved by President George Washington:

> Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That as soon as the jurisdiction of so much of the head-land of Cape Hatteras, in the State of North Carolina, as the President of the United States shall deem sufficient and most proper for the convenience and accommodation of a light-house, shall have been ceded to the United States, it shall be the duty of the Secretary of the Treasury to provide contract, which shall be approved by the President of the United States, for building the light-house thereon of the first rate, and furnishing the same with all necessary supplies, and also to agree for the salaries or wages of the person or persons who may be appointed by the President for the superintendence and care of building said light-house: and the President is hereby authorized to make said appointments. That the number and disposition of the lights in the said light-house shall be such as may tend to distinguish it from others, and as far as practicable to prevent mistakes in navigators.[4]

At its July 1794 session the North Carolina legislature passed "An Act to cede to the United States of America certain lands, upon condition therein mentioned," which granted to the United States

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[1] Hamilton, Alexander (Secretary of the Treasury). *Letter to President of the Senate.* "Report Relative to a Lighthouse on Cape Hatteras." February 20, 1794. Accessed at http://founders.archives.gov/documents/Hamilton/01-16-02-0038 on July 21, 2015.
[2] Ibid.
[3] Ibid.
[4] "Laws of the United States Relating to the Establishment, Support, and Management of the Light-Houses, Light-Vessels, Monuments, Beacons, Spindles, Buoys, and Public Piers of the United States. From August 7, 1789 to March 3, 1855." *Compiled by Order of the Light-House Board, June 30, 1855.* Washington: A.O.P. Nicholson, Public Printer, 1855. pp. 7-8. Accessed at https://books.google.com/books?id=OGdYAAAAYAAJ&dq=Shell+Castle+beacon&source=gbs_navlinks_s on July 13, 2015.

exclusive jurisdiction over Beacon Island in the harbor of Ocracoke Inlet and four acres of land at the headland of Cape Hatteras.[5]

On July 10, 1797, $44,000 was appropriated "for erecting a light-house on the head land of Cape Hatteras and a lighted beacon on Shell Castle Island, in the Harbor of Ocracoke, in the State of North Carolina." The appropriated money was expended in 1798-99. Additional appropriations "for the payment of contracts" were later made on May 7, 1800 for $35,698 for years 1800-3 and on March 2, 1803 for $1,000 for years 1804-5.[6]

On October 26, 1798, "four acres were purchased for $50 from William Jennett, Mary Jennett, Jabez Jennett, Aquilla Jennett, and Christian Jennett (designated guardian of minors under twenty-one years of age)...for the Cape Hatteras Light Station."[7] Unfortunately, by the time the land transfer was completed "the three-year limit on the legislation authorizing [Coxe's] efforts had expired, and he had to begin the process all over again."[8]

Meanwhile the Federal Government attempted to pinpoint a contractor interested in constructing the Cape Hatteras Lighthouse and the Shell Castle Island beacon. When locals displayed no interest in the work, Coxe posted advertisements in various government offices from Maine to North Carolina and asked collectors in North Carolina, Virginia, Maryland, New York, Connecticut, and Massachusetts to take out newspaper advertisements for bidders. Because of these efforts, several bids were received. After review of the various bids, Coxe found none acceptable.[9]

Finally in July 1797, recently retired Massachusetts congressman Henry Dearborn wrote to Coxe stating he was interested in building the Cape Hatteras and Shell Castle Island lighthouses. He later submitted a bid to Coxe. In late September of that year, the bids of Dearborn and two others were forwarded to President John Adams for review and approval. Coxe was so confident that Dearborn's proposal would be chosen that Coxe ordered the Collector of Customs in Edenton, NC to purchase the required land for both lighthouses.

Unfortunately, Coxe was removed as the Commissioner of Revenue before President Adams could approve any contract. Coxe was succeeded by William Miller, Jr., who felt Dearborn's proposal lacked key details on transportation, stone, and foundation work. Consequently, in February 1798, President Adams disapproved the contract. Miller then contacted Dearborn to say that a new contract should be written to provide additional details. Miller also contacted another former bidder to see if he might still be interested in bidding, but the former bidder declined.

During the fall of 1798, Dearborn submitted a final proposal which the President accepted.[10] On

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[5] Hamilton, *Letter to President of Senate,* 02/20/1794.

[6] From "Statement of Appropriations, &c." from March 4, 1789, to June 30, 1882. Published in 1888. Photocopy located in Cape Hatteras Light Station Engineer # 1 Binder, Section: Annual Reports, at Cape Hatteras National Seashore Archives, Manteo, NC.

[7] National Park Service. "Cape Hatteras Light Station Cultural Landscape Report." Southeast Region. Cultural Resources. 2003. p. 8.

[8] Yocum, Thomas, Bruce Roberts, and Cheryl Shelton-Roberts. "Cape Hatteras: America's Lighthouse." Nashville, TN: Cumberland House, 1999. p. 8.

[9] This section is a summary of the construction and early years of service of the first lighthouse by National Park Service historian Frances Ross Holland, Jr. See Appendix E for a complete transcription of the document.
Holland, Jr., F. Ross. "A History of the Cape Hatteras Light Station, Cape Hatteras National Seashore, N. Car." Division of History, Office of Archeology and Historic Preservation, National Par k Service, U.S., Department of the Interior. September 30, 1968.

[10] A transcription of Dearborn's proposal can be found in Appendix E.

October 9, 1978, Miller forwarded to Dearborn articles of agreement for signature. On October 31, Dearborn signed the contract; the contract was signed by the federal government on February 14, 1799.

Dearborn immediately began planning the project. In late November 1798, Dearborn requested and received an advance of $8,000 to buy materials for the lighthouses. By late spring 1799, he was prepared to begin transporting materials to the Outer Banks, but due to delays he was unable to begin until August. Further delayed by a shipping accident, Dearborn and the materials did not arrive at Shell Castle Island until the end of August. After a brief stay, Dearborn travelled to Cape Hatteras to begin the construction of the keeper's quarters there. Leaving men at Cape Hatteras, Dearborn returned to Shell Castle Island to meet Collector Samuel Tredwell from Edenton, who was to oversee the work of the contractor.

By October 1799, work at both locations was progressing well and Dearborn received his first payment of $2,000. Two months later, he received another payment of $4,000. Soon after, in advance of the winter season, Dearborn and his crew left the Outer Banks.

In March 1800, Dearborn and his construction crew returned to Cape Hatteras and began work on the foundation of the lighthouse. By May, a hole had been dug eight feet below grade, and the first course of stone of the lighthouse's base had been laid. By the beginning of July, two inspectors reported that the tower had reached twelve feet above grade and the framing for the second floor had been completed. Dearborn then received a payment of $2,500.

Before the end of July, many of the workers became ill and one died. Dearborn left the site, and placed Dudley Hobart in charge. By fall, Hobart sent the remaining men home. At this point, Shell Castle Island beacon was complete, except the lantern and its keeper's quarters was nearly complete. At Cape Hatteras, the keeper's quarters was complete, as was a well, but the tower was not.

Around the same time, Collector Tredwell reported the 29'-0"-diameter foundation began 9'-0" below grade; from the bottom of the foundation to 4'-0" high, the foundation was solid masonry; from this to the water table, the wall was 9'-0" thick; the first floor was complete (12'-0" high) to the send-floor framing; the exterior stone was hammer dressed, 0'-10" thick, and 1'-0" to 4'-0" long. This description would later be contradicted when investigation of this lighthouse was completed before its demolition in 1871. The superintendent of construction of the new 1870 lighthouse noted the following about the 1803 lighthouse: foundation was 9'-0" deep and built of slate stone with thicknesses of 0'-2" to 0'-6", set in lime mortar; only 1'0" larger at bottom of foundation than at the top; diameter of tower base was 26'-6" with walls 5'-6" thick; lime mortar was very soft; foundation stones laid directly on sand without a timber mat beneath.

In October 1800, Dearborn asked for an additional payment of $4,000 to $6,000. Commissioner Miller was sympathetic to Dearborn's issues on site, and passed his request on to the Secretary of the Treasury. Wolcott approved the payment of $4,000. In December, Dearborn asked for another $1,500, and in March 1801 another $3,000. Both of these payments were also approved. At this point, Dearborn had received $30,200 of the $38,450 stipulated in the contract (78.5%), despite the remaining work to be completed.

Dearborn's workers returned to Cape Hatteras during the spring of 1801. In the meantime, Dearborn was appointed Secretary of War by Thomas Jefferson. He would hold this position until 1809.

Around August 1, 1801, the workers departed Cape Hatteras, again likely due to illness. They returned during the spring of 1802. In June, Dearborn's on-site representative, Dudley Hobart, reported that the masons had completed their work. The lanterns for both lighthouses were needed to complete the contract. In August 1802, Hobart reported that the lighthouses were completed, but lights had not been raised (lit). Apparently, the raising was delayed for a while, but occurred by October 29, 1803 (fig. 19).



Figure 19. From left to right: the unpainted 1803 brick tower, the 1854 renovated tower with expanded height and new daymark paint, and the newest 1870 lighthouse with daymark paint completed in 1873. Figure: Graveyard of the Atlantic Museum, poster located in front lobby. Photographed by HPTC.

President Jefferson appointed Adam Gaskin as the first keeper of the Cape Hatteras lighthouse. He assumed his role on December 29, 1802 with an annual salary of $333.

Due to an addition to the contract (to reinforce the foundation at Shell Castle Island lighthouse), Dearborn's contract totaled $39,650. By the fall of 1803, he had obtained $39, 300 of the total (99%). After asking for the remaining amount, the Commissioner denied the request due to the contract not being completely fulfilled (details not known). The contract was not fully settled until May 6, 1824.

During its first couple of years, the Cape Hatteras lighthouse lantern was fueled by porpoise oil. Experiments of its use received mixed reviews and it was eventually replaced with sperm oil.

In 1803, the original oil cisterns were deemed too small and replaced with ones which held two thousand gallons.

On September 2, 1806, a severe gale affected the Outer Banks and damaged the lantern at the lighthouse so badly that the keeper was unable to display the light. The storm affected the area for two weeks, and it took this long for the keeper to get word to the local superintendent of lights. The repairs to the lantern took over a month to complete.

In January 1809, the lamp oil caught fire and destroyed all of the glass in the lantern. Because there was not enough glass on hand to repair the lantern, the keeper had to obtain more from the mainland.

By 1810, the lighthouse needed repairs to several components, including whitewashing the tower, installing new wire for bird netting around the lantern, a new covering for the oil vault, erosion control around the foundation of the tower, and prevention of repeated fires in the lantern.

Around 1815, the federal government entered into a contract with Winslow Lewis of Boston, MA, to update the lighting apparatuses in the country's lighthouses. At Cape Hatteras, Lewis installed eighteen Argand-style lamps and parabolic reflectors on a chandelier in the lantern, which could be rotated via a clockwork mechanism.

Despite the improved quantity of light over the old system and oil-saving qualities of the new lamps, complaints arose during the spring of 1817. The poor-quality light emitted from Cape Hatteras was ultimately blamed on poor-quality oil (also supplied by Lewis).

Further complaints of poor-quality light occurred in late 1819. The Commissioner of Revenue instructed Tredwell to investigate the cause, which proved to be dirty reflectors and lamp chimneys. Unfortunately the complaints continued.

In 1820, the Fifth Auditor of the Treasury, Stephen Pleasonton, assumed the responsibility of the supervision of the country's lighthouses. He too received complaints about the Cape Hatteras lighthouse, including a public complaint by ship masters and merchants in a North Carolina newspaper. This caused Pleasonton to replace the current keeper (Joseph Farrow) with new keeper Pharoah Farrow in April 1821. In addition, Pleasonton reassigned the responsibility of the lighthouse from Edenton, NC Collector Tredwell to the Washington, NC collector, because the latter was in closer proximity to Cape Hatteras.

Before his reassignment, Tredwell suggested that repairs be made to the lighthouse, including backfilling around the foundation with sand and whitewashing the tower. The foundation was backfilled. However, the tower failed to be whitewashed because it was thought to be a waste as it would need to happen again repeatedly.

On July 21, 1828, keeper Pharoah Farrow sold approximately forty acres to the federal government for $200. The new tract was just north of the original lot and would be the site of a new keeper's dwelling and the 1870 lighthouse.

In 1830, keeper Pharoah Farrow was removed from the job because he had been living away from the light station while lighthouse duties had been completed by several of his slaves. He was replaced by Isaac Farrow.

In June 1835, it was reported that the Cape Hatteras Lighthouse was in very poor condition. A new lantern was required to replace the current lantern, which was too small and much deteriorated; the lighthouse's window sills needed to be replaced; and the foundation of the new keeper's quarters needed to be backfilled. Pleasonton authorized the repairs; Lewis received the contract to build the new eighteen-lamp lantern and completed the work by April 1836. A report to Congress in 1838 on the country's lighthouses noted that the Cape Hatteras Lighthouse had eighteen lamps and was in excellent order. In 1840, however, the lamps required replacing again. The exact reason is

unknown.

In 1842, keeper Isaac Farrow died. He was replaced by Joseph Jennett.

In 1847, the lantern door needed to be replaced with a door to include glass and eight reflectors needed to be replaced in the lantern. Winslow Lewis was contracted to make repairs. His work included the installation of a new stone deck on the tower; placement of a new lantern; and outfitting the lantern with fifteen 21-inch reflectors. Afterwards, the collector reported to Pleasonton that the new lantern was a great improvement over the old.

Unfortunately, two storms struck the lighthouse only two months after the repairs were complete. The second storm, on September 7-8, 1846, broke many panes of glass in the lantern and damaged the lightning rod. When it was revealed that there was not enough replacement glass in storage at the lighthouse, Pleasonton was convinced the keeper was irresponsible. New glass was ordered anyway.

In 1850, Pleasonton deemed foundation work at the lighthouse to be very important. His solution was to surround the lighthouse with a 3'-0"-tall board fence 4'-0" from the base. The space between the fence and the lighthouse was to be infilled with brush.

Later in 1850, the lighthouse was again criticized for being poor in quality. The accuser, G.W. Blunt, suggested that the lighthouse had never been whitewashed or painted; the third tier of lamps in the lantern had been removed; the lower tier of lamps was too low; the lantern was uncleanly; and a slave tended the light for the keeper who was often away. Collector R.H.J. Blount defended keeper Joseph Jennett, missing a significant point—the lighthouse was extremely important to ocean navigators.

Interestingly, Pleasonton believed that the poor light emission from the lighthouse was due to the lighthouse being too tall. Due to the prevailing fog that existed at the height of 100'-0", he felt that the light should be located lower at 65'-0". Benjamin Isherwood, chief engineer in the U.S. Navy, was selected to study the lighthouse, the effect of the fog on the light, and whether it should be lowered. Isherwood visited Cape Hatteras in late May or early June 1851. His report stated that the station had nearly new reflectors with clean lamps, the keeper was reputable, the light was sufficient, and that the prevalent fog was indeed a severe problem. Regarding the fog, Isherwood had no suggestions; he simply chalked it up to man's inability to overcome nature. Because of this, Pleasonton was content with doing nothing.

Also in 1851, Lieutenant David D. Porter, U.S. Navy wrote the following about the light station:

> Hatteras Light, the most important on our coast, and, without doubt, the *worst* light in the world. Cape Hatteras is the point made by all vessels going to the south, and also coming from that direction; the current of the Gulf stream runs so close to the outer point of the shoals that vessels double as close round the breakers as possible, to avoid its influence. The only guide they have is the light, to tell them when up with the shoals; but I have always had so little confidence in it that I have been guided by the lead, without the use of which, in fact, no vessel should pass Hatteras. The first nine trips I made I never saw Hatteras light at all, though

> frequently passing in sight of the breakers; and when I did see it, I could not tell it from a steamer's light, excepting that the steamer's lights are much brighter. It has improved much latterly, but is still a wretched light. It is all important that Hatteras should be provided with a *revolving* light of great intensity, and the light to be raised fifteen feet higher than at present.
>
> Twenty-four steamships' lights of great brilliancy pass this point in one month-nearly at the rate of one every night, (they all pass at night,) and it can be seen how easily a vessel may be deceived by taking a steamer's light for a light on shore.[11]

Other Naval officers made comments on the light station as well. Lieutenant H.J. Harstene stated "The lights on Hatteras, Lookout, Canaveral, and Cape Florida, if not improved, had better be dispensed with, as the navigator is apt to run ashore looking for them." Lieutenant Thornton A. Jenkins, later a member of the Lighthouse Board, noted that the lighthouses along the Virginia-North Carolina coast were inferior due to their lighting apparatuses. Lieutenant H.K. Davenport, skipper of the mail steamer *Cherokee*, said "Cape Hatteras light, upon the most dangerous point on our whole coast, is a very poor concern; frequently cannot be seen outside of the shoals off the cape." This was concurred by the captain of the *Venice*. The master of the steamship *Ludlow* said the Cape Hatteras lighthouse "should be one of the most powerful..., as it is a point which coasters wish to turn close, south bound, to avoid the Gulf Stream."[12]

Meanwhile, the newly established United States Lighthouse Board independently inspected all of the lighthouses and other navigation aids in the United States. Their conclusion regarding the Cape Hatteras Light Station was as follows:

> There is perhaps no Light on the entire coast of the United States of greater value to the commerce and navigation of the country than this. That is not such a light as any sea-coast light should be, is too apparent to require argument; while its special requirements, having reference to the Gulf-Stream, the currents and counter-currents which sweep past it, and the very dangerous shoals, extending to the distance of ten nautical miles from the light, all tend to make it one of no ordinary importance. Vessels, propelled both by wind and steam, run for soundings off this cape; and it is of the first importance to navigators wishing to make quick passages that they should see this light in going south. At present it is of very little use, in consequence of its limited range. Navigators do not, as a general rule, rely upon it sufficiently to warrant them in running for it. It is fitted with fifteen lamps and twenty-one inch reflectors, having an elevation of about ninety-five feet, which would give it a range, under favorable circumstances, of fourteen and a half nautical miles, provided the apparatus for illuminating was of the best description.
>
> There is no single light on the coast believed to require renovation more than this does. An elevation of one hundred and fifty feet, and a first-class illuminating apparatus, are imperiously demanded, and without unnecessary delay.[13]

[11] Porter, David D., Lieutenant, U.S.N. commanding U.S. mail-steamer *Georgia. Letter to unknown.* July 1851.Transcription located in Cape Hatteras Light Station Engineer #1 Binder, Section: Annual Reports, at Cape Hatteras National Seashore Archives, Manteo, NC.
[12] Holland, Jr., "A History of the Cape Hatteras Light Station," pp. 54-55.
[13] Ibid, pp. 55-56.

The First Lighthouse Grows

Despite the unrelenting complaints which arose about the Cape Hatteras Lighthouse, the Lighthouse Establishment and Fifth Auditor Pleasonton's stance was to do nothing, even though the lighthouse's current height caused the lantern's light to be greatly dimmed by the frequent fog. Conversely, the newly established United States Lighthouse Board (USLHB) felt that the problem could and should have been solved.

Their first step was to place a buoy off Cape Hatteras and one on the Diamond Shoals. They asked the U.S. Army's Corps of Engineers to supply an engineer to assist with any technical problems on site. The engineer's first task was to determine how high the current lighthouse could be raised and what would need to be done to install a First Order Fresnel lens and lantern. The engineer's report caused Congress to appropriate $15,000 for elevating and refitting the light.

The lighthouse received a brick addition. With the installation of a new lantern and a revolving First Order Fresnel lens, the lighthouse now had a raised focal plane 150'-0" above sea level. The new flashing light was visible for twenty miles. Additionally, the Board whitewashed the lower seventy feet, and painted the upper portions red to act as a daymark (see fig. 19).[14]

Once chosen to receive a Fresnel lens, the U.S. Lighthouse Board had to acquire a lens from France despite sour relations between the Board and Augustin LePaute.[15] When relations improved, the United States again asked LePaute to manufacture a lens for the lighthouse at Cape Hatteras. LePaute told the Board that a partially finished lens, originally contracted in 1850 for the Sand Key lighthouse in Florida, could be finished for Cape Hatteras. It was accordingly reassigned to Hatteras.[16]

Before the Fresnel lens was installed in the updated lighthouse, the new lens was exhibited in 1853 at the "Exhibition of the Industry of All Nations" in New York City's Crystal Palace (fig. 20). The general superintendent of the exhibition, Samuel DuPont, brought U.S. Topographical Engineer George Gordon Meade to New York to assemble the new First-Order lens at the show, and the second First-Order lens in the United States. (Meade had just completed assembling the first First-Order lens of the U.S. at Sand Key lighthouse.) Meade provided the following description of the Cape Hatteras lens in Philadelphia's *American and Gazette:*

> Fancy a twenty-four sided structure of glass...the whole being about ten feet high and six feet in diameter...being composed of...prisms so scientifically calculated, so artistically constructed, and so nicely put together, that each prism refracts the ray from one of its surfaces, reflects it from the second, and refracting it again from the third, shoots it forth in a sun like beam of light. Thus, from its twenty-four sides and 1,008 lenses and prisms, at the same instant and perpetually, this marvelous contrivance darts forth its dazzling flash, and revolving as it flashes, only intermits its light still more to startle the beholder.[17]

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[14] Ibid, pp. 56-57.
[15] Relations between the United States and LePaute had previously taken a turn for the worse when a U.S. federal employee contracted for two lenses from LePaute, and once publicly known, Pleasanton abashed the large price tag. The contract was cancelled and LePaute was never paid for the work he completed. (Levitt, Theresa. "A Short, Bright Flash: Augustin Fresnel and the Birth of the Modern Lighthouse." New York: W.W. Norton & Company, 2013, pp.147-166.)
[16] Levitt, "A Short, Bright Flash," pp. 147-166.
[17] Duffus, Kevin. "New York's 1853 'Great Exhibition' reveals a new discovery in the storied history of the Cape Hatteras Lighthouse's historic Fresnel lens." *Island Free Press,* August 3, 2010. Accessed at http://islandfreepress.org/2010Archives/08.03.2010-NewYorks1853GreatExhibitionRevealsANewDiscovery.html on July 27, 2015.

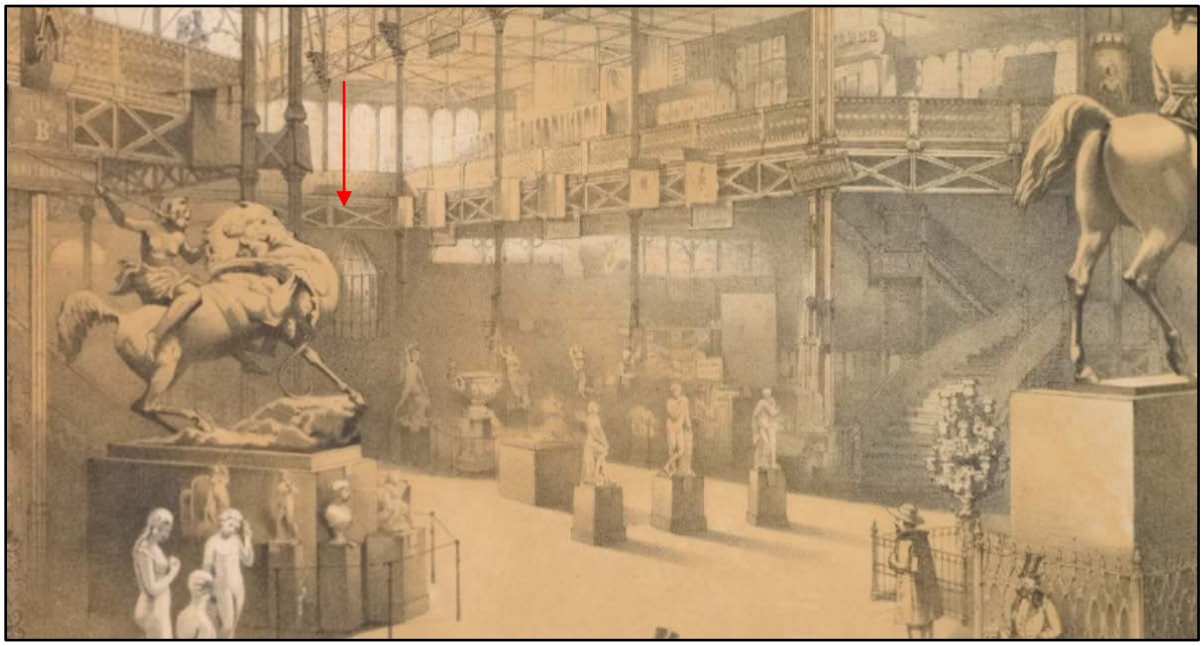


Figure 20. A rendering of the interior of the Crystal Palace in New York on December 1, 1853 shows the First-Order Fresnel Lens intended for the Cape Hatteras Lighthouse on display (arrow). Source: The New York Public Library Digital Collections.[18] Cropped by author.

In January 1855, the *New York Journal,* published by Frank Leslie, also reported on the lens:

> One of the most imposing and remarkable objects that arrested the attention of the visitor on entering the southern nave of the late exhibition at the Crystal Palace, in the evening, was a large and costly light-house lantern, known as the Fresnel Light. Its exterior, composed of clear and polished crystal, supported on a small base, and rising to a height of about twenty feet, presents the singular appearance of a tall monument, revolving continually upon its base, and flashing out at intervals rays of the brightest and purest light. It is denominated a revolving Fresnel light, of the first order, and was manufactured by Lepaute, of Paris, for the United States government. It is designed to be placed on a lighthouse at Cape Hatteras, which is now erecting....
>
> The principal part consists of a cylindric belt of glass, which surrounds the flame in the centre, and by its action refracts the light in a *vertical* direction upwards and downwards, so as to be parallel with the focal plane of the system. To near observers, this action presents a narrow vertical band of light, depending for its breadth on the extent of the horizontal angle embraced by the eye. This arrangement, therefore, fulfils all the conditions of a fixed light, and surpasses in effect any arrangement of parabolic reflectors. In order to save the light which would be lost by passing above and below the cylindric belt, *catadioptic* zones are employed. These zones are triangular, and act by *total* reflection; the interface *refracting*, the second *totally reflecting*, and third, or outer face, a second time *refracting*, so as to cause the light to emerge *horizontally*. The apparatus has received many smaller changes by the introduction of a new mode of grouping the various parts of the framework, by which the passage of the light is less obscured in every azimuth. These improvements have lately been introduced into the light-houses in Scotland.
>
> The dioptric system of lights was invented by M. Fresnel, in 1819.[19]

[18] Accessed at http://digitalcollections.nypl.org/items/5e66b3e9-1a90-d471-e040-e00a180654d7 on July 27, 2015.
[19] "The Fresnel Light." *Frank Leslie's New York Journal, Volumes 1 and* 2. Frank Leslie, 1855, p. 53. Accessed at https://books.google.com/books?id=moFNAAAAYAAJ&q=hatteras#v=snippet&q=hatteras&f=false on July 27, 2015.

After its display at the Crystal Palace in New York (likely between July 14, 1853—the inauguration of the exhibition—and at least December 1, 1853—the date of the above etching) the lens was installed in the Cape Hatteras lighthouse sometime soon after March 1854, as the USLHB "reported that the work was to be completed at an early date."[20] The lens was installed by lighthouse keeper William O'Neal and a lampist.[21] Around the same time, a site plan was completed for the light station (fig. 21).

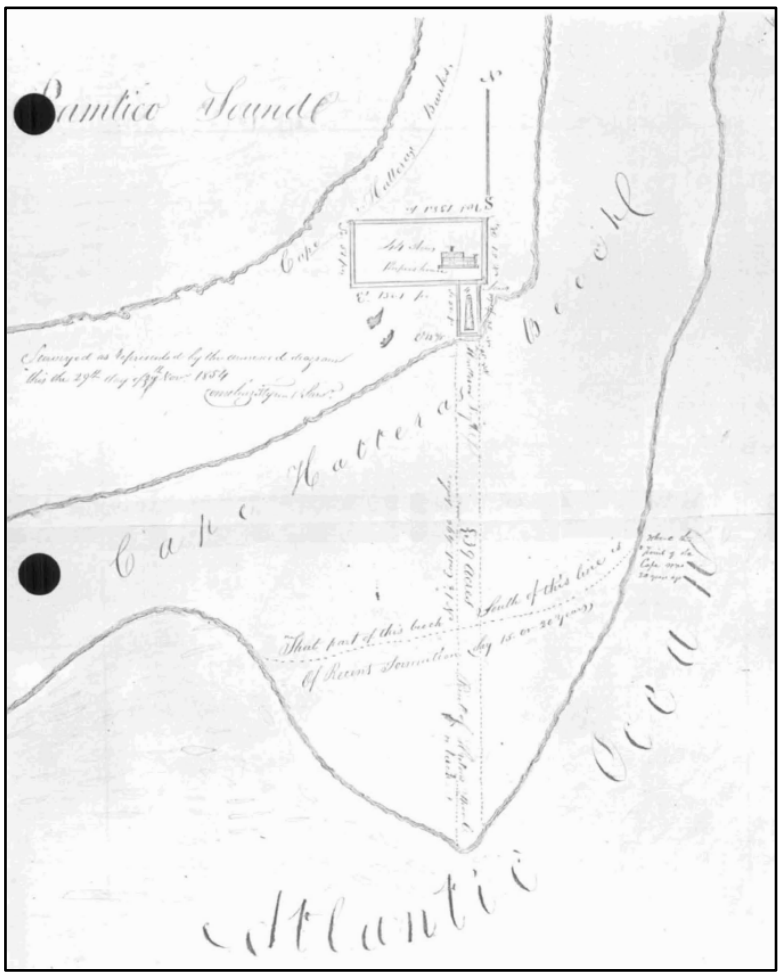


Figure 21. The layout of the Cape Hatteras Light Station in 1854. Source: Site File, Cape Hatteras Light Station, R.G. 26, National Archives. Copied from F. Ross Holland, Jr.'s 1968 Report, Appendix, Illustrations.

> The first order Fresnel lens installed in the lighthouse originally burned whale oil.... The original lens assembly, which rotated on a chariot at ½ rpm, was turned by three 150 pound iron weights suspended on a cable and dropping down the center. The cable was wound around a drum in the clockwork mechanism beneath the lens, which worked much like a grandfather clock. Each morning, the weights were slowly cranked by hand to the top and then released at dusk when the lamp was lit, causing the lens to rotate. The gears in the mechanism provided the leverage to turn the 1- ton lamp/lens assembly. The speed of rotation could be adjusted by a fan governor in the clockwork. A gentle hand push was used to start the lens rotating but, once it was in motion, it maintained its rotation until the weight reached the bottom of the tower and had to be rewound. Regulations required that the weight be rewound to the top of the tower every morning.[22]

No complaints were noted for the next few years at the newly refurbished lighthouse. Some repairs were necessary from time to time, including modifications to the revolving mechanism and sand blowing away from the foundation.[23]

[20] Holland, Jr., "A History of the Cape Hatteras Light Station," p. 57.
[21] Yocum, Roberts, and Shelton-Roberts, "Cape Hatteras," p. 21-22.
[22] National Park Service. "Cape Hatteras Light Station." *Cape Hatteras National Seashore.* Accessed at http://www/nps/gov/caha/planyourvisit/chls.htm on July 9, 2015.
[23] Holland, Jr., "A History of the Cape Hatteras Light Station," pp. 58-59.

Cape Hatteras during the Civil War

President Abraham Lincoln took office on March 4, 1861. After the surrender of Union troops at the battle at Fort Sumter on April 14, Lincoln ordered a blockade of the Southern coast to deter the South from acquiring manufactured goods they needed to import from the North and from, in turn, acquiring revenue from exports. The response from the Southern states was to extinguish all the lights in all the lighthouses in the Confederacy. By April 24, all were dark.[24]

The absence of the light at Cape Hatteras was especially noted in the north. "As one propagandist put it: 'Soon after the bombardment of Fort Sumter, the Confederate Government, with that murderous indifference to human life which has distinguished them from the first, extinguished all the lights they could reach, and among others the lighthouse erected at Cape Hatteras.'"[25]

Once North Carolina and Virginia joined the Confederacy, the Union had 3,549 miles of coastline to patrol with a limited fleet. Thus, the blockade proceeded slowly, as the Union hurried to expand their fleet.[26] On the Outer Banks, a Confederate fleet comprised of both private and government ships defended the coastline and were effective. They also established Fort Clark and Fort Hatteras at Hatteras Inlet to defend the lighthouse (fig. 22).[27]



Figure 22. A birds-eye view map of the Union attack on Forts Clark and Hatteras, south of the light station. Inset shows the original lighthouse with is addition and new lens. Map: Bachman, John. "Birds eye view of North and South Carolina and part of Georgia." ca. 1861.[28] Cropped by author.

Because of the extinguishing, the Union lost more ships in grounding accidents on the coast than in all of the war's naval battles combined. The Union lost nearly forty ships at Cape Hatteras. Consequently, both the USLHB and the Secretary of the Treasury then decided that recapturing Cape Hatteras Lighthouse was a priority. The Union Navy sent seven gunships south to Cape Hatteras in August 1861 as its first target of the Atlantic Blockading Squadron. The Union's fleet

[24] Levitt, "A Short, Bright Flash," pp. 188-91.
[25] Holland, Jr., "A History of the Cape Hatteras Light Station."
[26] Levitt, "A Short, Bright Flash," pp. 189-90.
[27] Yocum, Roberts, & Shelton-Roberts, "Cape Hatteras."
[28] Accessed at http://www.loc.gov/item/99447447/ on August 11, 2015.

bombarded Fort Clark and Fort Hatteras "relentlessly, lobbing more than three thousand shells in the space of three hours, while the forts' ammunition fell uselessly eight hundred yards short of their targets. Both forts were taken in a matter of hours, and the Union controlled Hatteras Inlet. . . ." Union troops soon discovered that the lighthouse's lens had been removed and taken to Washington, NC or Raleigh, NC.

> Commander S.C. Rowan sent an expedition there to try to retrieve the lens, but everyone the Union men spoke to claimed they did not have it, and that it had been shipped up the river 'without their knowledge or consent.' Rowen railed that he would demand the return of the lens before, as he put it, 'I promise protection to the inhabitants' (and given the amount of pillaging going on in the surrounding towns, the threat hung heavy). He insisted he would track down the guilty parties and 'take all the property I can find that will reimburse the Government.' And he wrote to his flag officer that with an armed boat or two, he 'would go there and frighten the people out of their boots unless the lens is returned.'
>
> But the lens was no longer in Washington. Indeed it was likely that no one there knew where it was. Superintendent Hancock had long ago fled upriver, leaving the lens unprotected in a warehouse; the warehouse owner, John Myers, was none too happy to be left holding hot property and fired off a letter to the Confederate treasury secretary, pointing out that Hancock had shirked his duty and Myers had been forced to take matters into his own hands. Only hours before the federal troops landed in Washington, he loaded the boxes containing the lens parts onto the riverboat *Governor Morehead,* and accompanied them upriver to the town of Tarboro, where he delivered them to the army quartermaster, Captain George H. Brown. Wanting to be rid of them as soon as possible, Brown wrote to Richmond, the capital of the Confederacy, begging for an agent to be sent to take the boxes off his hands. An agent, J.B. Davidge, did show up, but his behavior prompted another letter from the quartermaster, claiming him 'unfit to attend to any kind of business since his arrival. ... I find that his habits are those of intemperance & though a delicate matter I feel my duty as an officer to furnish the department with the facts of the case.' Davidge disappeared, along with the money allocated for the move. In desperation, Brown turned to Dr. David Tayloe, a physician from Washington who had been trying to join his family farther inland. If the army could furnish him a boxcar, he proposed, he would take the lens with him and hide it. On April 14, Tayloe rolled out of Tarboro, accompanied (according to the invoice) by forty-four boxes, two cases, sixty-four castings, fourteen fixtures, and two sheets of copper. After several days and considerable difficulty, he made it to Hibernia Plantation, where he rejoined his family and, he assured Martin, hid the apparatus in 'a good store house in the country.'[29]

Before the Union could re-light the lighthouse, the Confederate army tried to recapture the lighthouse (fig. 23).

> In October, six Confederate steamships, intent on taking back Hatteras Island, landed at dawn in the tiny town of Chicamacomico on the northern end of the island. The six hundred soldiers stationed there, many still not fully dressed, took off in the opposite direction, running the whole length of the long, narrow sand spit, over more than twenty-three miles, on a hot day with no water. The Confederate fleet that was supposed to cut them off had, with due irony, run aground on a sand bar. The Union troops were thus able to make it to the lighthouse just after midnight, and picked up reinforcements from the Ninth New York Regiment. The two adversaries then reversed direction, with the Yankees now chasing the Confederates the length of the island back to their ships. The lighthouse remained unharmed, but the episode, named the Chicamacomico Races, prompted Treasury Secretary Chase to press the War Department for better protection for the lighthouse if they were going to entrust Hatteras with a new lens. A steamer lamp had been hanging in the lantern room of the lighthouse since the Union troops arrived, but it was clearly not adequate for the job. Hatteras continued racking up its victims,

[29] Levitt, "A Short, Bright, Flash." pp. 190-3.

> including the celebrated USS *Monitor,* the U.S. Navy's first ironclad warship. Confederate cannonballs had bounced harmlessly off its seemingly indestructible sides during early battles, but in 1862 it passed too close to the Diamond Shoals and was swamped in its waves. Eventually, the flag officer of the Blockading Squadron announced that the lighthouse 'may now be lighted with perfect safety....'[30]

In November 1861, W.J. Newman, Acting District Engineer, visited Cape Hatteras...

> ...with a view to the relighting of that light, but at that time the Coast was not...sufficiently secure to warrant any step being taken for the purpose, but with the recent vistorys [sic] I presume a preliminary illumination, at least, might be made to determine the extent of the injuries. We know that the lens has been removed and probably most of the Lantern glass is broken. The lens itself is most likely so damaged by the hasty removal that another will have to be provided from New York.[31]

In February 1862, the Secretary of the Navy relayed "a comment from the Flag Officer commanding the blockading squadron along the Outer Banks" to the Secretary of the Treasury: "...the Light House at Cape Hatteras may now be lighted with perfect safety, and I would respectfully suggest that this should be done forthwith by the directions and agents of our Light House Board."

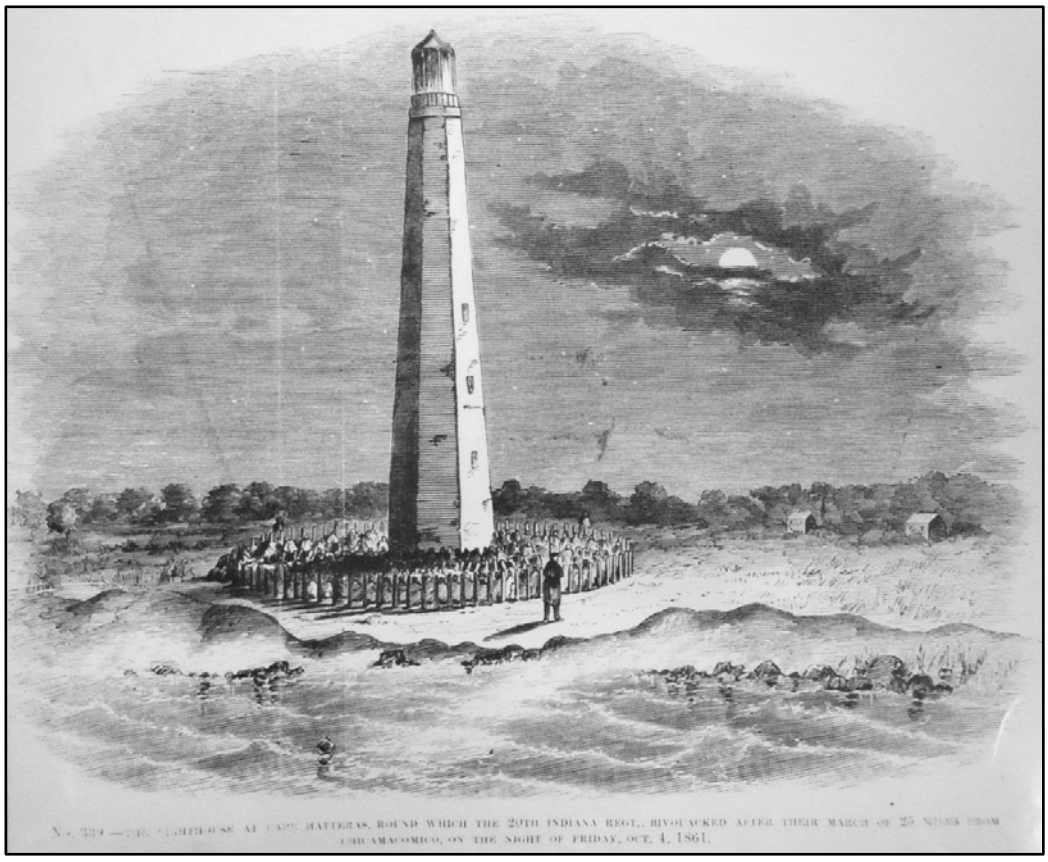


Figure 23. A rendering of the lighthouse during the Civil War shows the 20th Indiana Regiment camped on October 4, 1861. Source: Cape Hatteras National Seashore Archives.

[30] Levitt, "A Short, Bright Flash," pp. 193-4.
[31] Newman, W.J., Acting Engineer. *Letter to Commodore W.B. Shubrick, Chairman, U.S. Light-House Board.* February 15, 1862. Part of NARA's RG 26 Entry 3 (NC-63) "Records of the Fifth Light-House District (Baltimore), 1851-1912" and RG 26 Entry 24 (NC-31) "Letters Received from District Engineers and Inspectors, ca. 1853-1900;" Available for review at Cape Hatteras National Seashore Archives.

On March 11, 1862, the Chairman of the Lighthouse Board had Newman revisit Cape Hatteras to determine what was needed to relight the tower. On March 15, Newman arrived at Hatteras Inlet aboard the army transport *L.R. Spaulding*. The army then escorted him to the light station.[32] Newman reported on what he found:

> I have the honor to report the Light House Tower as uninjured. The Lens has been removed, but the Pedestal, the revolving base plate of the Lens, and the supports of the box that contains the revolving machinery remaining in their original positions at the summit of the tower. These are all very heavy, and their removal previous to the erection of the proposed new Lens will involve considerable labour.
>
> As regards the original Lens, the missing portions are generally understood to have been removed to Washington NC, and as General Burnside has, or is about to take possession of that place, it is just possible that he may regain them. He has signified his intention to do so, and I have communicated the object of my visit to him with a request that they be deposited on one of the Government Store Ships at the Inlet, where if they can be made serviceable, the working party on its arrival then can take charge of them. I fear however that they will be found too much injured to be set up again and it will be necessary in any event to be provided as proposed with an entirely new apparatus. . . .
>
> In the above report of the fitness of this Lt House for the purpose for which it is immediately required, I must not be understood as intending to convey the idea that it is in perfect condition. Far from it. It is defective in many respects. The old Land Stone portion of the structure requires a general inspection of joints and several cracks are apparent that need filing up. It was once proposed to place iron bands round this portion to strengthen it. The more modern portion constructed with brick requires repointing.
>
> The foundation has always been defective, causing much anxiety and labour in endeavors to retain the sand hill on which it stands from being blown away. It was contemplated to surround the hill with a stone wall and to pave the top as has been done at Cape Henry, and it must be done. Yet if the Tower is permanently retained, everything about [it] is obsolete. The Stairs are broad and most inconvenient, the windows defective, etc. etc. It will become a question to be settled shortly whether a new Tower should not be the cheapest in the long run, as even if all the minor defects are remedied, there exist those of construction and form, which can never be cured.[33]

In April 1862, Acting Engineer Newman wrote to the Chairman of the USLHB acknowledging the receipt of a letter informing Newman "that [he] may expect to receive at once, a 2nd Order Lens "fixed", and a 6th order lens fixed for Cape Hatteras Light Station, and also a year's supply of oil." Newman questioned the word "fixed" to ensure that no alteration had been made to the lens. He also noted that the working party bound for Cape Hatteras was capable to depart at any moment.[34]

Meanwhile, newspapers in New York and Philadelphia mentioned that the Cape Hatteras lighthouse had been relit. These reports were false. The confusion likely came from the nearby beacon which had been temporarily relit with a steamer's lamps.[35]

In Newman's April 19, 1862 letter, he noted "the continued risk to the lighthouse and its keepers. . . . Fearing the lighthouse might be attacked by Southern partisans once the light was restored,

[32] Holland, Jr., "A History of Cape Hatteras Light Station."
[33] Newman, W .J. Acting Engineer. *Letter to Commodore W.B. Shubrick, Chairman, U.S. Light-House Board.* March 26, 1862. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[34] Newman, W.J., Acting Engineer. *Letter to Commodore W.B. Shubrick, Chairman, U.S. Light-House Board.* April 17, 1862. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[35] Holland, Jr., "A History of Cape Hatteras Light Station."

Newman requested a detachment of troops to guard the lighthouse. He cited as his primary concern the well-being of the keeper...."[36] In addition, he reports on the location of the original Fresnel lens:

> The last I heard of the old lenses, was that they had been removed to the Interior (Tarborough) and if not available, the placing of the 2nd Order fixed lens, will not be a serious matter, as I anticipate that it will with the aid of a machinist to be readily adapted as temporary expedient to the pedestal of the original lens, which as I have before stated remains in its position in the Lantern.[37]

On May 7, the lenses arrived in Philadelphia, "and two days later the working party departed for Cape Hatteras. Just when the Cape Hatteras light was finally re-exhibited is not known, but it was probably around June 1, 1862."[38]

Just over a year later, on June 17, 1863, the replacement Second Order lens was extinguished. Three days later, an 1855 "Leparites Moderator Lamp 1st Order" was exhibited. "The 1st order lens [had] 24 sides making a revolution in 4 minutes, showing a flash and an eclipse every ten seconds; the flash and the eclipse are about equal duration, *5* each."[39]

In the 1864 Annual Report on the lighthouse, the following was noted by J.P. Smith, Acting Lighthouse Engineer:

> In my last report attention was called to the wooden stair way in the main tower. The great height of the risers and consequent difficulty in ascending; the rough appearance, and the danger from fire.
>
> I would respectfully recommend that as soon as the state of the Country will warrant it, that an iron stairway be substituted for the wooden stairway, etc. As the inside wall has the same batter as the outside, the erection of an iron stairway will involve the building of a brick cylinder on the inside from the base to floor of watch room.
>
> An estimate of the cost of the brick cylinder, iron stairway, window frames, door and frame, at the present prices of material, labor, etc., is appended hereto..., amounting to $14,000.52.[40]

Congress eventually responded to the Lighthouse Board's request for funds to replace the stairs. When prompted, District Engineer Newman replied...

> ...that the condition of the [Cape Hatteras] tower is such that it is not worth the contemplated outlay, but rather that an appropriation be applied for, to build a new tower.... [The tower had been built of poor quality sandstone and the]...vibrations during heavy gales are alarming and the cracks in the old Tower are extending. Nothing permanent had been done to keep the sand from eroding around the tower, except fences and brushwood. The structure is quite out of date and liable sooner or later to [be] a disaster.[41]

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[36] Yocum, Thomas, Bruce Roberts, and Cheryl Shelton-Roberts. "Cape Hatteras," p.29.
[37] Newman, W.J., Acting Engineer. *Letter to Commodore W.B. Shubrick, Chairman, U.S. Light-House Board.* April 19, 1862. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[38] Holland, Jr., "A History of Cape Hatteras Light Station."
[39] Smith, J.P., Acting Lighthouse Engineer. *Letter to Rear Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* June 23, 1863. Smith, J.P. Acting Lighthouse Engineer . *Letter to Rear Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* August 16, 1864. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[40] Smith, J.P., Acting Lighthouse Engineer. *Letter to Rear Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* October 10, 1864. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[41] Holland, Jr., "A History of the Cape Hatteras Light Station."

In September 1865, five months after General Robert E. Lee's surrender at Appomattox, Cape Hatteras' original First Order Fresnel lens was found by a Union patrol in Henderson, North Carolina. Upon this discovery, the lens was returned to the Staten Island, NY lighthouse depot. In 1867, the lens was returned to its maker, Henry-Lepaute Co. in Paris for repairs. Then, in 1868, it was returned to the Staten Island depot for storage.[42]

The New Lighthouse

It appears Congress took District Engineer Newman's last comments of a new tower to heart, because on March 2, 1867 Congress appropriated $75,000 "for rebuilding the first-class light-house at Cape Hatteras."[43]

According to the annual report for the fiscal year ending June 30, 1868, after the appropriation was made, plans were made for reconstructing the lighthouse, including the collection of associated materials. In addition, the original plan was to reconstruct a shorter tower than the one that was actually constructed.

> Contracts for the brick have been entered into, a tram road of the Peteler [portable railroad] pattern has been contracted for, and every other necessary preparation will be made looking to the commencement of work early in the ensuing season.
>
> Since the estimate for this work was submitted to Congress it has been found that the interests of commerce require a tower of much greater elevation than was provided for. At the time of making the estimate it was supposed that a tower of 150 feet in height (the ordinary altitude of first-order towers) would answer every requirement, but it is now deemed necessary to erect a structure having a focal plane of 180 feet. This increased height will augment the cost of the structure, and an estimate of the additional amount required is submitted.[44]

The contracted supplier of the brick was Nicholas M. Smith of Baltimore, MD, who was to "supply 1,000,000 'prime dark red' brick at $12.35 per thousand." The contracted supplier of stone for the foundation and stairs was Beattie, Dawson & Co.

Beattie, Dawson & Co. had a large granite quarry at Oswegatchie, Connecticut. The quarry was fortunate to have a dock on the nearby Niantic River where the stone could easily be loaded to ships. The company was best known for supplying the granite for the base of the Statue of Liberty (construction began after the Cape Hatteras Lighthouse, in September 1875).[45]

> The Board was deeply interested in the quality of materials that went into the structure at Cape Hatteras, saying, 'In a tower so expensive and exposed as the new one proposed for Cape Hatteras will be, it is desirable to take every measure to secure the very best materials,' and added, 'quality is a much greater object than price.' This attitude was in sharp contrast to that of the Fifth Auditor whose only concern was economy. On another occasion they said, 'it is the desire of the Board that this structure...shall be of as durable a character as the nature of the materials out of which it is built

[42] Duffus, Kevin P. "The Great Lighthouse Mystery Solved: The Missing Cape Hatteras lens Found!" *Lighthouse Digest.* November 2002. Accessed at http://www.lighthousedigest.com/digest/StoryPage.cfm?StoryKey=1474 on July 30, 2015.
[43] From "Statement of Appropriations, &c." from March 4, 1789, to June 30, 1882. Published in 1888.
[44] Unknown. "244. Cape Hatteras." 1868. Transcription located in Cape Hatteras Light Station Engineer #1 Binder, Section: Annual Reports, at Cape Hatteras National Seashore Archives.
[45] Hunt, A.M. (ed.). "Granite." Vol. XIV, No. 1. Boston, MA, January 1, 1904. Accessed at https://books.google.com/books?id=LBsAAAAAMAAJ&pg=RA2-PA19&lpg=RA2-PA19&dq=Beattie,+Dawson,+%26+Co+granite+quarry&source=bl&ots=TJAuSEjFTN&sig=9TNpp7A1Z0yVAC37TZS55jgA6nI&hl=en&sa=X&ved=0CB4Q6AEwAGoVChMIxcf2sKzJxwIVhUiSCh1ImwYr#v=onepage&q=Beattie%2C%20Dawson%2C%20%26%20Co%20granite%20quarry&f=false on August 27, 2015.

will admit, and that in the construction nothing be omitted which will tend to give it such a character.'[46]

On June 21, 1868, Acting Engineer W.J. Newman forwarded a preliminary design executed by him for the new lighthouse to U.S. Light-House Board's Engineer Secretary, General O.M. Poe. The following comments were included:

I have the honor to forward herewith, a design for a 1st Class Light House, with the focal plane 180 feet above ground level, and which I would respectfully submit for your consideration as suitable for the new Tower to be erected at Cape Hatteras, NC.

I have some hesitation in submitting so great an innovation upon the standard design for Towers for Light-House purposes, feeling also pretty certain there would be no saving in cost as compared with the ordinary form of construction, although of course the first consideration is to obtain the best forms and combination of materials. I do think there may be claimed for it, greater stability, by removing all the dead weight farther from the center of gravity, and also, that the introduction of the four cast-iron burbs or bonds, one at the base of each section of the Stairway, would materially strengthen the Tower, and prevent the vertical cracks which may frequently be observed in structures, especially in the line of the window openings. A detail of the link [?] here referred to is shown alongside the section of the Tower. It is the largest one, the others being graduated to suit their respective positions.

In lieu of the usual stairs with center newell [sic] enclosed within a cylinder 16'6" diameter, I have enlarged the latter to 18' diameter for a height of 32'8", and arranged a geometrical stairs within it 4'6" wide, which starting on the side of the entrance to the Tower and making one entire revolution, reaches a landing immediately over the entrance, where there is a window, the recess of which adds greatly to the size and convenience.

Hence starting again, a cylinder 16'4" diameter, another revolution attains a landing immediately above the first one, and so on to the top, except where the diameter of the cylinder is so much reduced as to require more than one revolution of the stairs to gain the height of 32'8". This causes irregularity and if the design is adopted, I would improve the arrangement by making each section just the requisite height to admit of one revolution of the stairs and no more, thus bringing all the landings immediately over each other. The sections would then all differ in height, instead of being equal as I have drawn them, and another cast-iron curb would be required. I think the arrangement would be greatly improved by this change.

The widths of the respective flights of stairs as drawn are 4'6" – 4'2" – 4'0" – 3'9" & 3'6", the total number of steps 245 to the deck plate.

I do not propose to build the steps into the wall but to provide a cast-iron stringer or carriage in lengths of 6 or 7 feet to be attached to stone blocks built into it and with dove-tailed bolts let into the blocks and run with lead. Each step would be fastened to the carriage by three tap bolts, and all of them united by bolts at the opposite end.

I would also propose to complete the Tower above the stone belt course entirely with wrought- and cast-iron. You are in favor of making the cylinder under the lantern of iron, and I think it may be extended with advantage to the stonework below the main… *[lines missing}*

…propose to have fixed sashes filled in with ¾ inch rough cast glass, leaving a sufficient number of windows at the landings to be opened for ventilation. I would also fill the alternate panels between brackets under the main gallery with thick rough-cut glass. The effect when seen from below would be much improved, because although the stairs appear in the section to occupy a large portion of the area, it would in execution appear little more than a narrow band and

[46] Holland, Jr., "A History of the Cape Hatteras Light Station."

considerable light would be required.

> The tracing is no more than a preliminary sketch as till you have had an opportunity to consider whether the idea would be sanctioned, it would be a waste of time to enter into further detail. I am satisfied however that the cost would come within the amount available, $88,700.[47]

In a July 3, 1868 letter, it was noted that bricks would be transported…

> …from Baltimore to Philadelphia to the anchorage in Pamlico Sound, at the entrance of what is called the "Cape Channel" about 4 miles from the beach at the back of the present Lighthouse. From this point it is proposed to land them on decked scows, or if suitable small vessels can be obtained in your neighborhood, the owners being willing to undertake their safe transportation from the Schooners on the beach, to include the careful landing and stacking of them for a fixed sum per thousand. This made would be preferred.
>
> It is intended to land 300,000 bricks by the end of next November, the balance, or 700,000, are to be delivered by the contractor by the 31st of July 1869.[48]

An October 8, 1868 letter noted an additional special $75,000 appropriation for a new lighthouse at Cape Hatteras."[49]

A working party departed Baltimore for Cape Hatteras on October 19, 1868 "with a complete outfit for carrying on operation, where they were to receive the first batch of brick, erect necessary sheds and prepare the heavy grillage for the foundation." Also at this time, District Engineer Newman selected Dexter Stetson to be superintendent of construction.[50]

A contract between the Lighthouse Board and Messrs. Lennox and Burgess of Philadelphia was completed in October 1868 "for the transportation from Baltimore to Cape Hatteras, of the materials required for the erection of a Light Tower there." Acting Engineer Newman specified in a letter dated October 24 that 300,000 bricks were awaiting transportation.[51]

The working party arrived at Cape Hatteras on November 4, 1868. The party then unloaded all the material. Until barracks could be built, the crew resided in a rented house.[52]

By November 24, 1868, the first shipment of the bricks had not yet arrived. This caused draftsman R.W. Preece to write to Messrs. Lennox & Burgess, shippers of the brick:

> The delay in the shipment of brick by you to Cape Hatteras is causing me considerable anxiety, as the Lt House Establishment have quite a large number of men engaged at Cape Hatteras who will soon have nothing to do but eat the rations furnished by the Government, which will be

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[47] Newman, W.J ., Acting Engineer. *Letter to General O.M. Poe, Engineer Secretary, U.S. Light-House Board.* June 31, 1868. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[48] Newman, W.J., Acting Engineer. *Letter to Mr. Scarborough, Cape Hatteras, NC.* July 3, 1868. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[49] Newman, W.J .,Acting Engineer. *Letter to General O.M. Poe, Engineer Secretary, U.S. Light-House Board.* October 8, 1868. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[50] Holland, Jr., "A History of Cape Hatteras Light Station."
[51] Newman, W.J., Acting Engineer. *Letter to Messers. Lennox & Burgess, Philadelphia.* October 24, 1868. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[52] Preece, R.W., draughtsman. *Letter to General O.M. Poe, Engineer Secretary, U.S. Light-House Board.* November ?, 1868. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.

> attended by considerable expense, unless you send vessels to carry the brick now ready for shipment, to keep them in operation.[53]

A letter dated December 15, 1868 said that the schooner *Joel Vangant* was to be loaded that day with material for Cape Hatteras. Mr. Lennox himself was to superintend the loading of his vessel.[54] Further letters regarding material shipments (brick, stone, pump, etc.) occurred from December 1868 through February 1869.[55]

On February 19, 1869, the schooner *Ida Nicholson* "caught on a lee shore and [was] stranded three miles from Hatteras Inlet during a severe winter gale."[56] Besides food, the cargo also contained 101,600 brick.[57] Because of this, Engineer J.H. Simpson was fortuitous in asking Messrs. Lennox and Burgees "to be prompt in the sailing of the next vessel."[58]

On March 3, 1869 Congress appropriated an additional $40,000 "for rebuilding the first-class light-house at Cape Hatteras."[59]

By March 27, 1869, significant site work had been completed at Cape Hatteras and engineer J.H. Simpson authored a Progress Report on the construction.

> I have the honor to report my return from Cape Hatteras Light House where I found everything going on very well, under Mr. Dexter Stetson, the Supt. of Work.
>
> Suitable buildings have been put up near the site of the proposed new Light House Tower, for the accommodation of the employees and Superintendent of Work; also a blacksmith shop; a building for the storage of cement and other material, and a crane derrick and coffer dam, composed of sheet piles properly braced, had been constructed around the site of the Tower and excavation made to an average depth of about three (3) feet. Now that a steam engine, boiler and pump have been sent down from this place, it is presumed that the work will go on with still greater dispatch.
>
> A wharf has been built on the Sound side of the Island about ¼ miles from the Light House, the nearest point accessible to the scow lighters; also two decked scows and one open for lighterage; one small rowboat and a crane derrick for unloading heavy stones. A portable railroad has also been laid down from the wharf to the Light House, on which all the bricks received as well as a large portion of the stone, have been transported to the Light House.[60]

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[53] Preece, R.W., draughtsman . *Letter to Messers Lennox & Burgess, Philadelphia.* November 24, 1868.
Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives..
[54] Preece, R.W., draughtsman. *Letter to General* O.M. *Poe, Engineer Secretary, U.S. Light-House Board.* December 15, 1868.
Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[55] Preece, R.W., draughtsman. *Letter to General* O.M. *Poe, Engineer Secretary, U.S. Light-House Board.* December 16, 1868.
Preece,R.W ., draughtsman. *Letter to General* O.M. *Poe, Engineer Secretary, U.S. Light-House Board.* December 28, 1868.
Preece,R.W ., draughtsman. *Letter to General* O.M. *Poe, Engineer Secretary, U.S. Light-House Board.* January 25, 1869.
Simpson, J.H. Lighthouse Engineer. *Letter* to *Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* January 29, 1869.
Simpson, J.H. Lighthouse Engineer. *Letter to Dexter Stetson, Superintendent of Construction.* February 17, 1869.
All part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[56] Helt, Judi. "North Carolina Shipwrecks." *Schooner Ida Nicholson – 19 February 1869 website.* April 25, 2012. Accessed at http://northcarolinashipwrecks.blogspot.com/2012/04/schooner-ida-nicholson-19-february-1869.html on July 14, 2015 .
[57] Preece, R.W., draughtsman .*Supply List.* February 27, 1869.
Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[58] Simpson, J.H., Lighthouse Engineer. *Letter* to *Messrs Lennox & Burgess, Philadelphia.* March 3, 1869.
Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[59] From "Statement of Appropriations, &c." from March 4, 1789, to June 30, 1882. Published in 1888.
[60] Simpson, J.H., Lighthouse Engineer. *Letter to Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* March 27, 1869.
Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.

After the preparation of the site was completed and a large accumulation of materials had been assembled, construction on the foundation could begin. On April 21, 1869 engineer J.H. Simpson wrote to the Chairman of the USLHB regarding the foundations:

> Pursuant to said instructions a bottom sounding iron rod, 1'4" in diameter susceptible of a length of 30 feet and provided with a proper head and sharp point at its lower end was furnished Mr. Stetson, the Supt of Construction; but with all the battering possible it seems he could not make it penetrate the sand at the site of the Tower more than 9 feet.
>
> He also drove some piles which he could not get down deeper than 6 feet. Indeed, he found when he reach the proper depth of excavation, the bottom so hard and compacted as to require no piling, and therefore mailing me, under date of the 4th Inst., that he intended to place a double grillage platform immediately on the bottom.[61]

The site of the lighthouse had been chosen by District Engineer Newman when he was the acting 5th District Engineer; however it was not approved by the Light-House Board. In April 1869, the board discovered its oversight.[62] On April 24th, a site plan of the lighthouse site was submitted by current Engineer Simpson to the Light-House Board for approval (fig. 24). It showed the location of the old tower on a 15'-0"-high sand hill and the keeper's dwelling 893'-0" to the north, the proposed site of the new tower (on the level beach 600'-0" north-north east of the old tower), and the temporary associated buildings which had already been constructed. These temporary buildings included an 18'-0" x 75'-0" cement house and an 18'-0" x 30'-0" blacksmith shop near the proposed location of the new lighthouse, and an 18'-0" x 21'-0" superintendent's quarters, an 18'-0" x 50'-0" men's quarters, and a kitchen (illegible dimensions) located near the keeper's dwelling.

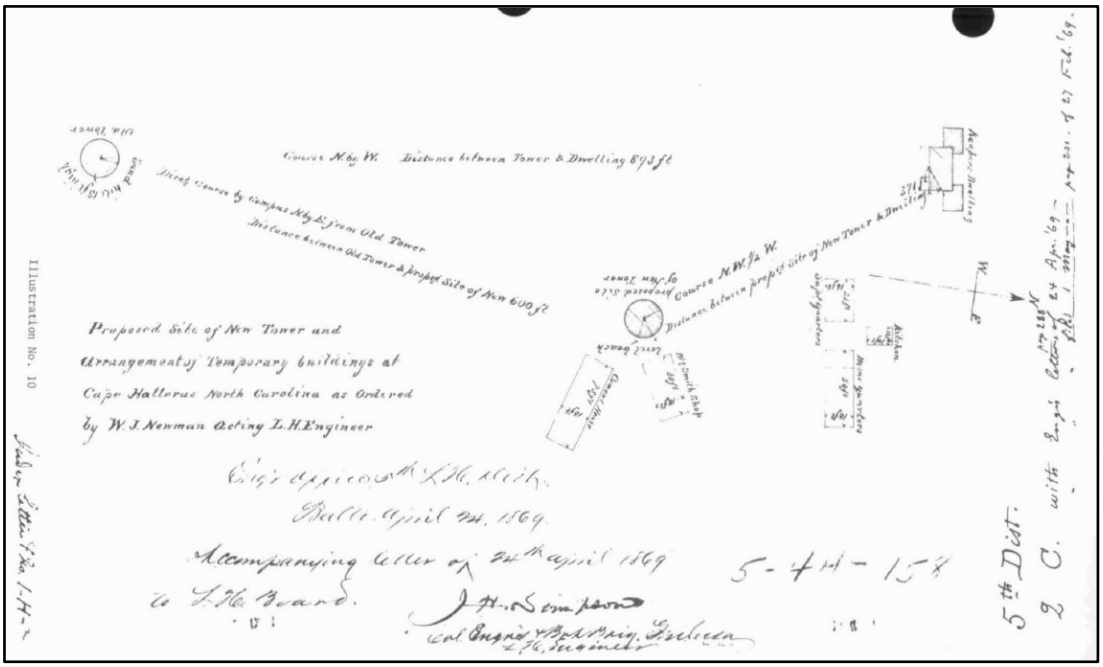


Figure 24. A drawing entitled "Proposed Site of New Tower and Arrangement of Temporary Buildings at Cape Hatteras North Carolina as Ordered by W.J. Newman, Acting L.H. Engineer." Dated April 24, 1869. Source: Engineering Files, 5th Coast Guard District Headquarters. Copied from Holland, Jr.'s "A History of Cape Hatteras Light Station."

[61] Simpson, J.H., Lighthouse Engineer. *Letter to Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* March 27, 1869. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[62] Holland, Jr., "A History of Cape Hatteras Light Station."

Despite the site plan and a positive recommendation from Simpson on the site selection, the Board sent a committee to the site during the second week of May 1869. The site was then approved.[63]

Throughout the summer months of 1869, communications revolved around the shipment of granite and brick (including face brick), and the castings for the ironwork. On June 5, 1869 engineer J.H. Simpson wrote a letter to H.W. Pauce demanding he go "immediately to Port Deposit, MD for the purpose of leading, with the greatest dispatch, the Schooner Trenton with Rough Granite from the quarry of McClellahan [sic] & Bros."[65]

> McClenahan & Bros. was a quarry based in Port Deposit, MD. "Port Deposit's granite is light bluish-gray and contains an abundance of black mica. … By 1816-17, there was a small quarry open in town near the Susquehanna [River] bridge. … From 1832 to 1914, the business was dominated by Ebenezer D. McClenahan and his descendants."[64]

The 1869 annual report (likely for the fiscal year ending June 30, 1869) offered the following report for the light station (Note: any information included in the report which has already stated above has not been transcribed):

> The site selected bears north by east 600 feet distant from the old tower, and is therefore as near it as it well could be. The sailing directions will be very slightly affected if at all. It is on the general level of the beach, and therefore is secure from the destructive action of the wind, which has always so seriously threatened the foundations of the old tower, and to counteract which very heavy expense was incurred through many years. The site is also above the highest level of the sea, and so far removed from the water line as to render it safe from encroachments of the sea. The foundation consists of two thicknesses of yellow pine timber, each 6 by 12 inches, laid crossways, close together, and immediately upon the sand, at a depth of six feet below the surface of the beach. This places the timber-work below low-water level, and to accomplish it required the use of a coffer dam, inclosing the foundation pit, and powerful steam pumps to keep it clear-an assurance that the timber will always be covered with water. Upon these massive timbers laid a massive octagonal foundation, composed of large blocks of granite laid in cement mortar, as rubble masonry, the interstices being filled with smaller stone of the same kind. At the proper height, octagonal plinth courses of cut granite were laid, and above the cut granite quoins and brick paneling, according to the design, were commenced, and the work has proceeded until, at the latest dates from there, the masonry had reached the height of the fifth course of quoins, and the stoop had been laid. The tower itself will consist of a frustum of a right cone of 150 feet in perpendicular height, resting on an octagonal base of 24 feet in height, and 45½ feet in diameter at the lower plinth course. The foundation is of rubble granite; the plinth courses, quoins, and cornice, of cut granite, and the rest of the structure of brick and iron. The whole will be surmounted by a lens of the first order, the focal plane of which will be 180 feet above the ground, and about 184 feet above the sea. When completed it will be the most imposing and substantial brick light-house on this continent, if not in the world. The flash of its lens should be seen from the deck of a vessel at a distance of more than 22 nautical miles.[66]

In 1869, *Specifications for a First-Order Light-House to be erected at Cape Hatteras, North Carolina* was published by the U.S. Lighthouse Establishment (printed by the Government Printing Office).[67]

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[63] Ibid.
[64] Andreve, George J., Architectural Historian, Maryland Historical Trust. "Port Deposit." *National Register of Historic Places Inventory—Nomination Form.* Completed Spring 1976. Signed by SHPO August 18, 1977. Accessed at http://msa.maryland.gov/megafile/msa/stagsere/se1/se5/007000/007600/007644/pdf/msa_se5_7644.pdf on July 14, 2015.
[65] Simpson, J .H., Lighthouse Engineer. *Letter to H.W. Pauce.* June 5, 1869.
Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[66] Unknown. "244. Cape Hatteras." 1869. Transcription located in Cape Hatteras Light Station Engineer #1 Binder, Section: Annual Reports, at Cape Hatteras National Seashore Archives, Manteo, NC.
[67] Office of the Light-House Board, Treasury Department. "Specifications for a First Order Light-House to be erected at Cape

It included specifications and drawings for both a first-order lighthouse and a lantern for a first-order lighthouse. Because the structure was already being constructed by the time the specifications were published publically, it is assumed the publication was meant for other purposes (fig. 25).

On August 13, 1869, engineer J.H. Simpson presented a progress report, which stated:

> The structure at Hatteras has reached a height averaging 18 courses of brick above the last plinth course and already, with its massive groins, begins to assume a very handsome, solid and imposing appearance. At present the laying of the groins and brick work can go no further, until the door frame and other castings for the base are received, which will not be probably until 30 days from the 2th of July according to the agreement with Messrs. Hazelhurst & Co. Meantime, however, a party will be engaged in receiving supplies and building the stoop. I regret to say that some 5 or 6 of the employees have been obliged to leave on account of sickness.
>
> ...In view of the probable completion of the base of the Light House at Cape Hatteras by the 10th of October, it is very desirable that the castings which are built in the wall of the Tower should be there at that date. I therefore respectfully suggest that they may be ordered at the earliest possible moment.[68]

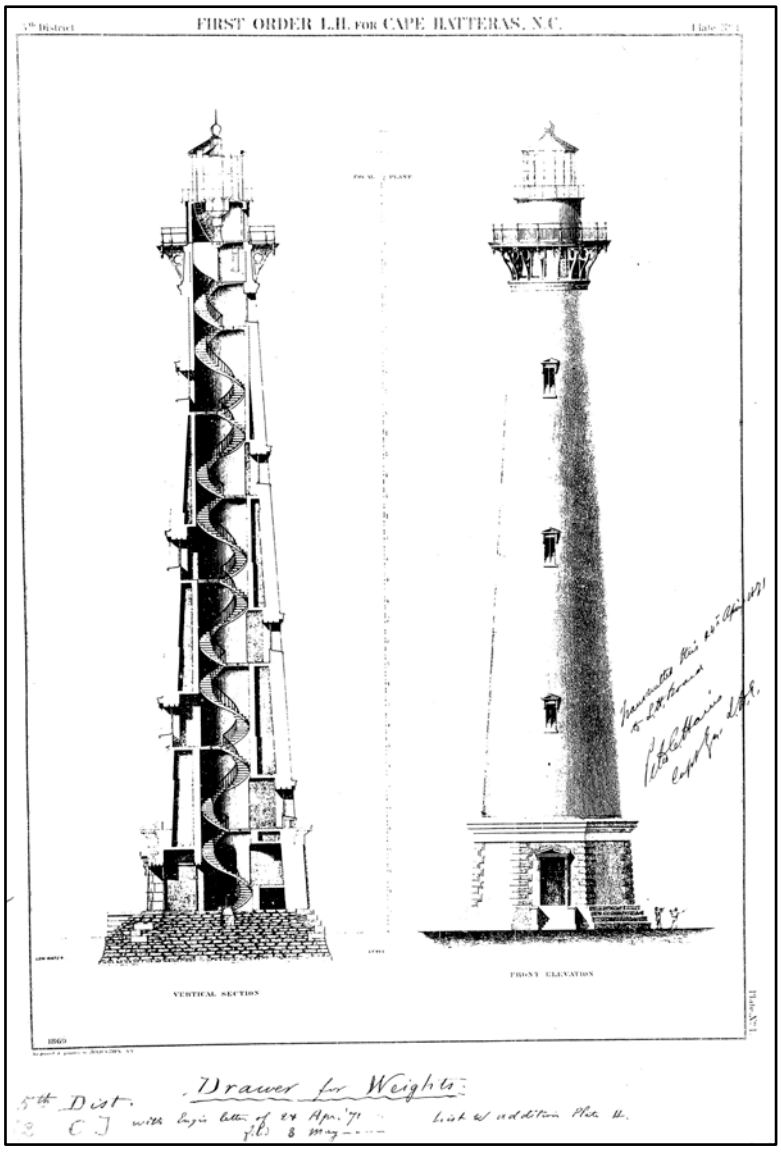


Figure 25. Plate No. 1 of the lighthouse construction drawings, published by the GPO in 1869. Drawing: NPS DSC eTIC No. CAHA 603 25007.

On August 17, 1869, engineer J.H. Simpson reported on an outbreak of sickness among the construction crew. He included a letter from Surgeon James Simon, U.S. Colonel, who recommended "as a preventative of intermittent and remittent fevers at that locality the daily issue of ½ oz. Whiskey and 5 grains Quinine to each man." Superintendent Stetson concurred and was

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Hatteras, North Carolina. Washington: Government Printing Office, 1869. Located at Cape Hatteras National Seashore Archives, Manteo, NC.

[68] Simpson, J.H., Lighthouse Engineer. *Letter to Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* August 13, 1869. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.

"of opinion that Whiskey, dealt out judiciously, should be resorted to as a prevention to fever." Therefore engineer Simpson requested approval from the Lighthouse Board to purchase whiskey.[69] Their decision is unknown.

On September 7, 1869, Simpson presented a progress report, which stated:

> At the close of this month this structure had attained to an average height of eighteen courses of brick above the upper plinth course, and the stoop laid. Some little delay has been occasioned by the sickness of the men and the tardiness of the foundry in getting out the castings for the base of the Tower. These castings went down in Steamer J.N. Seymore on the 28th of August 1869, and as the sick and others who have temporarily left the work on account of the unhealthy location will return on the 15th of September instant, it is expected that the work will go on with renewed diligence. This work already with its massive granite plinth corners and groins begins to assume quite an imposing appearance.[70]

A letter dated October 9, 1869 noted the award of the ironwork contract to Messrs. Bartlette, Robbins & Co. of Baltimore, MD.[72]

Messrs. Bartlette, Robbins & Co., as it existed under this iteration, was in business from 1866-78, and located at 200 Scott Street in Baltimore. They specialized as founders in stoves, architectural iron works, and heating apparatuses.[71]

On December 11, 1869, Simpson presented a progress report, which stated:

> Mr. Dexter Stetson arrived from Cape Hatteras at the close of the month to receive instructions in relation to the further progress of the work at that point and obtain the requisite supplies. On the 4th instant he returned to his work at Hatteras on the Tulip. Mr. Stetson reported the base of the new tower, on 30th November, including brick and stone work so far finished as to enable him to commence the brick work of the tower.[73]

By the end of December Superintendent Stetson reported: "I am now levelled up even with cornice and have laid three courses of brick in the shaft." In addition, the "castings for the first window in the shaft were forwarded by steamboat and rail to Newbern Dec. 17 and Mr. Stetson sent for them on the 30th."[74]

Due to the large amount of local Hatteras Island day laborers available to Stetson, work progressed rapidly on the lighthouse throughout 1870. "As many as a hundred local workers jumped at the opportunity to make as much as $1.50 per day, a princely sum for the islanders at the time."[75]

On March 3, 1870, Simpson presented a progress report, which stated:

> The schooner *Hattie Lou* sailed for Cape Hatteras on the 8th with 45,000 Hard Red and 15,000 [?] Bricks at $6 per thousand upon safe delivery on board of Schooner Lighters.

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[69] Simpson, J.H., Lighthouse Engineer . *Letter to Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* August 17, 1869. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[70] Simpson, J.H., Lighthouse Engineer. *Letter to Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* September 7, 1869. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[71] Historic American Engineering Record, National Park Service. "Bartlett-Hayward Industrial Complex." *Written Historical and Descriptive Data.* 1985. Accessed at http://www.loc.gov/pictures/item/md0998/ on July 15, 2015.
[72] Simpson, J.H., Lighthouse Engineer. *Letter to Rear Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* October 9, 1869. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[73] Simpson, J.H., Lighthouse Engineer. *Letter to Rear Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* December 11, 1869. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[74] Simpson, J.H., Lighthouse Engineer. *Letter to Rear Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* January 6, 1870. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[75] Yocum, Roberts, and Shelton-Roberts. "Cape Hatteras," p. 39.

> The Steamship *Tulip* started for Cape Hatteras with a quantity of stores and window frame casting No. 4. She returned to this port on the 2nd instant.
>
> Mr. Stetson, Superintendent of Construction, has arrived and reports that the tower had attained, on the 26th, a height of 50 feet from the first floor.[76]

On April 4, 1870, Simpson presented a progress report, which stated:

> The Schooner *A.J. Williams*, O.L. Minton, Master, having been chartered for the purpose, sailed on the 29th for Cape Hatteras with a cargo of bricks and the 1st and 2nd flights of Iron Stairways for the new light house at that point.
>
> Mr. Stetson, under date of the 26th, reports that he will put in the third set of beams the following week, and was then ready for the 2 first flights of stairways and would put them up as soon as they arrive.[77]

On May 5, 1870, Simpson presented a progress report, which stated:

> On the 30th [of April] the tower had attained a height of 103 above the ground, making it 97 feet above the main floor. The first two flights of stairway are in position as also the oil tanks. It is expected that the tower will be ready for the Lantern by the 1st of July. It gives me pleasure to state that the work is progressing finely, the structure, as far as built, having been constructed with the greatest care and precision and the prospect being the same, when completed, will conform in every respect, to the drawings, and anticipations of the Light House Board.[79]

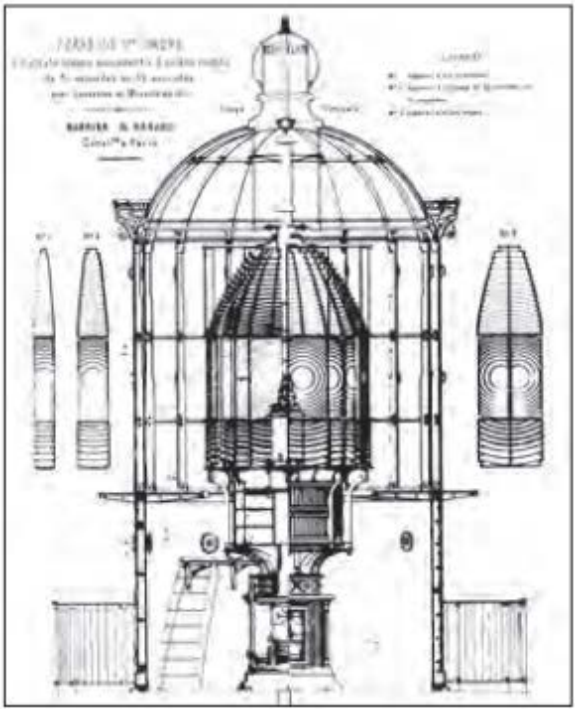


Figure 26. An original drawing of the Fresnel lens at Point Reyes Lighthouse, very similar to the original lens for Cape Hatteras Lighthouse. Drawing: NPS, "The Historic Point Reyes Lighthouse."[78]

In May 1870, discussions occurred regarding the reuse of the old tower's lens (the replacement First Order lens) in the new tower. On the 13th, Simpson directed his assistant to Hatteras "to measure the lens column of the old tower, and thus facilitate the transfer of the lens. A week later the Board wrote asking the District Engineer if he would like a new lens rather than go to the trouble of transferring the old one. The Board said it had on hand a first order flashing lens with pedestal."[80] On May 21, 1870, Simpson sent a letter requesting the new lens.[81] This "new" first-order flashing lens was actually the

[76] Simpson, J. H., Lighthouse Engineer. *Letter to Rear Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* March 3, 1870. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[77] Simpson, J.H., Lighthouse Engineer. *Letter to Rear Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* April 4, 1870. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[78] Accessed at http://www.nps.gov/pore/planyourvisit/upload/brochure_lighthouse.pdf on August 26, 2015.
[79] Simpson, J.H., Lighthouse Engineer. *Letter to Rear Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* May 5, 1870. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[80] Holland, Jr., "A History of Cape Hatteras Light Station."
[81] Simpson, J.H., Lighthouse Engineer. *Letter to Rear Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* May 21, 1870. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.

original Fresnel lens installed at the first lighthouse in 1854; it would be returned, rather unceremoniously, to its original light station![82]

On June 6, 1870, Simpson presented a progress report, which stated:

> On the 28th of May the tower had attained a height of 147 feet from the ground and four flights of stairway had been placed in position. My Assistant visited the work on the 16th of May and reports the batter and rotundity of the tower to have been admirably preserved. Sighting down from the top he could not discover a brick out of line an eighth of an inch.[83]

Around the middle of June the Board shipped the new lens to Simpson in Baltimore with the plans for the lens from the Point Reyes, CA lighthouse because the two lenses were similar in design and operation (fig. 26). Simpson had the Baltimore lantern makers examine the original lens and make minor alterations to the new lantern to accommodate the old lens.[84]

Engineer Simpson presented a progress report on July 8, 1870, which stated:

> On the 16th the tower had attained a height of 153½ feet; but owing some modifications of the iron work rendered necessary by the new lens, operations were temporarily suspended on that day, and all of the mechanics and laborers discharged except six who were retained to protect and care for the property. As soon as the alterations of the iron work referred to are advanced sufficiently to justify the resumption of operations to advantage, the work will be resumed and prosecuted with dispatch.[85]

Congress appropriated an additional $52,500, on July 15, 1870, for the construction.[86]

On July 26, 1870, Simpson wrote to Messrs. Bartlett, Robbins & Co. regarding the furnishing of wooden doors, glass for doors, window sash, and service room windows. These items are assumed to have not been specified in the original contract.[87]

Engineer Simpson presented another progress report on August 2, 1870, which stated no work had been completed during the month of July. "The modifications of the iron work rendered necessary by the new lens are being effected as rapidly as possible and will probably be completed in three weeks."[88] A similar progress report was submitted on September 6, 1870, which stated no work had been completed during the month of August. "The iron work of the capital is nearly ready for shipment and active operations will soon be commenced."[89] The iron work was eventually shipped aboard the *Tulip* on September 9, 1870.[90]

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[82] Duffus, Kevin P. "The Great Lighthouse Mystery Solved: The Missing Cape Hatteras Lens Found!" *Lighthouse Digest.* 11/02.
[83] Simpson, J.H., Lighthouse Engineer. *Letter to Rear Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* June 6, 1870. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[84] Holland, Jr., "A History of Cape Hatteras Light Station."
[85] Simpson, J.H., Lighthouse Engineer. *Letter to Rear Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* July 5, 1870. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[86] From "Statement of Appropriations, &c." from March 4, 1789, to June 30, 1882. Published in 1888.
[87] Simpson, J.H., Lighthouse Engineer. *Letter to Rear Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* July 21, 1870.
Simpson, J.H., Lighthouse Engineer. *Letter to Messrs. Bartlett, Robbins & Co.* July 26, 1870.
Both part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[88] Simpson, J.H., Lighthouse Engineer. *Letter to Rear Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* August 2, 1870. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[89] Simpson, J.H., Lighthouse Engineer. *Letter to Rear Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* September 6, 1870. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[90] Mitchell, Thos . W., Captain, Master of *Tulip. Letter to Lighthouse Engineer J.H. Simpson.* September 9, 1870. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.

On September 24, Stetson was provided with instructions for cleaning and finishing the white and black tiling located on the landings within the tower:

> To darken and polish the black tiling, rub the planed surface with a rag dipped in Linseed, Lamp or any kind of waste oil; using care that it does no touch the white tiles as it injures their appearance.
>
> For the purpose of removing statins from granite, one gallon of sulphuric acid is sent you.
>
> Dip a rag tied to the end of a stick in the acid and rub it on the granite and immediately wash the acidulated surface with clean water.[91]

Engineer Simpson presented an annual report on the progress of the lighthouse construction on September 30, 1870. It stated:

> The operations on this edifice progressed rapidly and satisfactorily from the date of the last annual report until the 16th of June. By then the entire portion of the brick work of the tower beneath the iron capital which carries the lantern was completed. All the window frames were set and four flights of iron stairway in position and their landings arched.
>
> The work thus far has been of the most thorough character; the iron work furnished by the contractors, Messrs. Bartlett, Robbins & Co of this city [Baltimore] excellent, and the brick work laid in the most substantial manner, each brick being completely embedded in the best kind of cement mortar, and each course as it was laid, brought truly to the batter and levelled. The cement and brick used were of unexceptionable quality. The structure thus far gives the assurance that it will meet in every respect the anticipations of the L.H. Board.
>
> The tower having attained the above height of 153 feet, a delay in procuring the iron work of the capital, and as nothing more could be done without it, I ordered on the 16th of June, Mr. Dexter Stetson to suspend operations and withdraw his force until such time as the casting would be ready, and leave a few men for the necessary care of the tower and materials.
>
> The lens sent to me by the Light House Board rendering necessary some modifications in the iron work for the new tower, also helped to delay matters.
>
> The capital finally advancing toward completion at the workshop, I dispatched to Hatteras the steamer Tulip on the 10th of Sept with Mr. Stetson and a few men in order that he might make preparations for the reception and setting up on the iron work. Two vessels subsequently chartered for the purpose of carrying the iron work of the capital, supplies, etc., and on the 27th they left under tow of the steam tender Tulip via the Albemarle and Chesapeake Canal for the work.
>
> The following is a brief summary of each months operations till temporary suspension:
>
> On the 25th of Sept 1869 the 9th course of granite quoins was set up and backed with brick, as was also a portion of the 10th course.
>
> During November extensive repairs were made to the keeper's dwelling and a large quantity of filling in of sand and soil was done to a slough surrounding the house.
>
> Dec 30 Tower leveled up even with cornice and 3 courses of brick laid in shaft.
>
> Jan 30 Brick work reached a height of 32 feet above the main floor.
>
> Feb 20 Brick work had attained a height of 50 feet above main floor.

[91] Simpson, J.H., Lighthouse Engineer. *Letter to Dexter Stetson, Superintendent of Construction.* September 24, 1870. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.

> April 30 The tower had reached a height of 103 feet above ground, making it 97 feet above the main floor. The first two flights of iron stairway were also placed in position as were also the wrought-iron oil tanks.
>
> May 23 A height of 147 feet above the ground or 141 feet above main floor was reached.
>
> June 16 The brick work was leveled up to a height of 153½ feet from the ground to the lower edge of the necking or belt course of the capital. Four flights of iron stairway were in position in the cylinder. At this date the work was temporarily halted, as above related.[92]

The construction of the lighthouse resumed on October 5, 1870.[93]

On October 31, 1870, Simpson wrote to Noel Sannel & Antoine of New York regarding an order for French plate glass, likely for the lens.[94]

On November 1, 1870, Simpson wrote to Messrs. Bartlett, Robbins & Co. of his dismay that the lantern was not yet ready.[95]

The November 4, 1870 progress report by Simpson detailed the resumption of activity at the lighthouse:

> I am grateful in being able to say that the Tower at Hatteras progresses finely, all the heavy iron work of the capital having already been placed in position, except two short flights of stairs. Indeed I am informed by the Superintendent Mr. Stetson, under date of 31st [October], since I left that he will be able to set the lantern as soon as it arrives. By working day and night, Messrs. Bartlett, Robbins & Co. promise me that the lantern will be ready for shipment by Thursday next week.[96]

Another November Progress Report included the following:

> The shipment of the various parts of the iron capital, the lens, etc., was effected without an accident. The capital is already in position and ready for the lantern. The stairways are all fixed to their places and the landings arched. The main work of building being completed, there yet remains besides the setting up of the lantern and lens, considerable work to be done in the way of finishing, laying tiling, fitting doors and sashes, glazing, cement and whitewashing, etc.
>
> The iron fence and its granite base authorized by the Light House Board for this tower, is being made in this city [Baltimore].[97]

On November 19, 1870 Captain of Engineers, Peter C. Hains instructed lampist George J. Crossman on the installation of the lens at Cape Hatteras:

> You will proceed with the Steamer *Tulip* to that place for that purpose. After placing the lens and apparatus in position and the new light exhibited, you will take down the old lens and apparatus

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[92] Simpson, J.H., Lighthouse Engineer. *Letter* to *Rear Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* September 30, 1870. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[93] Simpson, J.H., Lighthouse Engineer. *Letter to Rear Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* October 5, 1870. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[94] Simpson, J.H., Lighthouse Engineer. *Letter to Noel Sannel & Antoine, NY.* October 3 1, 1870.
Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[95] Simpson, J.H., Lighthouse Engineer. *Letter to Messrs. Bartlett, Robbins* & Co. November 1, 1870.
Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[96] Simpson, J.H., Lighthouse Engineer. *Letter to Rear Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* November 4. 1870.
Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[97] Simpson, J.H., Lighthouse Engineer. *Letter to Rear Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* November[?], 1870.
Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.

and pack up the same in the boxes which now contain the new lens. The old lens thus packed will be placed by Mr. Stetson on board a schooner which will convey it to the Inlet or Newberne [sic], as may be found expedient, for shipment to the L.H. Depot at Tompkinsville, NY.[98]

On December 8, 1870, it was noted that $11,000 remained in the appropriation for the lighthouse's construction.[99]

The following occurred during the month of December 1870, as described in the January 12, 1871 progress report by Hains:

> ...the new lantern & illuminating apparatus was put up in the new tower & the light exhibited Dec 16th, 1870. Since that date it has been continually in operation & the light in the old tower extinguished. The character of the new light, together with its location & the characteristics of the new tower were such that the usual notice to mariners was rendered unnecessary.
>
> The illuminating apparatus including the revolving machinery is all in good working order. As soon as it was found that the new light worked well in every respect, the removal of the lens & lantern on the old tower was commenced; this was accomplished about the last of the month. It was then carefully packed in the boxes used for transporting the new lens to Hatteras & on Jan 2nd this year was shipped to Newberne [sic], NC. From thence to go by steamer to the Light-House Depot Tomkinsville, NY, Mr. Crossman, Lampist, being ordered to accompany it all the way & see that it was properly handled in transshipment.
>
> Nearly all the iron work in the new tower has been painted (finishing coat). The inside has been white-washed & the cement washing of the outside carried down about one third of the way from the top. The staging around the tower has been removed for about the same distance. This work has been very much delayed by the continuous stormy weather during the latter part of the month.
>
> The foundation for the iron fence around the tower has been laid & is now ready to receive the granite sill.
>
> In the old tower a portion of the iron work has been removed preparatory to the demolition of the old structure. The old iron or such of it as is worth it & not needed elsewhere, will be sent to Lazaretto [Point, Baltimore, MD] to be sold at auction.[100]

On February 15, 1871, Hains reported that scaffolding had been removed and the fence had been erected.[101]

On February 16, 1871, Hains reported on the focal point of the new tower (fig. 27):

> Taking the stage of the water at the time the levels were seen as 'mean low,' (it was this at the time as nearly as could be ascertained), the height of the focal plane is 190.89 feet above the mean low water of the sea; in round numbers 191 feet; the bottom of the grillage foundation being 3.89 feet above mean low water, or about one & a half feet above high water.[102]

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[98] Hains, Peter C., Captain of Engineers. *Letter to* Geo. *J. Crossman, Lampist.* November 19, 1870. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[99] Hains, Peter C., Captain of Engineers. *Letter to Rear Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* December 8, 1870. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[100] Hains, Peter C., Captain of Engineers. *Letter to Rear Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* January 12, 1871. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[101] Hains, Peter C., Captain of Engineers. *Letter to Rear Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* February 15, 1871. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[102] Hains, Peter C., Captain of Engineers. *Letter to Rear Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* February 16, 1871. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.

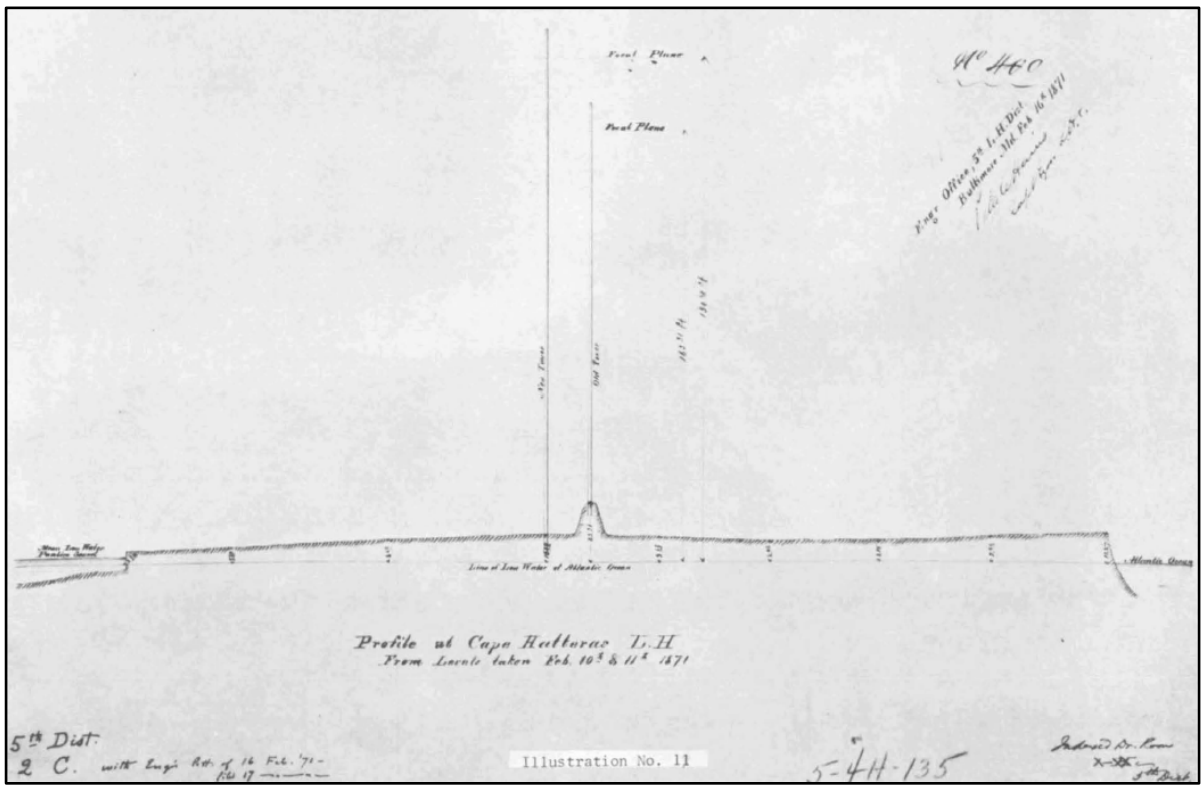


Figure 27. Drawing entitled "Profile at Cape Hatteras L.H." from February 10-11, 1871. The drawing shows the focal point of the old tower and the new tower. Source: Engineering Files, 5th Coast Guard District Headquarters. Copied from Holland, Jr.'s "A History of Cape Hatteras Light Station."

On March 18, 1871, Hains reported on the progress:

> At Cape Hatteras the fence around the new tower was finished...; a new board walk has been commenced and partially completed from the keeper's dwelling to the tower.
>
> The old tower was blown up with powder and totally destroyed on the 11th of the month; a lot of old iron from the lantern etc. was shipped to Lazaretto [Point, Baltimore, MD] and will be sold with the other old iron and material at that place.[103]
>
> The enclosing fence was a "four-foot-high, octagonal, iron, picket fence. The fence was secured with a base of eight rectangular granite stones. [It was] constructed to keep out free-ranging cattle and hogs. . . ."[104]

An archival site plan shows the basic dimensions and site features within the vicinity of the base of the lighthouse (fig. 28).

On April 11, 1871, Hains reported on the progress:

> The whitewashing of the lower portion of the tower has been delayed to enable it to dry more thoroughly; the same has been done in regard to the painting of the interior of the upper portion of the tower. A temporary building was erected at the wharf for storing cement and other materials not used.

[103] Hains, Peter C., Captain of Engineers. *Letter to Rear Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* March 18, 1871. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[104] NPS, "Cape Hatteras Light Station CLR," p. 14.

> It is proposed to take the buildings and material left over from Hatteras to Bodies Island as soon as the work at that place is authorized to be commenced.
>
> All the lumber, brick, cement and other property left at Hatteras on the completion of the work has been placed in charge of a watchman.[105]

The transfer of the stored materials did not occur until June 1871. At that time "the District Engineer dispatched a working party to Cape Hatteras to remove to Bodie Island the leftover materials and all the structures, including the workmen's quarters, cement storage shed, and tramway. Around the middle of June the party arrived on Bodie Island and began the erection of the buildings, indicating that Cape Hatteras was pretty well cleaned up by this time."[106]

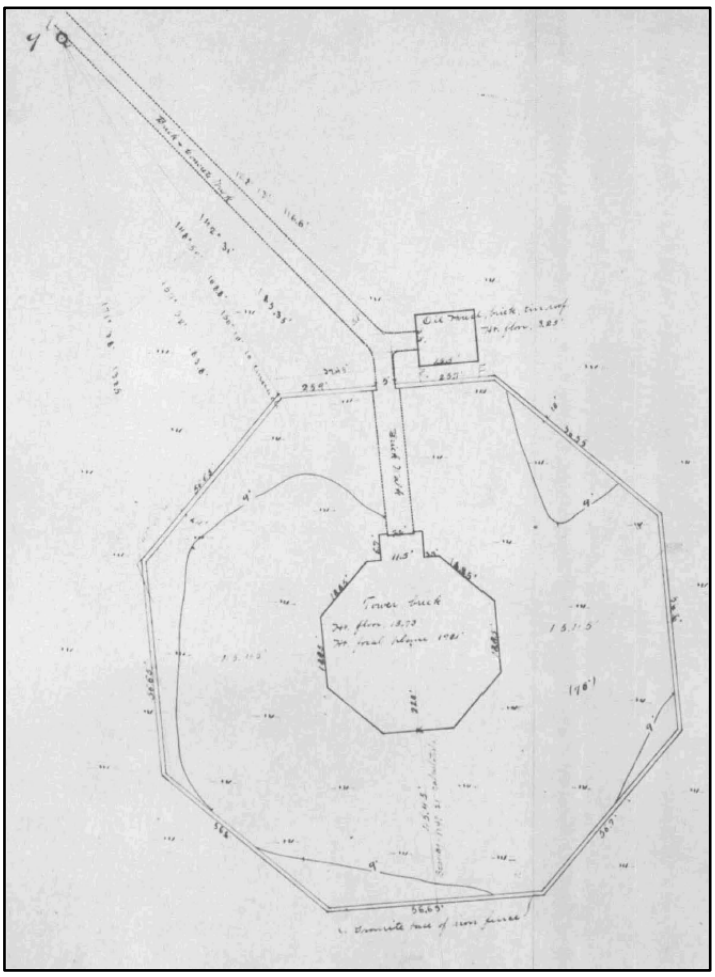


Figure 28. A site plan of the tower area with measurements, including those for the granite and iron fence surrounding the base of the lighthouse. Source: Site File, Cape Hatteras Light Station, RG 26, National Archives. Copied from Holland, Jr.'s "A History of Cape Hatteras Light Station."

The annual report for 1871 (likely coinciding with the fiscal year ending June 30, 1871) included the following about Cape Hatteras:

> This important light-house was well advanced toward completion at the date of last annual report. During the month of December, the new lens was received and set up and on the 16th of the same month the light from the new tower was exhibited. The lens on the old tower was then removed and sent to the depot at New York. The new tower has been covered with a cement wash to protect it from the effects of the weather, the upper part (projected against the sky) colored red, and lower part (projected against the foliage in the rear) colored white, all the ironwork of stairs, lantern, etc., painted and the tower enclosed in a neat iron fence.
>
> During the month of February the old tower, being no longer of any use and in danger of falling during some heavy storm, was blown up and totally destroyed. In addition to the finishing of the new tower, a brick dwelling for the principal keeper of the light-station was built and enclosed in a neat picket fence. The above completed the work at this station.[107]

A drawing from October 24, 1870 shows the old lighthouse prior to its demolition (fig. 29).

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[105] Hains, Peter C., Captain of Engineers. *Letter to Rear Admiral W.B. Shubrick, Chairman. U.S. Light-House Board.* April 11, 1871. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[106] Holland, Jr., "A History of Cape Hatteras Light Station."
[107] Hains, Peter C., Captain of Engineers. *Letter to Rear Admiral W.B. Shubrick, Chairman, U.S. Light-House Board.* n.d. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.



Figure 29. A drawing of the original lighthouse, from the west, on October 24, 1870 before it was demolished. Source: Site File, Cape Hatteras Light Station, RG 26, National Archives and Records Administration.

The New Lighthouse Begins Service

Only a few short years after the new lighthouse was lit did the Light-House Board begin discussions on the tower's painted day mark.

> In February 1873 the Board wrote the District Engineer instructing him to submit a study "for painting the Light House tower at Cape Hatteras in Special Stripes, say two black stripes making one and a half (1½) revolutions in the height of the tower."[108]

On March 22, 1873, District Engineer Hains replied to a request for painting the lighthouse in spiral stripes:

> I beg to submit herewith a set of views showing the appearance of the tower when colored in as four spiral stripes- two white and two black, the width of each stripe increasing as it approaches

[108] Holland, Jr., "A History of Cape Hatteras Light Station."

> the base in proportion to the diameter of the tower. The base of the tower should be colored white between the [quoins].[109]

The Board approved the new white and black spiral-striped markings on March 25, 1873. Concurrently, the white and black checkered marking for Cape Lookout was also approved. The Board then ordered that both towers be "painted at the same time so that only one notice to mariners need be sent out. [Upon completion,] the Board felt the Cape Hatteras tower was now 'a better daymark on this low, sandy coast'" (fig. 30).[110]

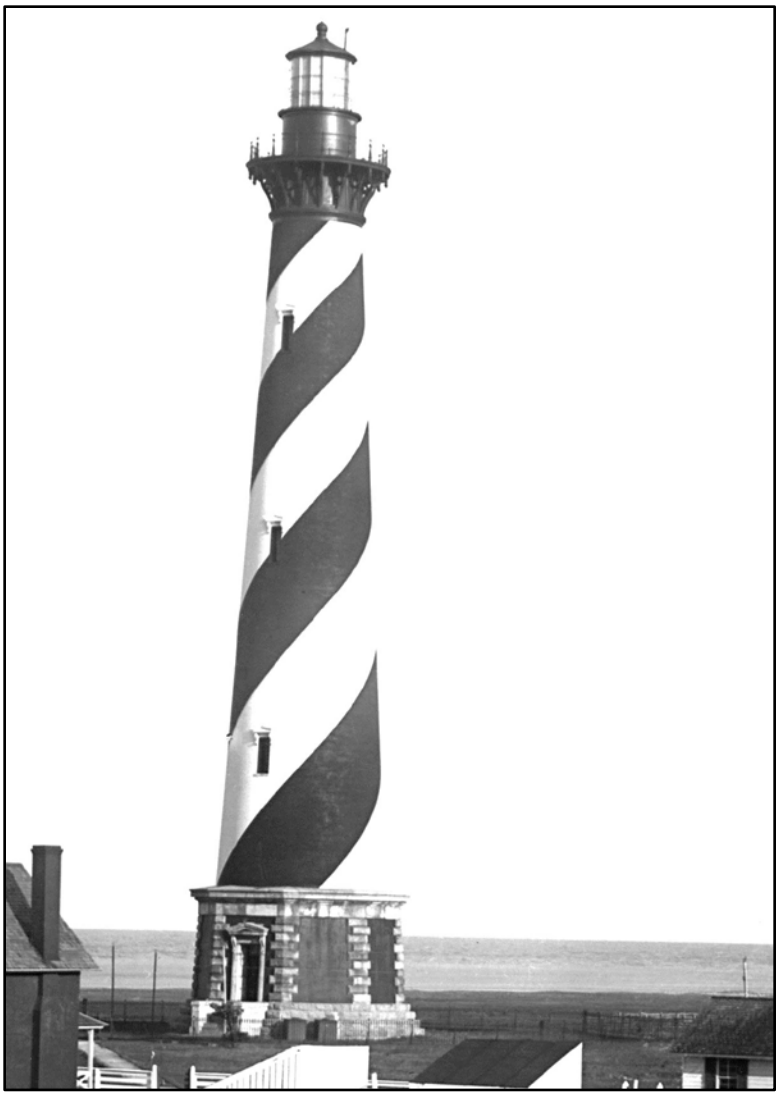


Figure 30. The lighthouse on May 30, 1893. Note the neat iron fence at the base, spiral-striped paint, window hoods over each window, and blinds on the interior of the lantern. Photo: National Archives and Records Administration RG 26, LG 26 82A. Copy found in NPS Harpers Ferry Center photographic archives and Cape Hatteras National Seashore Archives. Cropped by author.

On July 1, 1874, Hains reported that a new tablet with the name of the station, date of erection, etc., had been placed in the tower during the previous month.[111] Prior to this, the Board had...

> ...instructed the keeper to take down the tablet that the then District Engineer had placed at the entrance to the tower at the completion of construction. The Lighthouse Board ordered another one "with a different inscription" to be installed; apparently the Board objected to the inclusion of the names of the District Engineer, the Assistant District Engineer, and the construction foreman on the original tablet.[112]

The 1876 annual report for Cape Hatteras noted that the exterior of the lighthouse had been repainted.[113]

At 4:00pm on April 17, 1879 the lighthouse was struck by lightning. The following details

[109] Hains, Peter C., Captain of Engineers. *Letter to Major George H. Elliot, Engineer Secretary, Chairman, U.S. Light-House Board.* March 22, 1873. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[110] Holland, Jr., "A History of Cape Hatteras Light Station."
[111] Hains, Peter C., Captain of Engineers. *Letter to Professor Joseph Henry, Chairman, U.S. Light-House Board.* July 1, 1874. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[112] Holland, Jr., "A History of Cape Hatteras Light Station."
[113] Unknown. "244. Cape Hatteras." 1876. Transcription located in Cape Hatteras Light Station Engineer# 1 Binder, Section: Annual Reports, at Cape Hatteras National Seashore Archives.

are known:

> The keeper was at his dwelling but feeling sure after the vivid flash that the tower had been hit; went to examine it. He found the marble tiling on the first floor between the base of the baluster and the weight well had shattered and the pieces scattered on the floor. No other damage was found on the 17th. On the next morning two cracks were found in the masonry on the inside, running from the first to the third floor landing. The cracks are on the north and south sides of the tower, the general direction being vertical. They are quite small – exactly in appearance like those in the Body Island tower, though not as numerous or as wide as some of the latter.
>
> At the time of the storm on the 17th the Second Assistant Keeper was in his quarters several hundred feet from the tower, engaged in adjusting the bell wire, leading from the landing of the tower to his quarters and used to call him to his tour of duty - and was struck, thrown halfway across the room and severely stunned, though he received no permanent injury.[114]

The Lighthouse Board then decided "that the damage was 'due to imperfect connection of the iron-work of the tower with the earth,' [and] ordered 'the placing of a metal rod to connect the iron-work of the tower with an iron disk sunk in the ground.' The rod ran from the staircase to the disk."[115]

In September 1879, the use of mineral oil was substituted for lard oil.[116]

The 1880 annual report for Cape Hatteras noted:

> This station was put in thorough repair in January. While at the station the engineer of the district received from the keeper full particulars of the tower being struck by lightning in the spring of 1879, and the subsequent appearance of cracks in the masonry of the tower. The Board deeming this due to imperfect connection of the iron-work of the tower with the earth, the defect was remedied in March by the placing of a metal rod to connect the iron-work of the tower with an iron disk sunk in the ground.[117]

A request for two sets of first-order hydraulic float lamps, to replace the original mechanical lamps, was made on June 13, 1881. The following description of the lens was included with the request: "Maker of lens, Lepaute. Height of lamp with burner and bottom, 36 inches. Distance between the 3 pillars on which the lamp rests, 15 ¾ inches. Height of focal plane of the lens and top of the ring, 5 feet 4¼ inches. Diameter of top ring of the lens outside 13 inches. Inside diameter of cylinder around which lens revolves, 6¼ in."[118]

The annual report for the fiscal year ending on June 30, 1881, was submitted a day early and summed up the work which had been completed at Cape Hatteras that year. This included repairs to the keepers' dwellings and "scraping and scaling tower and repainting with coral-oil paint and whitewashing [for] $1,000."[119]

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[114] Babcock, O.E., Lighthouse Engineer. *Letter* to *Rear Admiral John Rodgers, Chairman, U.S. Light-House Board.* February 2, 1880. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[115] Holland, Jr., "A History of Cape Hatteras Light Station."
[116] Unknown. *Letter* to *Rear Admiral John Rodgers, Chairman, U.S. Light-House Board.* September 5, 1879.
Unknown. *Letter to Rear Admiral John Rodgers, Chairman, U.S. Light-House Board.* September 16, 1879.
Both part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[117] Unknown. "244. Cape Hatteras." 1880. Transcription located in Cape Hatteras Light Station Engineer #1 Binder, Section: Annual Reports, at Cape Hatteras National Seashore Archives.
[118] Babcock, O.E., Lighthouse Engineer. *Letter to Rear Admiral John Rodgers, Chairman, U.S. Light-House Board.* June 13, 1880. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[119] Babcock, O.E., Lighthouse Engineer. *Letter to Rear Admiral John Rodgers, Chairman, U.S. Light-House Board.* June 29, 1880. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.

On October 23, 1881 plans were made for the installation of "electric [battery] call bells on the keepers' dwellings, connecting the same with the lighthouse tower…."[120] The following year, the Board authorized this installation.[121]

On December 26, 1883, a description of the lens apparatus was provided: "Lepaute lens; flashing white, 360°; Mechanical lamp now in use; height of lamp, with burner, to focal plane, 2 feet 11¾ inches; distance between the center of the three pillars, 15¾ inches; height from focal plane to the low edge of the cylinder 5 feet 2 inches; diameter of the iron cylinder inside, 6¼ inches."[122]

Repairs to the lighthouse windows and lantern and assistant keepers' dwelling were authorized on July 13, 1886, for an estimated cost of $300.[123]

On August 31, 1886 a Magnitude-7.3 earthquake (Intensity X), with an epicenter near Charleston, SC, struck. At Cape Hatteras, it was felt at Intensity V.[124] The following was noted about how it affected the lighthouse:

> There were four shocks. The first lasted from 10 to 15 seconds, and was accompanied by a rumbling noise. The others followed at intervals of 10 to 22 minutes and ranged from "very light" to "moderate." The force was sufficient to set suspended objects to swinging, and to overthrow light objects. Of one of the shocks, probably the first, it is said: "The tower would sway backward and forward like a tree shaken by the wind. The shock was so strong that we could not keep our backs against the parapet wall. It would throw us right from it. The swinging was from northeast to southwest." The observations were made from the lantern of the tower, 191 feet above sea level.[125]

There are no records that any structural damage occurred to the lighthouse as a result of the earthquake. (It should be noted that despite no records of structural damage, it is quite possible that damage did occur and the details of such damage no longer exist. It is realistic that some damage did occur in this unreinforced masonry tower.)

On April 18, 1887, a request was made for assorted items including 100 gallons of Indian red paint and a barrel of lime.[126] These items could have been used for painting the base and whitewashing the interior of the lighthouse, respectively.

On May 23, 1887, the lighthouse engineer received a request for a new oil room, as the area on the first floor of the lighthouse was inadequate. "A suitable oil room for stowing the oil is very much needed, with the exception of about 1,000 gallons, 200 boxes, the oil is stowed in recesses at the

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[120] Babcock, O.E., Lighthouse Engineer. *Letter to Rear Admiral John Rodgers, Chairman, U.S. Light-House Board.* October 23, 1880. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[121] Holland, Jr., "A History of Cape Hatteras Light Station."
[122] Babcock, O.E., Lighthouse Engineer. *Letter to Rear Admiral John Rodgers, Chairman, U.S. Light-House Board.* December 26, 1883. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[123] U.S. Light-House Board Engineer Secretary. *Letter to Lighthouse Engineer.* July 13, 1886.
Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[124] United States Geological Survey, Earthquake Hazards Program. "North Carolina Earthquake History." *Abridged from Earthquake Information Bulletin, Volume* 7, *Number* 5, *September-October 1975, by Carl A. von Hake.* Accessed at http://earthquake.usgs.gov/earthquakes/states/north_carolina/history.php on July 9, 2015.
[125] McKinley, Carlyle. "The Charleston Earthquake, August 31, 1886." Charleston, SC, 1887. p. 43.
[126] Smith, D.V., keeper. *Letter to James F. Gregory, Lighthouse Engineer.* April 18, 1887.
Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.

base of the tower."[127] On June 8, 1887, the engineer concurred.[128] About a month later, the USLHB concurred.[129] (The oil house was not constructed until 1892.)

The Annual Report for the fiscal year ending June 30, 1889 noted that the lighthouse was in good condition.[130]

In 1893, USLHB civil engineer and surveyor Herbert Bamber surveyed Cape Hatteras Light Station. His survey drawings show how the buildings of the site related to one another (fig. 31) and that the mean low water line had already moved to 1,325'-0" from the base of the new lighthouse (fig. 32). Additionally, his photographs show the condition of the buildings, site, and their distance from the ocean (figs. 33-36).

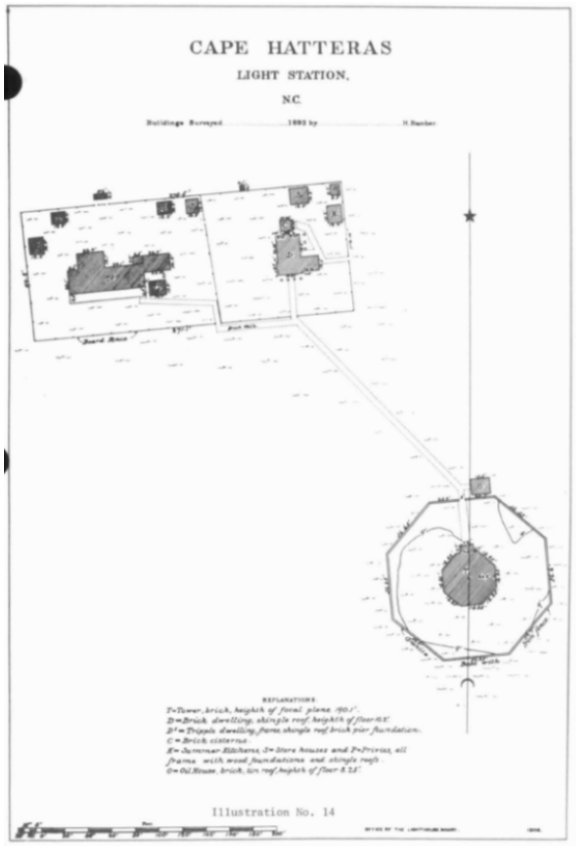


Figure 31. An 1893 site plan of the buildings at Cape Hatteras Light Station by Bamber (published by the USLHB in 1904. Source: Engineering Files, 5th Coast Guard District Headquarters. Copied from Holland, Jr.'s "A History of Cape Hatteras Light Station."

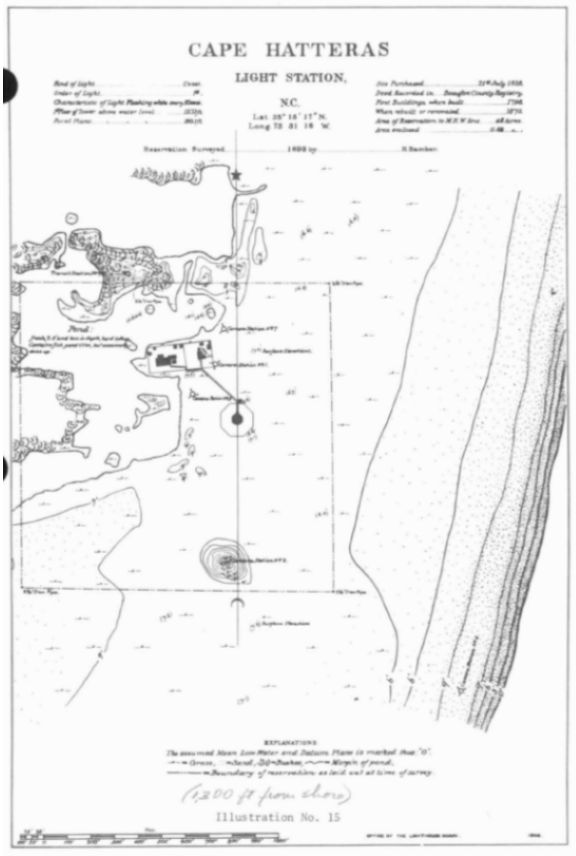


Figure 32. An 1893 site plan of the Cape Hatteras Light Station by Bamber (published by the USLHB in 1904. Source: Engineering Files, 5th Coast Guard District Headquarters. Copied from Holland, Jr.'s "A History of Cape Hatteras Light Station."

[127] Heap, D.P., Engineer Secretary, U.S. Light-House Board. *Letter to* James *F. Gregory, Lighthouse Engineer.* May 23, 1887. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[128] Gregory, James F., Lighthouse Engineer. *Letter to* Chairman, U.S. Light-House Board. June 8, 1887. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[129] Heap, D.P., Engineer Secretary, U.S. Light-House Board. *Letter to James F. Gregory, Lighthouse Engineer.* July 8, 1887. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[130] Mallery, J.C., Lighthouse Engineer. *Letter to Chairman, U.S. Light-House Board.* June 30, 1889. Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.



Figure 33. The Cape Hatteras Light Station on May 30, 1893. This photo is taken from the northwest. The foundation mound of the first lighthouse can be seen just beyond the right of the white double keepers' quarters. Photo: National Archives and Records Administration RG 26, LG 26 82A. Copies found in NPS Harpers Ferry Center photographic archives and Cape Hatteras National Seashore Archives.



Figure 34. The light station from the southeast on May 30, 1893. The 1803 lighthouse foundation mound is located at the left of the photo. Photo: Cape Hatteras National Seashore Archives.



Figure 35. Another May 30, 1893 view of the light station. This photo is taken from the south and was likely taken from atop the foundation mound of the first lighthouse. Photo: Cape Hatteras National Seashore Archives.



Figure 36. The lighthouse on June 1, 1893, from the north. Photo: Cape Hatteras National Seashore Archives.

In early 1895, the Cape Hatteras Light Station was inspected. An inspection report was submitted on February 13: "Tower, lens and oil-house in excellent condition. The lock of the tower door needs repairs which will be made. The call-bell apparatus is out of order.... The pickets of the iron fence around the tower are badly rusted. Some of the hinges of the blinds are broken and also several panes of window glass."[131]

Another inspection occurred and was relayed on November 12, 1897. It noted:

> Tower is in excellent order. Painted outside. The painting is somewhat worn, but not to such extent as to affect its distinctive visibility in the distance. No renewal will be needed for some time. The interior is whitewashed and is in very fine condition. The same may be said of the painting of the stairway and in watchroom and lantern. The lantern, lantern gallery, watchroom and gallery are in good order. Railing to the latter is badly rusted. It should be replaced with galvanized iron, painted first with red lead and then a coat of black. Lens in excellent order. Also lamp and spare lamp, except the wick raisers. These work badly. Clock work of lens and lamp in good order. Call bells not in good order. The carpenter from the tender remedied the difficulty. As soon as it can reasonably be done, I would like to equip all of the high towers with telephone having metallic circuit....[132]

On May 30, 1898, it was reported that the Cape Hatteras station gained "telephonic connection with telegraph stations and [were] equipped for service as Coast Signal Stations to operate in conjunction with U.S. Life-Saving Stations in their immediate neighborhood."[133]

At 1:45am on June 1, 1899, the light in the lighthouse showed "a fixed white light. ...it was not revolving for at least twenty minutes. At 1:53 a.m. it began revolving again." It was assumed the keeper had fallen asleep.[134] An investigation into the matter then occurred. The 1st Assistant Keeper F.E. Simpson supplied the following explanation:

> 1st. The weights have slipped off the rod several times since I have been at the station.
>
> 2nd. There was no precaution taken to prevent the weights from falling off the rod the nut on the end was alright, but the bolt or rivet that holds the rod together that caught on the beam of the landing.
>
> 3d. Did not delay winding the machinery until it had run down, but wound it up a few minutes before the accident occurred.
>
> 4th. There is no precaution we can take to prevent this nut on the end of this bolt that holds the rod together from hanging some times it does not happen all the time but once in a while but the weights does not fall off every time the rod hangs. I hope you will not be too hard on me this time it is the first I will try and not let it happen again.[135]

Comments were then supplied by Inspector E.P. Wood. He first relayed the above statement of the first assistant keeper and added his opinion:

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[131] Bergland, Eric, Lighthouse Engineer. *Letter to Light-House Board.* February 13, 1895.
Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[132] Jones, W.A ., Lt. Col., Lighthouse Engineer. *Letter to Lighthouse Board.* November 11, 1897.
Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[133] Jones. W.A., Lt. Col., Lighthouse Engineer. *Letter to Lighthouse Board.* May 30, 1898.
Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[134] Mackenzie, S. *Letter to Captain Perry, U.S. Light-House Board.* June 4, 1899.
Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[135] Simpson, F.E., 1st Assistant Keeper. *Letter to Inspector.* September 11, 1899.
Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.

> In my opinion, the keepers should not be dismissed, they being very efficient and the general condition of the station is very good condition in every respect. At my next inspection of the station an examination will be made to see what can be done to remedy this defect in construction.[136]

On August 19, 1899, "San Ciriaco," a Category-3 hurricane, made landfall at Hatteras with a 105-knot landfall intensity.[137]

An inspection of the light station occurred in November 1899 by Dr. H.S. Pritchett, Member and Captain Thomas Perry, USN, Naval/secretary of the Lighthouse Board:

> Station was in excellent order. Special attention was given to the suspension of the weights for the clockwork of the revolving machinery, and also to the effects of the great hurricane of August 17, 18, and 19, 1899.
>
> The only trouble with the rod suspending the weights was, the pin bolts at the joints were turned so as to engage the landing platform in case of the oscillation of the weights. They should have been disposed at right angles to this position. Nothing is necessary to be done, however, as the keepers had remedied the matter by a very simple contrivance. In the great storm the tower behaved very well indeed, and the rotation of the lens was perfectly satisfactory throughout. The keepers had to wade in water to their waists to get from the dwellings to the tower. The former leaked very badly, but no shingle roof can be made to resist the driving effect of water before such a wind. The tower windows also leaked badly, and large quantities of water came into the lantern through the cowl. The oscillation of the tower broke off considerable plaster at the junction of the beams which support the landing platforms of the stairway. The air was filled with "spoon drift" from the ocean waves to such an extent that the foliage on many of the trees all over the island was blighted and killed.
>
> The lens, lamp and outfit from the Hatteras beacon tower, whose site has been washed away, were taken on board the Jessamine.[138]

On June 1, 1900 it was reported that telephones were installed at the station to replace the old call-bell system.[139]

Correspondence dated September 1, 1900 notes that the revolving machinery and lens table had not been properly used for some time.

> The principal and one assistant keeper are newly appointed to this station and have had no experience with revolving machinery. The principal keeper who preceded this one had no previous experience with first-order revolving machinery. The first assistant keeper has been here many years, but even he is not sufficiently instructed in the use of this machinery. He does not recall that the lens has been leveled up for a long time. Had no idea in fact that it was out of level...
>
> There is no necessity for changing the characteristics of this lens, nor for changing the machinery. As soon as possible I will level up the lens table and place ball-bearing washers against the outer hub faces of the chariot wheels, and I think that the machinery will then work with satisfaction.

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[136] Wood, E.P., Inspector. *Letter to Light-House Board.* August 1, 1899.
Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[137] NOAA HRD. "Chronological List of All Hurricanes which Affected the Continental United States: 1851-2005."
[138] Jones, W.A., Lighthouse Engineer. *Letter to Lighthouse Board.* November 27, 1899.
Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[139] Jones, W.A., Lighthouse Engineer. *Letter to Lighthouse Board.* June 1, 1900.
Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.

> The pitting of the face of the steel plates on which the chariot wheels run may, in time, make it necessary to substitute new plates....
>
> I would suggest that at all stations where first-order lenses are revolved, keepers should be selected who have either had experience with revolving machinery or who have sufficient practical mechanical ability to enable them to thoroughly understand this simple machinery and its operation and adjustment, and I would further suggest that in all cases where keepers are appointed to such stations, they be instructed in the use of this machinery by the Engineer upon request of the Inspector.[140]

A monthly report dated October 1, 1900 stated: "All joints of the metal covering of the roof of the lantern have been brazed and made tight; also, the smoke pipe of lantern has been straightened and leak stopped."[141]

An October 15, 1900 update included the following: "Overhauled lens machinery thoroughly and set it up again. Same is now in good order, excepting two new roller cog wheel plates and new chariot wheels necessary. Same will be supplied as soon as possible."[142] It is assumed that the new chariot wheels were installed by the end of 1900.

In early 1903, inquiries began for the reuse of some of the old foundation stones from the original lighthouse.[143] The Light-House Board authorized Lighthouse engineer Jones "to consider that the DeForest wireless Telegraph Co. of Washington, DC, want stone for the foundation of their tower for the wireless telegraph station near Cape Hatteras, NC, to make one hundred cubic yards of concrete."[144] Jones replied: "...in order to dispose of this property, it will be necessary to have a public auction. About 60 cubic yards of stone will be required. While I do not approve of disposing this stone, which will, sooner or later, be required in repairs and improvements at this station and which can only be replaced at considerable expense, it might, perhaps, in the interest of science, be well to grant this request under lawful restrictions."[145]

In 1910, the U.S. Light-House Board was abolished by Congress. It was replaced by the Bureau of Lighthouses, under the purview of the Department of Commerce.[146]

In 1913, the illuminant for the lighthouse "was provided by an incandescent oil vapor (IOV) lamp using pressurized kerosene in a mantle. Official records show that kerosene still fueled the Cape Hatteras light as late [as] 1927."[147]

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[140] Jones, W.A., Lighthouse Engineer. *Letter to Light-House Board.* September 1, 1900.
Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[141] Jones, W.A., Lighthouse Engineer. *Letter to Light-House Board.* October 1, 1900.
Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[142] Jones, W.A., Lighthouse Engineer. *Letter to Light-House Board.* October 15, 1900.
Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[143] U.S. Light-House Board Engineer Secretary. *Letter to Lt. Col. W A. Jones, Lighthouse Engineer.* January 9, 1903.
U.S. Light-House Board Engineer Secretary . *Letter to Lt. Col. W.A. Jones, Lighthouse Engineer.* January 23, 1903.
Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[144] Jones, W.A., Lt. Col., Lighthouse Engineer. *Letter to U.S. Light-House Board Engineer Secretary.* February 11, 1903.
Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[145] Jones, W.A., Lt. Col., Lighthouse Engineer. *Letter to U.S. Light-House Board Engineer Secretary.* February 27, 1903.
Part of NARA's RG 26 Entry 3 (NC-63). Available for review at Cape Hatteras National Seashore Archives.
[146] NPS, "Cape Hatteras Light Station CLR," p. 17.
[147] National Park Service. "Cape Hatteras Light Station." *Website.*

A February 21, 1916, Magnitude-5.2 earthquake (Intensity VII), centered outside Asheville, NC, was felt at Cape Hatteras. The intensity on the coast was II-III.[148] It is unknown if any damage occurred to the lighthouse because of the quake.



Figure 37. The ca. 1920 replacement fence as seen in June 1936. Photo: Cape Hatteras National Seashore Archives.

In ca. 1920, the Bureau of Lighthouses removed the iron fence which was installed in 1870. Atop the original granite stones which formed the octagonal base, they then added new metal railings, about 3'-0" to 4'-0" high, set between white concrete posts (fig. 37).[149]

By 1919, the shoreline had encroached to within approximately 333'-0" of the lighthouse (fig. 38). Beginning in 1924 and for five years after that, the Commissioner of Lighthouses asked Congress for funds to support erosion control. Unfortunately, Congress was unresponsive. In 1930, however, as a result of damage by a hurricane, alterations were approved to the light station (fig. 39). This included installation of 900'-0" of "interlocking sheet pile groins" along the beach (fig. 40).[150]

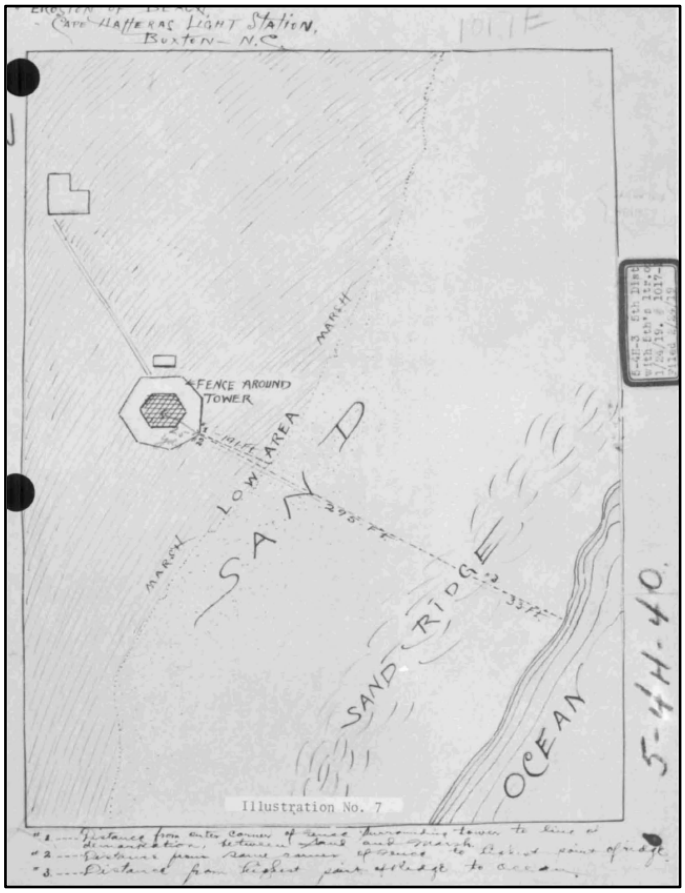


Figure 38. A drawing from ca. 1919 depicting the erosion at the light station. Source: Site File, Cape Hatteras Light Station, RG 26, National Archives. Copied from Holland, Jr.'s "A History of Cape Hatteras Light Station."

On September 16, 1933, a Category-3 hurricane made landfall at Ocracoke, south of Cape Hatteras, with a 100-knot landfall intensity.[151] The installation of the 1930 groins did not deter storm-driven water to move within 100'-0" of the tower. That same year, more steel groins were installed.[152]

Until this time, the lamp had used electricity to power its light, and the clockwork and weight system still turned the lens. In 1934, the entire mechanism was electrified, and the manual mechanisms were no longer needed.[153]

[148] USGS, Earthquake Hazards Program. "North Carolina Earthquake History." *Website*.
[149] NPS, "Cape Hatteras Light Station CLR," p. 14.
[150] Holland, Jr., "A History of Cape Hatteras Light Station."
[151] NOAA HRD. "Chronological List of All Hurricanes which Affected the Continental United States: 1851-2005."
[152] NPS, "Cape Hatteras Light Station CLR," p. 12.
[153] National Park Service. "Cape Hatteras Light Station." *Website*.





Figure 40, above. Interlocking sheet pile groins located along the beach, as seen in November 1936. Photo: Cape Hatteras National Seashore Archives.

Figure 39, left. The lighthouse, as seen from the roof of the principal keeper's quarters on March 2, 1927 shows water washing over the land between the buildings. Photo: Cape Hatteras National Seashore Archives.

Because of the new battle with beach erosion near the lighthouse tower, the Bureau of Lighthouses began the process to acquire land to build a new light station. Cape Hatteras Keeper Unaka Jennett owned the land which the bureau preferred. After negotiations, Jennett sold the land to the Bureau for $266,880 in 1935. Because of defects in the title and the emergency (erosion) causing the procurement of the land, both parties agreed to condemnation proceedings. This resulted in a court case, and the Bureau officially acquired the land in 1936. Meanwhile, a new 150'-0"-tall skeleton tower, painted black was constructed on the new land which was located approximately 1½ miles WNW from the 1870 tower. It was completed on September 18, 1935 (fig. 41).[154]

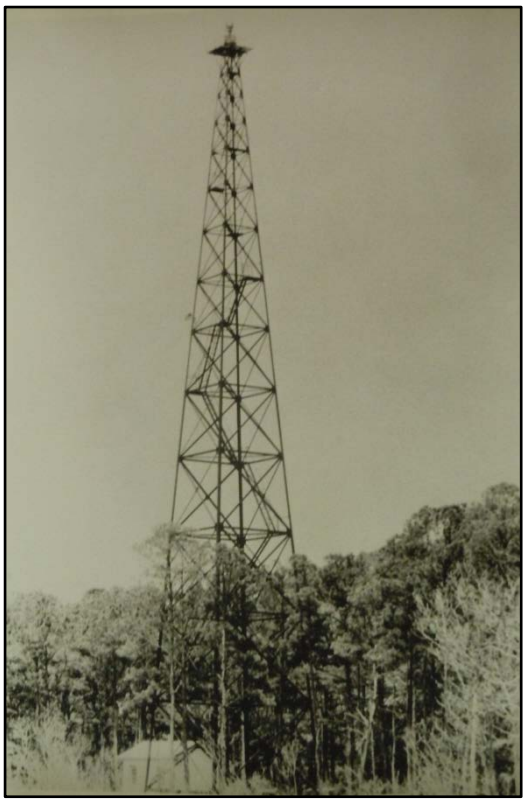


Figure 41. The new skeleton tower as seen on June 22, 1936. Photo: Cape Hatteras National Seashore Archives.

At the time of the new steel tower's completion, a Civilian Conservation Corps (CCC) camp was established on Hatteras Island, approximately half a mile southwest from the 1870 lighthouse (fig. 42). The camp housed two hundred men.[155] The CCC

[154] Holland, Jr., "A History of Cape Hatteras Light Station."
[155] NPS, "Cape Hatteras Light Station CLR," p. 18.

camps were assigned to the "Outer Banks to protect the shore and revitalize the natural vegetation of the islands" (fig 43). The efforts by the CCC "resulted in the construction of a series of wooden revetments and sand fences to check erosion. Sand fences constructed both in front of and behind the lighthouse lowered wind velocity and allowed dunes to form."[156]

On May 13, 1936, the new light tower, or the "Buxton Light," was activated. It had "a 90,000 candlepower flashing light. The beacon was…166 feet above sea level and could be seen nineteen miles at sea."[157] Two days later, on May 15, the light on the1870 lighthouse was extinguished.[158]



Figure 42. The CCC camp in 1936, located SW of the lighthouse. Photo: Cape Hatteras National Seashore Archives.



Figure 43. CCC men planting grasses at the light station in 1937. Photo: Cape Hatteras National Seashore Archives.

Formation of a National Park

In 1934, at the request of the Secretary of the Interior, the National Park Service (NPS) surveyed "the seashores of the continental United States to ascertain whether there were remaining relatively unimpaired areas of such outstanding character and magnitude as to be worthy of acquisition and preservation by the people of the United States as National Seashores." The survey revealed that the Outer Banks of North Carolina "presented one of the finest opportunities to establish and preserve as a national Seashore an area of great biological interest, scenic beauty, historical value, and recreational appeal." It was recommended that the seashore be added to the national park system.[159]

On July 31, 1936, shortly after the newest Hatteras Lighthouse was activated, Secretary of the Interior Ickes…

> …approved a plan to transfer the [former] Cape Hatteras Lighthouse property (about forty-four acres) to the Park Service for designation as a National Historic Site. His reasons included that the light could be obtained without cost, it was historic, and it was "an outstanding example

[156] Ibid, p. 18.
[157] Yocum, Roberts, & Shelton-Roberts, "Cape Hatteras," pp.65-67.
[158] National Park Service. "The Creation and Establishment of Cape Hatteras National Seashore." 2007, p. 43.
[159] National Park Service. "History of the Establishment of Cape Hatteras National Seashore Recreational Area." July 13, 1961. NPS DSC eTIC No. CAHA 603 D136. P.1

> of a picturesque and fast-disappearing type no longer constructed." Moreover, the light fit in well with general NPS plans for development along the North Carolina coast that was also associated with the historic sites of Wright Brothers Memorial and Fort Raleigh."[160]

The Department of the Interior formally requested title to the light station on August 4, 1936. On August 31, Acting Secretary of the Treasury Wayne C. Taylor notified the Secretary of the Interior that the NPS would receive the light station and its grounds.[161]

The "Cape Hatteras Lighthouse Reservation" was formally transferred to the National Park Service on November 9, 1936, with its "illuminating apparatus and other objects which add to the historical background of the lighthouse tower left intact until such time as they might again be needed by the Lighthouse Service." E.J. Byrum, the Project Supervisor for the CCC camp, had been designated the custodian of the property in September 1936, on behalf of the NPS.[162]

The transfer was publically announced on December 6, 1936. Five days later, Conrad Wirth, the NPS supervisor for CCC activities in parks, wrote to Byrum regarding repairs to the lighthouse. He advised Byrum to use CCC labor and funds as necessary.[163]

In March 1937, a field investigation and photographic survey of the lighthouse was undertaken by F. E. Whitehouse and Charles Porter respectively. The field investigation noted the following: no settling had occurred in the brick and granite work despite the sand foundation; the exterior brickwork was in excellent condition due to paint covering; cracks could be seen on the inner wall, but were deemed "old" due to obliteration by many paint layers; interior cast and wrought iron in good condition; exterior metal work of the balconies was rusted badly in some locations; all railings and some cast posts were not securely fastened; some leaking had occurred at the roof "due to the opening of joints"; broken window panes had caused leaking and rusting; window hoods and sash were badly rusted, including fallen pieces of the hoods; lens apparatus in excellent condition. Recommendations for preservation of the structure and securing it for safe visitor use included:

1. Repairs to the copper roof, including re-soldering, or if needed, replacement.
2. Replacement of "cast iron window heads, pediment and brackets" with new castings or lead-coated copper replicas "where rusting has progressed far enough to be considered dangerous or joints have opened."
3. Replacement of all "broken or leaking glass in the lantern and the window below…with the proper thickness of glass to fit the glass stops provided," with special consideration given to installing obscure glass at the service room level.
4. Cleaning and repairs to window sash, installation of new hinges.
5. Replacement of the entire railing at the main gallery floor level for visitor safety.
6. Installation of safety guard rail/chain at the balcony around the lantern.
7. Cleaning/chipping of all exterior metal work and repainting.
8. Cleaning/chipping of all interior metal work and repainting/re-oiling.
9. Repainting of the exterior brickwork.
10. Repointing of granite base, quoins, and belt course.
11. Repointing of interior cracks in brickwork; repainting of interior with "at least three coats of white cement paint."

[160] NPS, "The Creation and Establishment of Cape Hatteras National Seashore ,", p. 44.
[161] Yocum, Roberts, & Shelton-Roberts, "Cape Hatteras," pp. 67-68.
[162] NPS, "The Creation and Establishment of Cape Hatteras National Seashore," pp. 44-5.
[163] Ibid, p. 45.

12. Repainting and re-glazing inner vestibule doors.
13. Repairs to hardware on inner and outer vestibule doors, and the gallery door.
14. Installation of new water proof shades to fit extant rollers at the top of the lantern.

In summation, Whitehouse noted "this structure is definitely worthy of preservation," despite the non-expectation of many future visitors. "It is our firm belief that the above listed repair operations are all important, and if carried out correctly, would greatly extend the life of this structure."[164]

The survey shows that the exterior paint was showing wear, but at that time, the interior of the lens and its related mechanical equipment appeared to be in good condition (figs. 44-49).

During the summer of 1937, repairs were made to the lighthouse by NPS and CCC staff.[165] Because of the CCC work to construct the wood revetments and sand fences, the dunes were of "considerable height" by 1937. Afterward, shoreline erosion was somewhat reduced, but the ocean was still only 600'-0" from the lighthouse.[166]

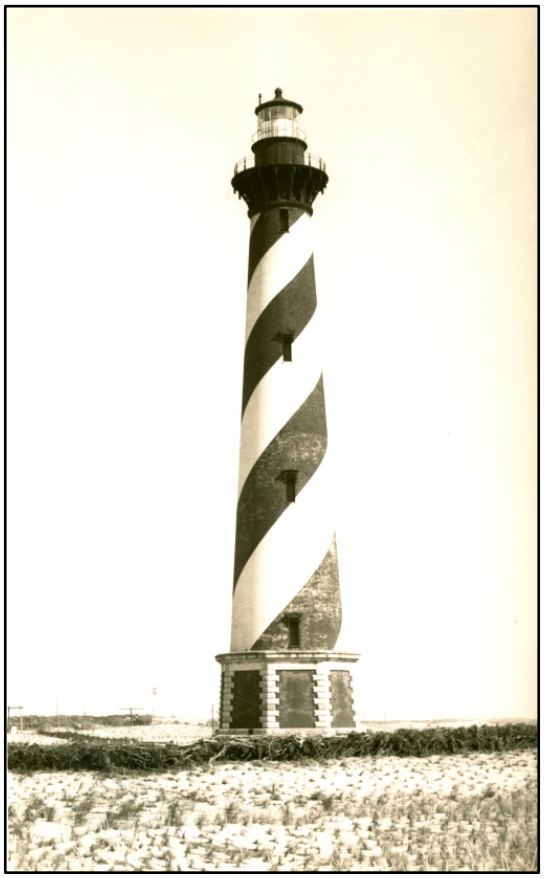


Figure 44. The south elevation of the lighthouse in March 1937. Photo: Cape Hatteras National Seashore Archives.



Figure 45. A view of the base, entrance, and lower portion of the tower in March 1937. Note the degraded paint, detail of the window hood, and buried perimeter fence. Photo: Cape Hatteras National Seashore Archives.

[164] Whitehouse, F.E., Associate Engineer. "A Field Investigation of Cape Hatteras Lighthouse, Buxton, North Carolina." March 15-18, 1937. Cape Hatteras National Seashore Archives.
[165] Yocum, Roberts, & Shelton-Roberts, "Cape Hatteras," p. 68.
[166] NPS, "Cape Hatteras Light Station CLR," p. 18.



Figure 46. The exterior of the lighthouse from the west in March 1937. Photo: Cape Hatteras National Seashore Archives.



Figure 47. The interior of the first-order Fresnel lens in March 1937. Photo: Cape Hatteras National Seashore Archives.

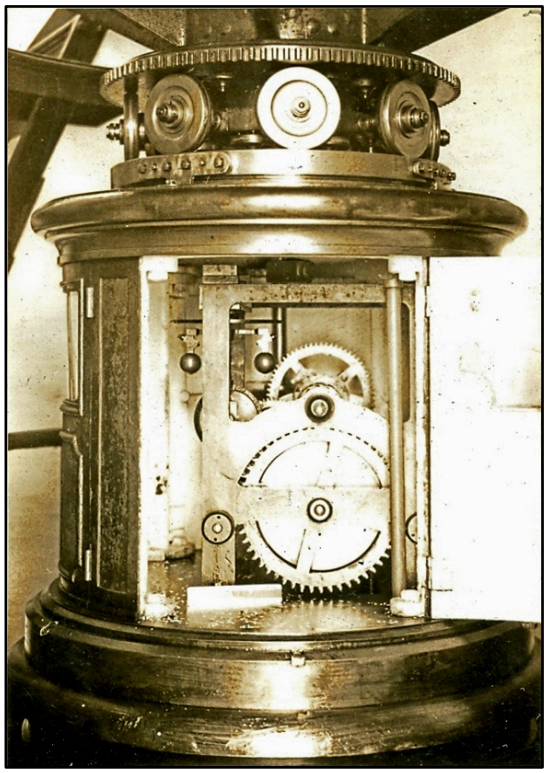


Figure 48. The interior of the clockworks with rotating chariot wheel above. Photo: Cape Hatteras National Seashore Archives.

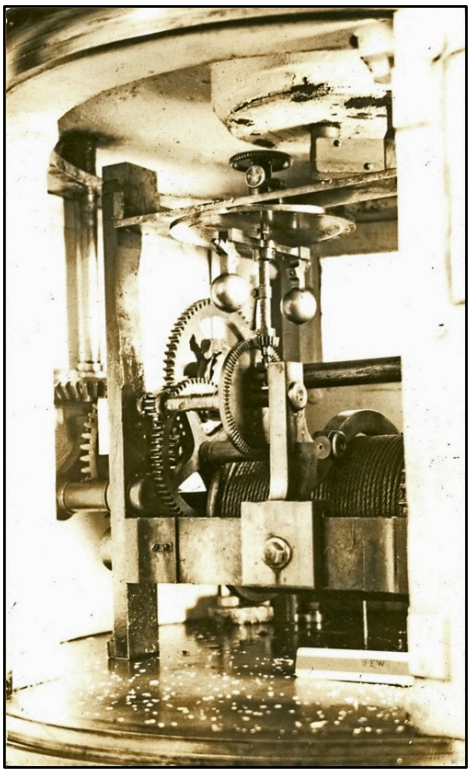


Figure 49. The interior of the clockworks at the gallery level. Photo: Cape Hatteras National Seashore Archives.

On August 2, 1937, the House of Representatives unanimously passed the Cape Hatteras park bill. On August 14, the Senate passed the bill and sent it to the President. "The bill authorized the creation of Cape Hatteras National Seashore, contingent upon donation of ten thousand acres of land by the state of North Carolina or private gift within a period of ten years." On August 17, 1937, President Roosevelt signed the bill.[167]

On November 11, 1937, the light station was transferred to the NPS. Even though the park was not operational at the time, the light station were included as part of the nation's first National Seashore.[168] However, it was not until 1939 that the property was used for any recreational or tourist use when the CCC began giving tours of the lighthouse (fig. 50).[169]

On February 14, 1939, "Horace A. Dough, Custodian of Kill Devil Hill National Monument, [was appointed] as acting custodian of both the Cape Hatteras and Currituck Lighthouse reservations." E.J. Byrum continued to lead CCC efforts, but received Dough's authorization and direction as needed.[170]

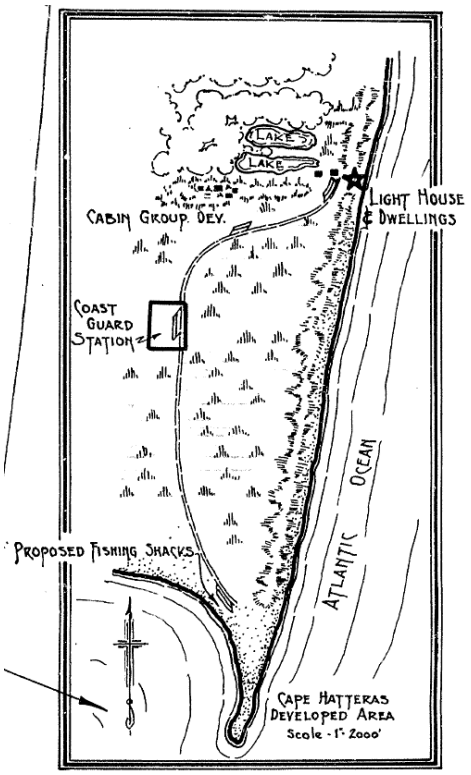


Figure 50. January 1939 GMP site plan showing the layout of the Cape Hatteras Developed Area. Drawing: NPS DSC eTIC No. CAHA 603 2060. Cropped by author.

Also in February 1939, a site plan was made showing the movement of the Atlantic Ocean closer to the light station. Between 1852 (old tower) and 1872 (new tower just completed), the ocean moved 720'-0" closer to the lighthouse. Between 1872 and 1937, the ocean had moved an additional 1,420'-0" feet closer to the lighthouse. In 1939, the lighthouse was approximately 600'-0" from the shoreline (fig. 51).

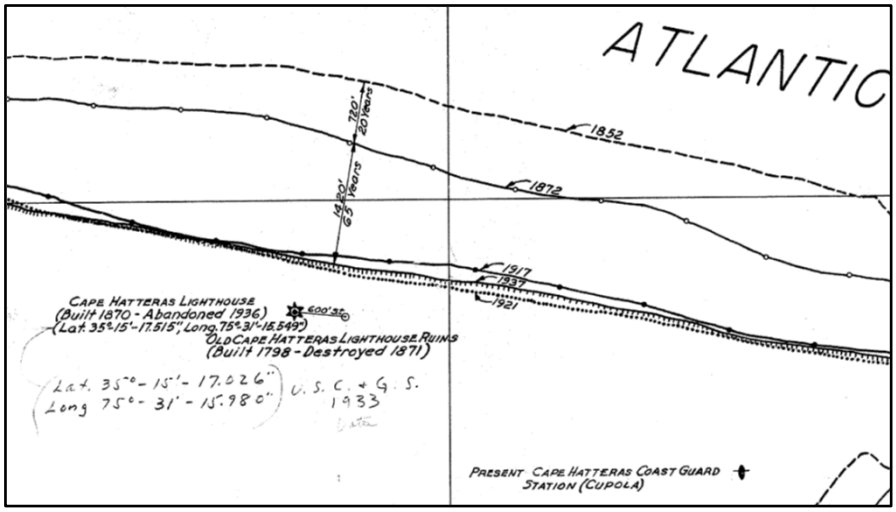


Figure 51. A 1939 site plan showing the erosion of the shoreline toward the lighthouse. Drawing: NPS DSC eTIC No. CAHA 603 5300 Z1. Cropped by author.

[167] NPS, "The Creation and Establishment of Cape Hatteras National Seashore," p. 35-7.
[168] National Park Service. "Cape Hatteras Light Station." *Website.*
[169] National Park Service. "Cape Hatteras Light Station." *Website.*
[170] NPS, "The Creation and Establishment of Cape Hatteras National Seashore," p. 45.

In preparation of the United States' likely participation in World War II, the United States Light House Service was absorbed by the United States Coast Guard (USCG) in 1939. This was part of President Franklin Roosevelt's second reorganization plan. It was an announced on May 9, 1939 and became official in June 1939.[171]

The CCC camp at Buxton was shut down on March 31, 1940. (All coastal CCC work would cease in 1942.)[172]

On June 29, 1940, the park was re-designated Cape Hatteras National Seashore Recreational Area.[173]

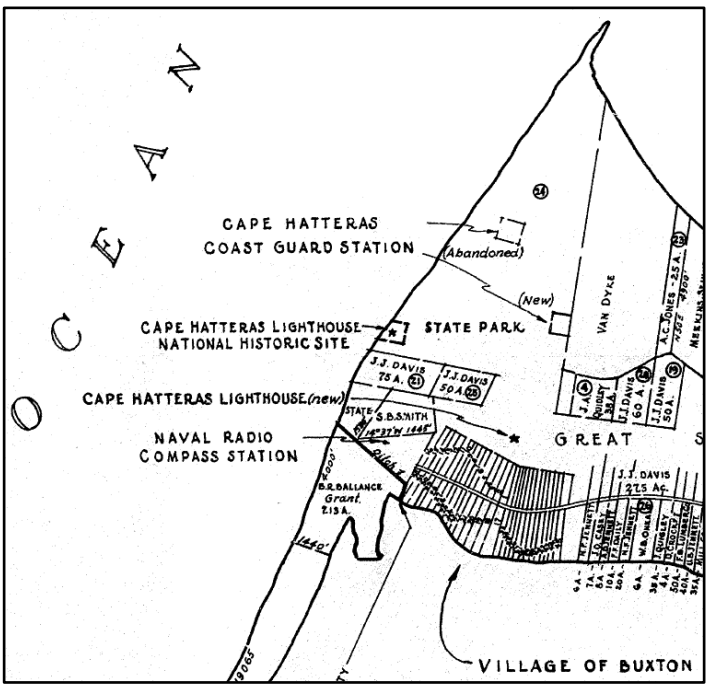


Figure 52. A December 1941 site plan of the Cape Hatteras Lighthouse National Historic Site, the State Park surrounding it, and other area landowners. Drawing: NPS DSC eTIC No. CAHA 603 2018. Cropped by author.

An August 1940 site plan for the development of the light station shows the introduction of parking and a new restroom facility to the west of the lighthouse. In was approved by the Acting Regional Director the next month.[174] Another site plan, dated January 3, 1941 shows the parking lot and restroom facility had been constructed by that time.[175]

After much debate, on January 16, 1941, NPS Chief Historian Ronald F. Lee "recommended that the lighthouse and surrounding state park lands be together designated as a national historic site that would eventually be absorbed by...Cape Hatteras National Seashore Recreational Area" (fig. 52).[176]

On January 29, 1942, after the United States entered World War II, "the Coast Guard leased the Cape Hatteras lighthouse under a special permit for use as a coastal watchtower to scout for German 'U-boats,' which were menacing shipping lanes even before U.S. entry into the war and sunk dozens of ships in the early months of 1942."[177]

In September 1943, lighthouse inspector Lieutenant Commander F. Phippany raised the issue of reestablishing the Hatteras Lights with his superiors:

[171] Yocum, Roberts, & Shelton-Roberts, "Cape Hatteras," pp. 70-4.
[172] NPS, "The Creation and Establishment of Cape Hatteras National Seashore," pp. 46-7
[173] NPS, "History of the Establishment of Cape Hatteras National Seashore Recreational Area," p. 2.
[174] National Park Service, Branch of Plans and Design, Regional Office. "Park Road Realignment." *1 drawing sheet.* August 7, 1940. NPS DSC eTIC No. CAHA 603 2002.
[175] National Park Service. "State Park Area Development Plan, Part of the Master Plan, Cape Hatteras national Seashore Recreational Area, North Carolina." *1 drawing sheet.* January 1, 1941. NPS DSC eTIC No. CAHA 603 2013.
[176] NPS, "The Creation and Establishment of Cape Hatteras National Seashore," p. 45.
[177] Ibid, p. 46.

> In the course of travel to Cape Hatteras, [I] took the opportunity to inspect the old brick lighthouse at Cape Hatteras. It is in an excellent state of preservation. The lens, lens chariot, and clockwork could be put in use in a short time by cleaning and oiling. While a number of lantern panes are cracked, the lantern is otherwise in good shape. The wiring from the lens to the base of the tower appears O.K.-It is suggested that consideration be given to the exhibition of the Cape Hatteras light from the tower rather than the steel tower located back in Buxton Woods. It would be much more accessible to the new Cape Hatteras Coast Guard Station.[178]

It is unknown if Phippany received a response to his suggestion.

On September 14, 1944, the "Great Atlantic Hurricane," a Category-3 hurricane, made landfall at Cape Hatteras with a 100-knot landfall intensity.[179] It "did great damage to much of what the WPA-era erosion control efforts had accomplished."[180]

In October 1944, Phippany again contacted his superiors:

> We inspected the old Hatteras Light on this trip. I inspected this tower about 13 months ago and on return to Headquarters recommended consideration be given to re-establishment of the Cape Hatteras Light in the old tower.
>
> That recommendation is renewed for the following reasons:
>
> a) The shoreline is moving further away from the tower. The recent severe hurricanes have not changed the tendency of the beach to move out at Cape Hatteras.
> b) Although the National Park Service has evidently made some of the repairs on the tower including a good paint job inside and out, it is not locked, nor has it been for some months, if we may believe local gossip, and considerable vandalism is occurring particularly to the lantern and lens. The lens, a beautiful example of a first order 24 panel symmetrical Fresnel lens has been permanently ruined by the removal of practically two complete flash panels and a start has been made on a third flash panel.
> c) There is no more excellent land mark than this tower and the light should be exhibited from the same point.
> d) It is only about one mile from the Lifeboat Station and this convenient for maintenance by Coast Guard personnel.
>
> I consider it a pity to continue to fail to utilize this splendid tower as a lighted aid to navigation.[181]

Even though Phippany's superiors seemed to hear his recommendation...

> ...they were still unsure that the efforts to hold back the ocean would continue to be successful. They suggested keeping the beacon on the steel tower for a period of two or three years in order to better support the conclusion that the beach is no longer subject to excessive erosion. In the meantime, the old tower could be properly cared for thus preventing undue deterioration and should conditions finally suggest that the old tower be relighted, steps could be taken to effect the change probably with greater facility and at less cost than the present time.
>
> Unfortunately, Phippany's superiors had missed a key element of his report. Vandals were attacking the lighthouse, stealing sections of the beautiful lens and breaking whatever they could not carry home as souvenirs. For another two years, little would be done to arrest the destruction. By the time any official action was implemented it was too late. The Fresnel lens, the wonderfully complex heart of the Cape Hatteras Lighthouse, had been destroyed.

[178] Yocum, Roberts, & Shelton-Roberts, "Cape Hatteras," p. 81.
[179] NOAA HRD. "Chronological List of All Hurricanes which Affected the Continental United States: 1851-2005."
[180] NPS, "The Creation and Establishment of Cape Hatteras National Seashore," p.66.
[181] Yocum, Roberts, & Shelton-Roberts, "Cape Hatteras," pp. 81-2.

In November 1946 Horace Dough, the site custodian, reported on the condition of the lighthouse.

> On a recent inspection trip of the Cape Hatteras Lighthouse property I found the lighthouse had been broken open by vandals and many of the window panes broken out. I also found that most of the heavy glass prisms that form the powerful lens for the light had been removed from about twenty-eight panels in the lens....
>
> I noted that the heavy door lock on the steel entrance door had been torn off and the Coast Guard had refastened the door with a heavy iron chain and the doors had been broken open again by prying the bolts that held the heavy chain out of the steel doors.
>
> Since the Cape Hatteras Lighthouse was turned over to the Coast Guard in January, 1942, in order that they might establish a coastal look out station in the tower thereof—this office has never received any notice that the Coast Guard had turned it back over to the National Park Service—we assumed that it was still under the protection of the Coast Guard.
>
> If the Coast Guard has not relinquished their permit to use the lighthouse it seems to me that they might be willing to return it to our custody in as good condition (natural water and tear accepted [sic]) as it was when we turned it over to them and in the event it has been officially returned to our custody perhaps they would be willing to give us a hand in restoring the damage.[182]

By December, Dough's report had reached the highest levels of the NPS and the USCG. Another inspection of the lighthouse occurred which further discussed the damages.

> Subject lighthouse has been inspected and the following deficiencies noted.
>
> a) Window panes in outside frame at top broken
> b) Rail on outside at top badly rusted. One bottom section of rail missing.
> c) Lens on inside frame that protects main light is a total distruction [sic].
> d) Light missing and light stand is badly damaged.
> e) Both top decks badly rusted.
> f) All doors, windows, rails and lockers need replacing.
> g) Large crack from top deck visible.
> h) Fence around lighthouse total destruction.
> i) Lighthouse needs painting inside and out and all iron work needs chipping and painting.[183]

In a January 1947, the USCG tried to defend itself. . . .

> ...saying they cared for the lighthouse as well as they could during the time of war, but that the Coast Guard has ceased to use the lighthouse property "sometime before the cessation of hostilities." In addition, it was inferred that the vandalism was inevitable, but promises were made to provide better security at the lighthouse.
>
> Before long, local newspapers picked up the fight, accusing the park service, not the Coast Guard, of allowing the Cape Hatteras Lighthouse to fall into disrepair. The criticism stung park service officials who had already spent months coaxing even a minor level of cooperation from Coast Guard brass. At first glance, however, it is easy to understand the confusion. Although the Coast Guard had been responsible for the lighthouse during the war, their permit had expired [on August 15, 1947]. The lighthouse was again park service property.
>
> Throughout the remainder of 1947, park service and Coast Guard officials batted the issue of responsibility back and forth. Although increased security and surveillance seemed to have arrested any more significant vandalism, the damage had been done. Worse, the broken

[182] Ibid, p. 83.
[183] Ibid, pp. 83-84.

> windows and doors were letting the fierce weather of the island gain ground on the tower. Rust and decay were beginning to take their toll.
>
> Despite continued pressure by local park service staff and the local papers, little was done to current the situation at the lighthouse throughout the remainder of 1947 and the early part of 1948."[184]
>
> In April 1948, the Coast Guard requested a special-use permit to continue its use of the Cape Hatteras Lighthouse, now mainly as an aid to navigation. It proposed to install a new more-modern light and to pay considerable costs to restore the lighthouse to use. . . . Finally, the Park Service accepted an offer by the Coast Guard to replace the broken light with a similar one retired from another light. Unfortunately, no new Fresnel lens was ever found and a modern fixture eventually had to be installed.[185]

An interesting letter dated May 20, 1948 noted "A cracked plate glass window in the eighth floor of the tower is unusual in that it was cast in a brick mould. It is about 1½ thick, it does not leak. We should like to preserve this glass as it is."[186]

National Park Service Regional Director, Elbert Cox, travelled to the lighthouse in June 1948, and reported the following (fig. 53):

> I climbed to the top of the tower very hurriedly during my trip to Hatteras in early May. I did not have the opportunity to make a thorough investigation, but I am sure that much more damage has been done to the old light and machinery than you realize. All of the prisms, except one, in the vertical panels or sections of the light have been broken or are gone. The larger prisms at the top and base portions of the light were apparently too strong for the tools at hand so remain in place, although the fine edges are badly chipped and scarred. I could see little or nothing in the way of machinery or parts which operated the old light.[187]



Figure 53. The lighthouse as seen on May 8, 1948. Photo: Cape Hatteras National Seashore Archives.

NPS planner Arthur Perkins visited the site in October 1948 and reported that "It is, in fact, a disgrace. It appears the condition of the tower is a sore subject locally and with very good reason, even though it may not be just to attribute the fault to this Service."

The USCG relented and met with the NPS in November 1948 to assess damage to the lighthouse and determine repairs which were necessary. The USCG made the required repairs in 1949. This included painting the interior and the exterior;

[184] Ibid, pp. 84-85.
[185] NPS, "The Creation and Establishment of Cape Hatteras National Seashore," pp. 47-8.
[186] Drury, Newton B., Acting Commandant USCG. *Letter to Rear Admiral Merlin O'Neill, USCG.* May 20, 1948. Cape Hatteras National Seashore Archives, Box: CAHA Lighthouse Fresnel Lens, HA284. "Items Worth Noting from Old Lighthouse Lens File."
[187] Yocum, Roberts, & Shelton-Roberts, "Cape Hatteras," p. 86.

restoring the windows; installing 6'-0"-tall chain-link fence around the lighthouse and oil house to prevent vandalism; and removal of the remaining portions of the Fresnel lens for safekeeping at Kill Devil Hills National Monument (fig. 54). The USCG was also to find a replacement historic lens, but never followed through. They also agreed to be responsible for the structure's upkeep.[188]

After this work, the 1870 Cape Hatteras Lighthouse was reactivated by the USCG on January 23, 1950.

> Under joint management with the National Park Service, the Coast Guard had installed commercial power lines and a new forty-inch lens made by Corning Glass Works that emitted three times the light of the old French-built Fresnel lens, which vandals had damaged during the war after the lighthouse was left unprotected by the Coast Guard. The new light was fully automatic and utilized a Swedish-built clock to turn the light off and on and to adjust it for differences in the length of days [fig. 55].
>
> Reactivation of the lighthouse...was possible mainly because experimental erosion-control efforts conducted under NPS oversight during the 1930s were successful in extending the shoreline, at least in the immediate vicinity of the light. The unsightly steel-framed lighthouse tower that had replaced the historic lighthouse had never endeared itself to locals, and its location two miles from shore limited its use as a daymark. The old lighthouse continued to serve as a daymark, but the considerable distance between it and the night light confused mariners and was blamed for at least one ship sinking. Thus, for entirely practical reasons, the Coast Guard worked with the Park Service to return the lighthouse to service, and in 1950 the park Service reopened the tower to visitors on a limited basis."[189]



Figure 54. Upper dioptric and catadioptric prism panels removed from the lighthouse in ca. 1949. Photo: Cape Hatteras National Seashore Archives. Cropped by author.



Figure 55. The duplex lens assembly as seen on June 22, 1956. Photo: Cape Hatteras National Seashore Archives.

[188] Ibid, pp. 85-86.
[189] NPS, "The Creation and Establishment of Cape Hatteras National Seashore," p. 97.

Between 1950 and 1951 the North Carolina Highway 12, which runs from the north down to Hatteras Island, was constructed, as was a ferry service at Oregon Inlet.[190]

In 1951, discussions between the NPS and the USCG occurred on the repair of the original Fresnel lens. A letter from the Coast Guard to the NPS stated:

> The repair of an old lighthouse lens would normally be a very impractical procedure. In the first place there are no design drawings of these lenses available, the lenses having been manufactured in France many years ago. From the very nature of the materials, glass and brass, no repairs due to deterioration have ever been needed. There are actually no such things as repair parts. In the extremely rare cases where a lighthouse lens in service has been damaged beyond the point of usefulness it has been replaced with another complete lens. It appears to this office that if the Cape Hatteras lens were to be repaired it could only be done by some "specialty" glass fabricator who would make detailed drawings from the actual lens, make molds for the various segments and then cast the individual pieces. Even if such a glass fabricator could be relocated and interested the cost would probably be prohibitive.[191]

In 1953, after years of negotiations, fundraising, meetings, site visits, and surveys, the stars aligned for the formal formation of the national park.

> On January 12, 1953, [NPS Director] Wirth recommended that Secretary [of the Interior] Chapman approve an order, consistent with Section 4 of the Act of August 17, 1937, directing that certain lands on the Outer Banks of North Carolina be "administered, protected, and developed by the National Park Service for national seashore recreational purposes for the benefit and enjoyment of the people. This order marked the formal establishment of Cape Hatteras National Seashore Recreational Area, although the date was not immediately observed, however, because the land acquisition process was not complete. In 1959, the year after the park's formal dedication, Region One Director Elbert Cox authorized the park's second superintendent, who had no record of when the park was officially established, to use January 12 as the date for annual observances of the park's creation.[192]

The new park's boundaries were detailed in a site plan dated October 27, 1952 (fig. 56). Lighthouse climbs by visitors began in 1953; uninterrupted free climbing continued until 1975.[193]

During the month of August 1954, the NPS…

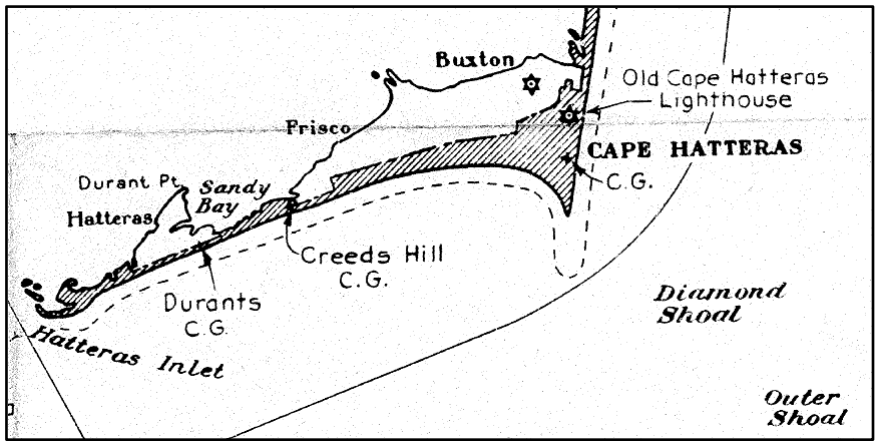


Figure 56. The late-1952 site plan showing a portion of the boundary of the new park. Drawing: NPS DSC eTIC No. CAHA 603 7017B. Cropped by author.

[190] NPS. "Cape Hatteras Light Station." *Website*.
[191] O'Neill, Merlin, Vice Admiral, Commandant USCG. *Letter to A.E. Demaray, Director, NPS.* May 21, 1951. Cape Hatteras National Seashore Archives, Box: CAHA Lighthouse Fresnel Lens, HA284. "Items Worth Noting from Old Lighthouse Lens File."
[192] NPS, "The Creation and Establishment of Cape Hatteras National Seashore," pp. 121-2.
[193] NPS, "Cape Hatteras Light Station," *Website*.

> ...announced the beginning of a major study of natural and cultural features of the Cape Hatteras seashore area. The study sought specifically to investigate the effect of storms and recent vegetative changes as well as geologic changes as the Outer Banks slowly migrate. Under the direction of [geologist Richard J. Russell, director of Coastal Studies Institute of Louisiana State University (LSU), LSU geographer Gary S. Dunbar, and archeologist William G. Haag were contracted as lead investigators to research published and archival collections pertaining to the area." From these studies, Geographical History of the Carolinas by Gary S. Dunbar and Fred Knives was released in 1957 and Historical Geography of the North Carolina Outer Banks by Dunbar was released in 1958. The studies were "intended for park management purposes and for an academic audience."[194]

On October 15, 1954, Hurricane Hazel, a Category-4 hurricane, made landfall near the South Carolina-North Carolina border, with a 115-knot landfall intensity.[195]

"President Eisenhower's budget request to Congress for FY1955 included $207,350 in total funds to operate Cape Hatteras National Seashore. These funds would allow the Park Service to proceed with management, protection, maintenance, rehabilitation and construction projects at the seashore."[196]

A site plan dated 1955, shows the fence surrounding the lighthouse was to be removed down to the granite foundation stones original to the 1870 site (figs. 57-58). The plan also shows another planned parking area and new configuration of the buildings as a ranger station and museum.

A hurricane in July 1955, Hurricane Connie on August 8, 1955 (Category 3 with 100-knot landfall intensity), Hurricane Ione on September 9, 1955 (Category 3 with 100-knot landfall intensity), and a winter storm in April 1956 "caused so much damage to the coastline that it was 'considered a disaster area.'"[197]

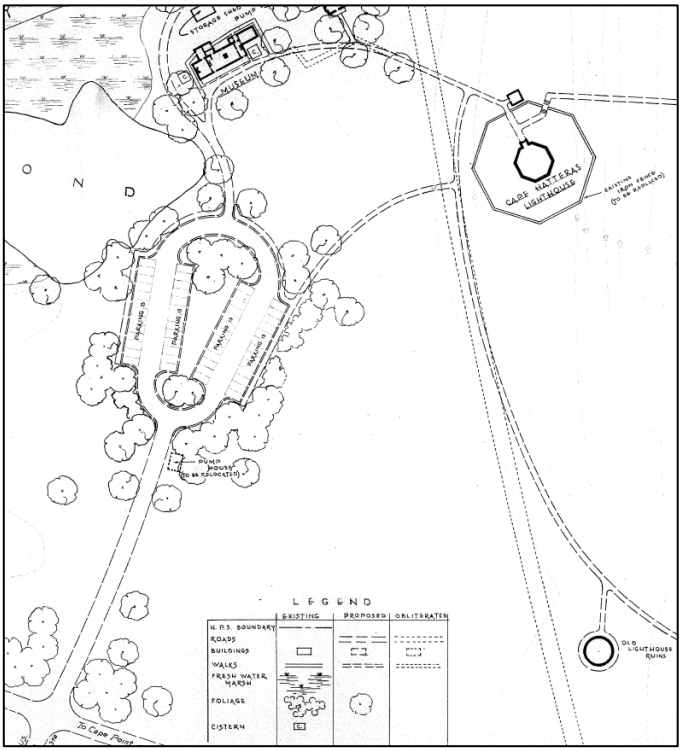


Figure 57. The 1955 site plan depicting the light station. Drawing: NPS DSC eTIC No. CAHA 603 3025. Cropped by author.

[194] NPS, "The Creation and Establishment of Cape Hatteras National Seashore," pp. 140-1.
[195] NOAA HRD. "Chronological List of All Hurricanes which Affected the Continental United States: 1851-2005."
[196] NPS, "The Creation and Establishment of Cape Hatteras National Seashore," p. 139.
[197] NOAA HRD. "Chronological List of All Hurricanes which Affected the Continental United States: 1851-2005."

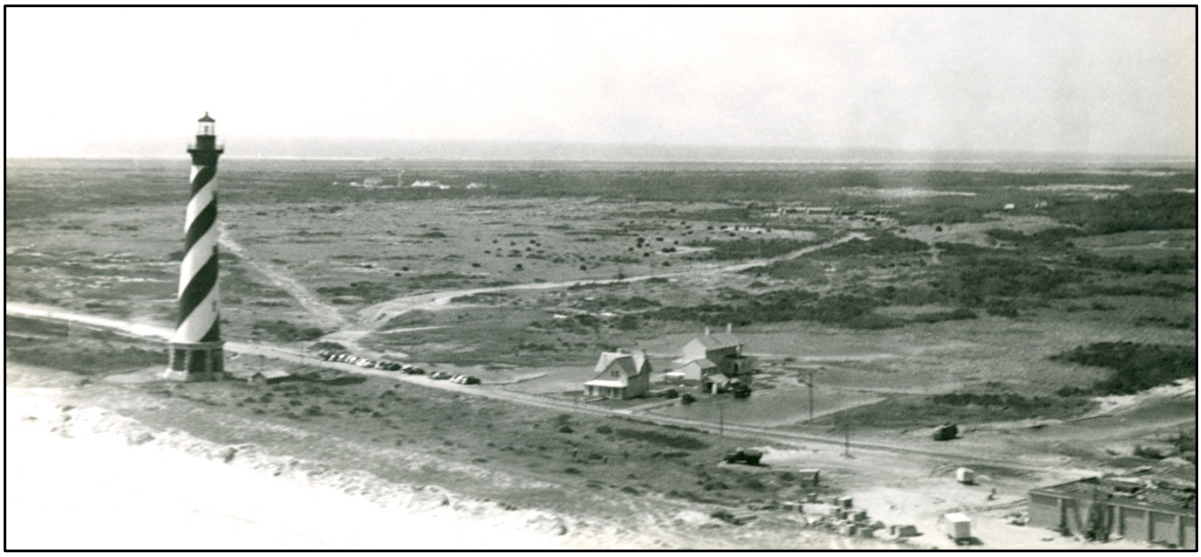


Figure 58. The light station in 1955. Note the fence around the base of the lighthouse has been removed and the presence of cars due to construction of the major road to Hatteras Island. Photo: Cape Hatteras National Seashore Archives.

Cape Hatteras National Seashore & Erosion Control Efforts

Mission 66 was launched by President Eisenhower on February 2, 1956 with urging from NPS Director Wirth.[198] Mission 66 was a decade-long program (1956-1966) of capital improvements to the deteriorating National Park Service infrastructure, due to an influx of visitation after World War II. The year 1966 coordinated with the fiftieth anniversary of the formation of the NPS.[199]

The Cape Hatteras National Seashore Mission 66 Prospectus included the following management priorities:

1) Control beach erosion above all improvements.
2) Contain dune breaches where over-wash had denuded areas of vegetation.
3) Rehabilitate the CCC dune system and maintain it perpetually.
4) Provide adequate roads, walkways, trails, and parking to overlooks, beaches, ponds, and forests.
5) Avoid heavy concentrations of people in any one area.[200]

The Prospectus was approved by Director Wirth on November 15, 1956.[201]
Just prior to this approval, in "the middle of October 1956, the Dune Construction and Beach Rehabilitation Project began." It "was intended to carry on the work done by the WPA and CCC some twenty years previous."[202]

Even though the park had been developing for several decades, it was not until April 24, 1958 that Cape Hatteras National Seashore was dedicated.[203]

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[198] NPS, "The Creation and Establishment of Cape Hatteras National Seashore," p. 159.
[199] See http://www.mission66.com/mission.html for more information (accessed September 29, 2015).
[200] NPS, "Cape Hatteras Light Station CLR," p. 24.
[201] NPS, "The Creation and Establishment of Cape Hatteras National Seashore," p. 161.
[202] Ibid, pp. 174-5.
[203] Ibid, p. 182.

A series of storms in the late 1950s and early 1960s caused park planners to reassess the needs of goals of the park. On September 9, 1958, Hurricane Helene, a Category-3 hurricane, made landfall on the Outer Banks, with a 100-knot landfall intensity. The hurricane annihilated the new road and destroyed dune stabilization work on Ocracoke. On September 11, 1960 Hurricane Donna, a Category-3 hurricane, made landfall at Emerald Isle, NC, (south of Hatteras) with winds up to 123 miles per hour. The hurricane caused extreme devastation to dunes, buildings, vegetation, and roads throughout the park.[204] The March 7-9, 1962 nor'easter, or the "Ash Wednesday Storm," most affected park planning. "For three days, the storm battered the Mid-Atlantic coast, killing dozens and causing hundreds of dollars in damage." This led to the establishment of park headquarters in Manteo, on Roanoke Island, instead of at Bodie Island.[205]

Based on photographic evidence, the exterior window hoods were removed from the lighthouse between July 1963 and August 1965 (figs. 59-60).

In 1966, the NPS pumped 312,000 cubic yards of sand "from the Pamlico Sound onto the beach in front of the Buxton lighthouse area" immediately north of the light station. The sound's sand has much finer particles than ocean sand, and the new sand was quickly eroded away.[206]

During the spring of 1967, a nylon sandbag revetment was constructed to protect the U.S. Naval Facility located north of the lighthouse. "The bags were placed along the seaward toe of the dunes to an elevation 13 feet above sea level, covering 1,100 feet of shoreline. The effect of the revetment upon the lighthouse, if any, was presumably minor since the work was centered around the Navy Facility and terminated approximately 500 feet north of the lighthouse." Additionally, the bags deteriorated within three years.[207]



Figure 59. The lighthouse as seen in July 1963. Note the presence of the hoods over the windows. Photo: Cape Hatteras National Seashore Archives.

[204] Ibid, p. 166.
NOAA HRD. "Chronological List of All Hurricanes which Affected the Continental United States: 1851-2005."
[205] NPS, "The Creation and Establishment of Cape Hatteras National Seashore," pp. 167-8.
[206] National Park Service. "Synopsis: Study and Report, Cape Hatteras Lighthouse." September 1995. Cape Hatteras National Seashore Archives, CAHA 5032/016 Cape Hatteras Light Station Building Records Collection. Box 1. Folder 1: Building Records. 1977-1996 of Light Station.
[207] U.S. Army Corps of Engineers, Wilmington District. "Seawall and Revetment Design for Long-Term Protection of Cape Hatteras Lighthouse North Carolina." November 1985. NPS DSC eTIC No. CHAHA 603 D160. p. 2-2.

In February 1970, the Naval Facilities Engineering Command, again in order to protect their facility, began constructing three parallel sheetpile groins.

> The original design called for the [groins to be]…spaced 450 feet apart with the southernmost groin being 610 feet in length and the remaining two being 530 feet in length. The individual sheetpiles were reinforced concrete, 12-inches thick by 4 feet wide by 21 feet in length. The spacing of the groins was increased to 650 feet immediately after award of the contract so that the lighthouse would also be protected. The selected groin location positioned the northern-most and middle groin approximately 1,200 and 550 feet north of the lighthouse, respectively, with the southern-most groin being approximately 100 feet south of the lighthouse.

During construction, design changes were required due to the significant wave action and damage to the completed portions of the groin. Construction was completed during the fall of 1970. Despite noted structural deficiencies of the design, the groins were deemed effective in limiting shoreline erosion in the area between the lighthouse and the Naval Facility to the north. Unfortunately, south of the groin field, erosion accelerated.[208]

During the winter of 1971-72, the beach received second nourishment, constituting only 200,000 cubic yards of sand. This quantity was deemed too small to have a positive impact on the beach and its erosion.[209]



Figure 60. The window hoods had been removed by August 1, 1965 (date of this photograph). Note the smooth appearance of the tower walls. Photo: Cape Hatteras National Seashore Archives.

In 1972, an "800,000-candlepower beacon [was] installed, consisting of a rotary beacon with two 100-watt lamps. [It] flashes every 7.5 seconds." This beacon is still extant within the tower and is operated by the USCG. The NPS provides the following description of the extant beacon on its website:

> Two separate units, similar to search lights, are mounted side by side facing in opposite directions, and are turned by an electric motor. The beacon is controlled by a photocell, which automatically turns the light on at sunset and off at dawn. Each 1,000-watt bulb (120 volts—same as your house), less than 10 inches tall, puts out an 800,000-candlepower beam focused by two parabolic reflectors. A spare bulb and primary reflector automatically rotate into place when the primary bulb burns out. GE makes the bulbs. They are halogen/argon filled, with a tungsten filament, and cost about $240 each. The mechanism is similar to an airport beacon.
>
> The beacon rotates like an airport beacon. The 'flash' is visible when the beacon points at you. The original Fresnel lens system cast 24 beams, the current beacon projects two.
>
> The official range is 24 nautical miles (a nautical mile is 6,080 feet). At night, most vessels in clear weather can see the lighthouse from up to 20 nautical miles at sea. Seen exactly at sea level, the direct visible range is about 15.6 nautical miles. The USLHS standard was to allow an extra ten feet of height to account for the height of the bridge deck, giving 16.2 miles.[210]

[208] Ibid, pp. 2-3 to 2-4.
[209] Ibid, p. 2-5.
[210] NPS, "Cape Hatteras Light Station," W*ebsite.*

In 1973, a third beach nourishment project was completed. A total of 1,250,000 cubic yards of sand was placed 3,500 feet north of the lighthouse and extended northward for 1.5 miles. "At the completion of the project, the beach was generally wider by 300 to 350 feet. Although no material was pumped directly into the Navy groin compartments, these areas experienced a build-up of up to 200 feet indicating a southerly redistribution of material."[211]

An April 1974 letter to the NPS Southeast Regional Director discussed multiple options for addressing the lighthouse at the associated erosion. The letter notes a report by David Clary (report was not located), an employee within the Office of Archeology and Historic Preservation, which mentioned an alternative "to stabilize and save the lighthouse site while the rest of the barrier island was left free to migrate away from it." The justification:

> We might reflect the historic process, whereby the long-term impermanence of such lights was recognized, the natural destruction of them accepted, and the construction of new lights near the shifting shoreline undertaken when a move became necessary. In the present case, our action would comprise periodic removal and re-erection of the structures when their survival became doubtful. This would satisfy the end of preserving the structures, and as long as the orientation to the sea approximated the historic, would do so in an appropriate environmental context. It would not entail unacceptable measures to stem natural forces. This seems to be the best choice at hand.

The report also mentioned an alternative which would "allow natural processes to take the lighthouse site thus allowing the lighthouse to fall into the sea." While acknowledged that this was the preferred natural option, it would not honor the historic nature of the site and lighthouse. In summation, the letter stated:

> …there is appreciation for a naturally shifting barrier island, a recognition that there is historical precedent for the abandonment of lighthouse and the movement of the light by building a replacement structure at a new site. With a desire to preserve historic buildings, the suggestion is made that the Hatteras light could be saved by moving the existing building.
>
> A pure naturalist might argue in reply that historical tradition would be best saved by allowing the lighthouse to fall into the sea.
>
> When professional emotions are set aside, however, the dilemma turn out to be an economic one. What will it cost to move the lighthouse? This is a priority question since we have some knowledge of what it might cost to save the present site and what the cost of the alternative of allowing the lighthouse to fall into the sea might be.

Finally, the letter recommended that arrangements be made with the Denver Service Center (DSC) for a feasibility study on moving the lighthouse, with particular concentration of methods of moving and associated costs, to advise management.[212]

In 1975, the lighthouse was 175'-0" from the shore. That same year, structural cracks in the lighthouse led to its closure to the public.[213] It is unknown when the lighthouse was reopened.

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[211] USACOE, "Seawall and Revetment Design for Long-Term Protection of Cape Hatteras Lighthouse North Carolina," p. 2-5.
[212] Hendrickson, William H., Special Assistant to the Regional Director, Southeast Region, National Park Service. "Cape Hatteras Lighthouse." *Letter to Regional Director, Southeast Region.* April 2, 1974. Cape Hatteras National Seashore Archives, Manteo, NC, CAHA 3429 Cape Hatteras Binder Collection, Box 1, Folder 1: D24 Maintenance Cape Hatteras Lighthouse Balcony Stress Tests.
[213] NPS, "Cape Hatteras Light Station," *Website.*

In the mid-1970s, the Outer Banks Preservation Association (OBPA) was formed "as a public voice for concerned citizens and beach user groups interested in preserving the traditional way of life prevalent on the Outer Banks…." This includes the Cape Hatteras National Seashore.[214]

In July and August 1977, North Carolina State University completed three reports on the Cape Hatteras Lighthouse. The first report, *Examination of the Corroded Metal Components at Hatteras* Lighthouse, detailed the condition of all exterior components above the gallery floor and three-quarters of the exterior components below the gallery floor.[215] (The remaining portions one-quarter were inspected later, with a report dated January 24, 1980.[216]) The second report, *Recommendations on Repair of Hatteras Lighthouse*, included recommendations for the parapet walls, guard rail, guard rail posts, guard rail support and bracket grid, gallery floor, lower part guard rail support and anchor nut, and bracket large holes. A suggested method of repair was also included.[217] The third report, *Supplemental Report on Examination of Corroded Metal Components at Hatteras Lighthouse*, addressed "the removal of masonry inside the lighthouse just below the watch room floor and inspection of iron-work components inside the wall at these points…[as well as] the results of mechanical property tests, spectrographic analyses, and metallographic examination of a cast iron sample from a section of cornice or overhang at the outer edge of the lantern-room gallery." The following conclusions were drawn from the examinations and testing:

1. Removal of masonry and visual examination of four of the 16 brackets, revealed serious rusting and cracking of the brackets and related components.
2. These conditions will necessitate further (non-destructive) inspection of the lighthouse structure, and the installation of an external tie-band (cable around and through the brackets) as previously recommended.
3. Chemical, spectrographic, metallographic and mechanical property tests were made on a fragment from the lantern-room gallery cornice or overhang. These tests showed that (except for its high Sulphur and phosphorous contents) the fragment was normal and met existing specifications….
4. There was no evidence whatever of any harmful internal effects of prolonged corrosive exposure.[218]

In 1978, water from the high tides was affecting the ruin of the 1803 lighthouse's stone foundation.[219] Because of this, the NPS implemented a "No Action" policy on the protection of the ruins, after a study other options.[220] Only two years later, in March 1980, a nor'easter caused the ocean to come within 70'-0" of the tower and washed away what remained of the 1803 lighthouse foundation (fig. 61).[221]

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[214] Outer Banks Preservation Association. "About OBPA." *Website.* Accessed at http://www.obpa.org/index.php?option=com_content&view=article&id=103&Itemid=100 on September 29, 2015.
[215] Austin, William W., Department of Materials Engineering, North Carolina State University. "Examination of Corroded Metal Components at Hatteras Lighthouse." *Memo to William W. Smith, Chief, Maintenance and Cultural Resource Management, Southeast Regional Office, National Park Service.* July 14, 1977. NPS DSC eTIC No. CAHA 603 D125.
[216] TECH-FAB, INC. "Report on Complete Inspection of Cape Hatteras National Lighthouse." *To William W. Smith and William Sowers, National park Service, Southeast Regional Office.* January 24, 1980. Cape Hatteras National Seashore Archives, Manteo, NC, CAHA 5057 Cape Hatteras Lighthouse Restoration Project (c. 1987), Box 1, Folder 2.
[217] Manning, Charles R., and William W. Austin, Department of Materials Engineering, North Carolina State University. "Recommendations on Repair of Hatteras Lighthouse." *To William W. Smith, Chief, Maintenance and Cultural Resource Management. Southeast Regional Office, National Park Service.* July 24, 1977. NPS DSC eTIC No. CAHA 603 D126.
[218] Austin, William W., Department of Materials Engineering, North Carolina State University. "Supplemental Report on Examination of Corroded Metal Components at Hatteras Lighthouse." *Memo to William W. Smith, Chief, Maintenance and Cultural Resource Management, Southeast Regional Office, National Park Service.* August 15, 1977. NPS DSC eTIC No. CAHA 603 D125.
[219] NPS, "Synopsis: Study and Report, Cape Hatteras Lighthouse."
[220] Cape Hatteras National Seashore, Museum Resource Center archives, CAHA 5041: Cape Hatteras 1803 Lighthouse Ruins "No Action" Policy Collection, 1978-1979.
[221] NPS, "Cape Hatteras Light Station CLR," p. 28.

Simultaneously, and likely because of the loss of the foundation, "the NPS realized the futility of attempting to stabilize the shore. It moved to evaluate existing control measures and to make an 'informed decision' that would protect the site's cultural resources."[222]



Figure 61. The original lighthouse foundation ruin in June 1979 before it was washed away in March 1980. Photo: Cape Hatteras National Seashore Archives.

By the fall of 1980, the southern shoreline had moved to within seventy feet of the lighthouse's base. Because of this, the extension of the southernmost groin was warranted. According to the Army Corps of Engineers…

> The erosive action was presumably due to the flanking of the southern groin and the development of flow between the shoreward end of the groin and the land around the lighthouse base. The flanking of the south groin necessitated emergency action by the NPS which involved driving 25-foot long PZ 27 steel sheetpiling landward from the end of the existing groin. The extension covered 150 linear feet and was placed along an alignment which was south of and approximately 35° from the existing groin alignment. Asphalt rubble and large sand bags were added to fill the gap between the groin extension and the lighthouse base in December 1980. This action proved to be insufficient and a further 100-foot landward extension of rip rap and sand bags was made in December 1981. This second extension was made more permanent with the driving of 150 linear of PZ 27 steel sheetpiling, along and beyond the toe of the riprap, in January 1982.[223]

About this time, a study was completed by MTMA Design Group, P.A. to outline alternate solutions for protecting the lighthouse.[224] The alternatives included moving the structure (figs. 62-63),

[222] Ibid, p. 27.
[223] USACOE, "Seawall and Revetment Design for Long-Term Protection of Cape Hatteras Lighthouse North Carolina," pp. 2-5 to 2-6.
[224] Ibid, p. 1-1.

constructing a full revetment (figs. 64-65), constructing a partial revetment with new groins and beach nourishment (figs. 66-67), the installation of new groins with beach nourishment (figs. 68-69), and only beach nourishment (figs. 70-71).

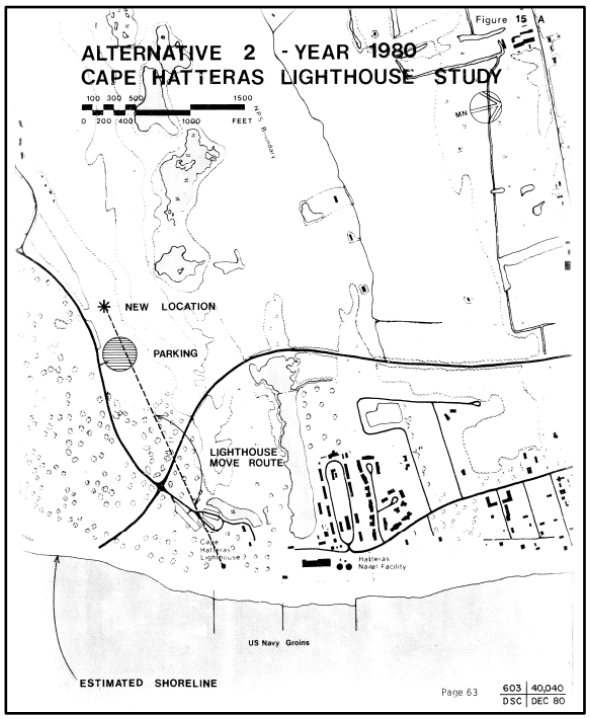


Figure 62. Alternative 2 (moving the lighthouse) in 1980. Drawing: NPS DSC eTIC No. CAHA 603 40040.

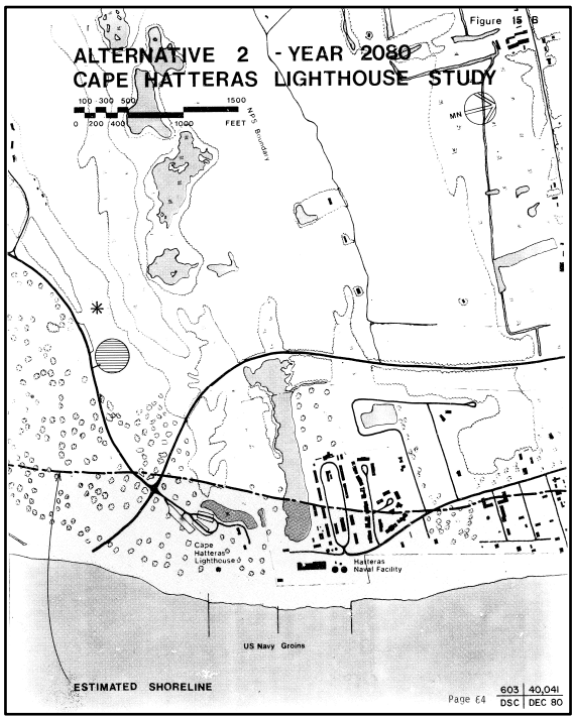


Figure 63. Alternative 2 projected to 2080. Drawing: NPS DSC eTIC No. CAHA 603 40041.

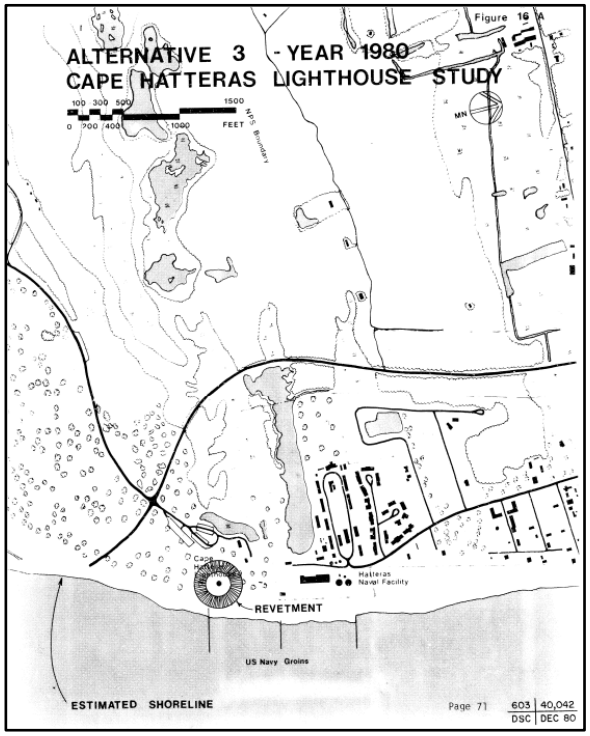


Figure 64. Alternative 3 (revetment) in 1980. Drawing: NPS DSC eTIC No. CAHA 603 40042.

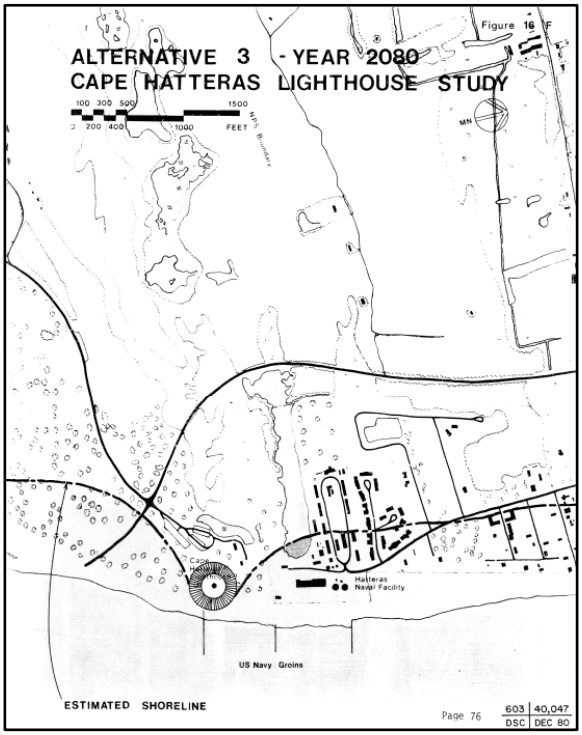


Figure 65. Alternative 3 projected to 2080. Drawing: NPS DSC eTIC No. CAHA 603 40047.

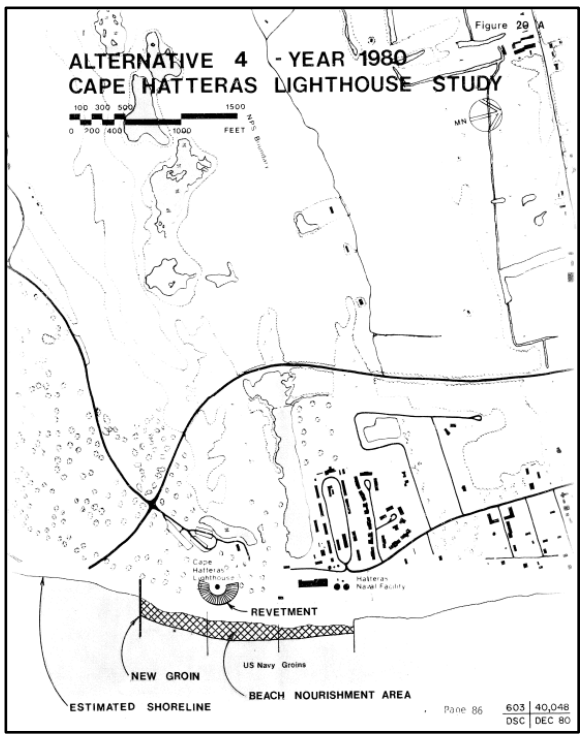


Figure 66. Alternative 4 (partial revetment, new groins, beach nourishment) in 1980. Drawing: NPS DSC eTIC No. CAHA 603 40048.

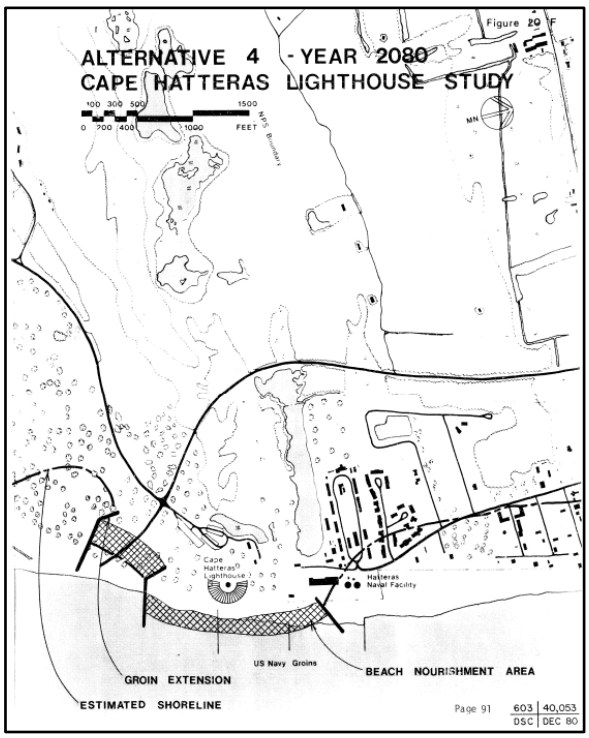


Figure 67. Alternative 4 projected to 2080. Drawing: NPS DSC eTIC No. CAHA 603 40053.

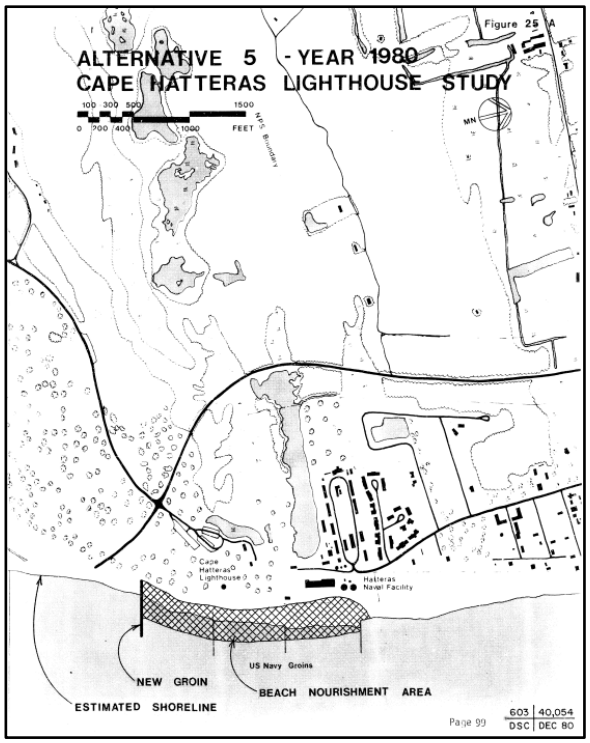


Figure 68. Alternative 5 (new groins, beach nourishment) in 1980. Drawing: NPS DSC eTIC No. CAHA 603 40054.

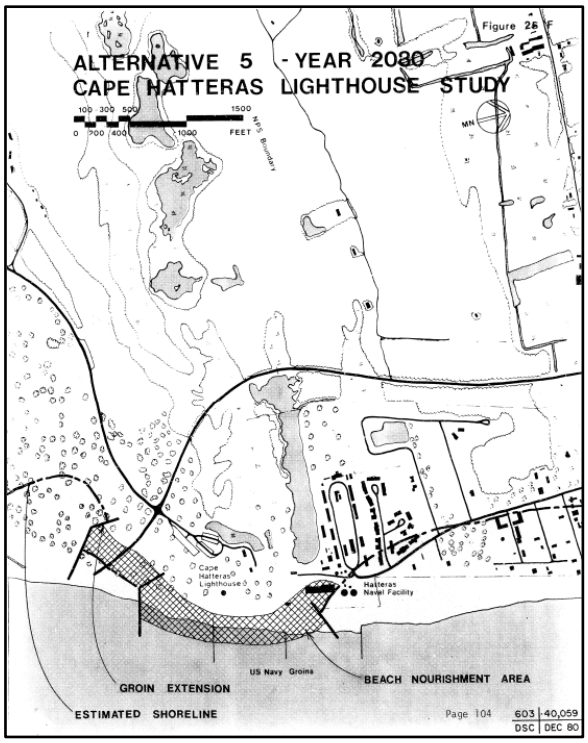


Figure 69. Alternative 5 projected to 2080. Drawing: NPS DSC eTIC No. CAHA 603 40059.

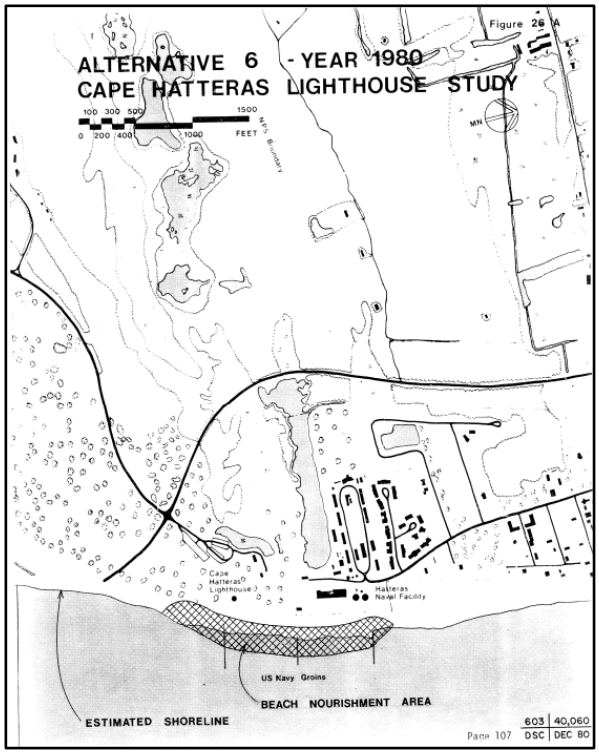


Figure 70. Alternative 6 (beach nourishment) in 1980. Drawing: NPS DSC eTIC No. CAHA 603 40060.

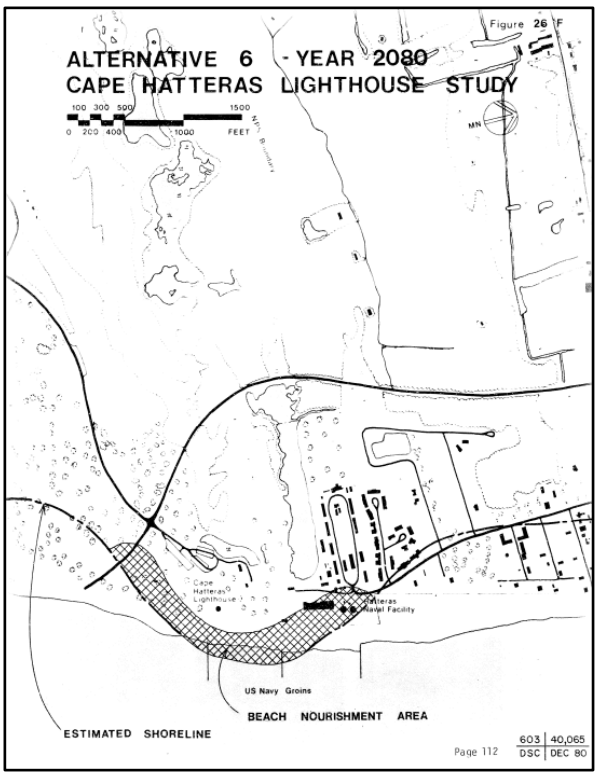


Figure 71. Alternative 6 projected to 2080. Drawing: NPS DSC eTIC No. CAHA 603 40065.

Another interim protective measure concerned installation of SEASCAPE, an artificial seaweed composed of polypropylene fabric. The units consisted of 5'-0"-long anchor tubes filled with sand with 4'-0"-long and 0'-2"-wide fronds attached. Buoyant foam was attached to the ends of the fronds to make each float vertically. The artificial seaweed was intended to reduce the speed of the sand-bearing currents. This would allow the sand to settle and accumulate in the area around the artificial seaweed. The first round of installation, comprising of five hundred units, was completed in May 1981. The units were placed in water 4'-0" to 7'-0" in depth. A significant buildup of the beach occurred after the installation.[225]

The Army Corps of Engineers (ACOE) and the NPS began their relationship involving the erosion issues at Cape Hatteras Lighthouse in 1981. In December of that year, the ACOE transmitted "preliminary analysis and design of two protection alternatives each of which would provide long-term protection…." The alternatives included (1) a seawall revetment plan encircling the lighthouse and (2) "construction of … four inshore breakwaters fronting the shoreline in the vicinity of the lighthouse."[226]

In 1982 the Save the Cape Hatteras Lighthouse Committee "was formed by North Carolina entrepreneur and developer Hugh Morton, who gained the support of the North Carolina Travel Council, which spearheaded a statewide campaign to save the lighthouse. Schoolchildren donated nickels and dimes, and large corporations made sizable donations to the group." North Carolina

[225] Ibid, pp. 2-6 to 2-7.
[226] Ibid, p. 2-8.

Governor Jim Hunt and United States Senator Jesse Helms united their efforts to sponsor the committee.[227]

On April 1-2, 1982, the NPS hosted a public workshop to discuss viable alternatives for interim and long-range protection of the lighthouse.[228]

On July 29, 1982, an Environmental Assessment (EA) was distributed which outlined "the methods, costs, and environmental consequences of several options borne out by…studies and a public workshop on the issue." The EA contained "descriptions of the proposed revetment and five alternatives." The five alternatives being (1) offshore breakers, (2) beach nourishment, (3) an additional groin, (4) relocation, (5) no action. "The seawall revetment was proposed as the preferred alternative…." Public comment collected later that summer generally supported the preferred alternative.[229]

In September 1982, funds were provided to the ACOE "to initiate detailed work on [the revetment] alternative…." The first phase included "hydraulic model testing at the U.S. Army Engineer, Waterways Experiment Station, in Vicksburg, Mississippi."[230]

The same month, in preparation of the upcoming winter storm season, approximately seven hundred "sandbags were placed around the base of the lighthouse."[231]

Due to the apparent success of the first installation of SEASCAPE, the Save the Cape Hatteras Lighthouse Committee funded a second installation in October-November 1982. Five thousand units were installed in 6'-0" to 10'-0" of water about one mile long, south of the lighthouse. The NPS asked the ACOE to study the effectiveness of the second installation from October 1982 through February 1984. The ACOE found "no conclusive evidence that the artificial seaweed was responsible for the positive shoreline change as there was a general accretion of the shoreline 3 miles north and south of the lighthouse. In addition, many…units and fragments of units were found strewn along the beach indicating that the units could not withstand the turbulent surfzone environment in the vicinity of the lighthouse."[232]

Another interim measure, the "installation of a protective scour mat apron around the toe of the southern groin," was completed in March 1983.[233]

Also in the spring of 1983, the top third of the Fresnel lens was removed from the Museum of the Sea located in the Double Keepers' Quarters, where it had been on display, to storage at the Naval Storage Facility.[234] It is unknown how long the lens had been on display at the museum or how long it was kept in storage. The lens was later reinstalled as a display in the museum.

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[227] Yocum, Roberts, & Shelton-Roberts, "Cape Hatteras," p.94.
[228] USACOE. "Seawall and Revetment Design for Long-Term Protection of Cape Hatteras Lighthouse North Carolina," p. 2-8.
[229] Baker, Robert, Regional Director, Southeast Regional Office, National Park Service. "Plan Approval and Finding of No Significant Impact, Cape Hatteras Lighthouse Protection Plan, Environmental Assessment, Cape Hatteras National Seashore." November 26, 1985. NPS DSC eTIC No. CAHA 603 D239.
[230] USACOE. "Seawall and Revetment Design for Long-Term Protection of Cape Hatteras Lighthouse North Carolina," p. 2-8.
[231] Ibid, p. 2-6.
[232] Ibid, pp. 2-6 to 2-7.
[233] Ibid, p. 2-7.
[234] Wrenn, Warren, Lead technician, Hatteras Island Interpretation. "Moving the Fresnel Lense [sic]" *Letter to Whom it May Concern.* May 30, 1983. Cape Hatteras National Seashore Archives, Manteo, NC, Box: CAHA Lighthouse Fresnel Lens, HA284, Folder: Moving the Fresnel Lens.

In 1983, the National Park Service Southeast Regional Office released a Research/Resources Management Report entitled "Coastal Erosion at Cape Hatteras: A Lighthouse in Danger" authored by the University of Virginia. The report synthesized compilations "of several prior data collections of coastal changes at Cape Hatteras…to evaluate the processes threatening to destroy the lighthouse." This included: "erosion trends since 1852…," "variances in trends," "the effect of change in sea level rise rates," "storminess," and "prediction of coastline position, under natural conditions." The ultimate conclusion stated:

> Without a major engineering effort to protect it, the Cape Hatteras Lighthouse will soon be destroyed by an encroaching sea. Considering the cost of this protection, an inventory of other Atlantic coast structures under similar threat should be made before other protection projects are undertaken. We can only afford to save the most valuable property. The Cape Hatteras Lighthouse may well stand out as a notable example of the dangers of construction on barrier islands where the erosion rates are large and variable.[235]

Drawings for the "Preservation of Cape Hatteras Lighthouse Gallery" were completed by Lee Wan & Associates in February 1984.[236] The contract specifications summary of work stated:

> The work involves the preservation of the Main Gallery and its supporting structure. The work includes replacement of severely deteriorated items with identically configured new items, and in-place repair of items not sufficiently deteriorated to warrant replacement. In general, the cast iron supporting brackets (railing, railing post assemblies, floor plate, cornices, bracket grids, and lintel grids) will be replaced with new cast iron items.[237]

The work was advertised in October 1984. However, no awards were made because all of the proposals were in excess of appropriated funds.[238]

In a separate planning process, the 1984 *General Management Plan* (GMP) for the park recommended that the fate of the lighthouse not be determined by the GMP itself. Although it did state that part of the park's mission was to protect historic resources, it was futile to fight erosion and the moving shoreline. The 1984 GMP did identify four objectives for the park:

1) The future development of the lighthouse complex was to be dependent upon the permanent method of protection.
2) The park would be committed to identifying and preserving the cultural resources of the Outer Banks, particularly those relating man's adaptation to life at the ocean's edge.
3) The park would cooperate with the Chicamacomico Historical Association and other local and civic organizations to preserve the unique cultural traditions and historic structures of the Outer Banks.
4) Natural processes would be allowed to occur by halting future stabilization measures.

In addition to these recommendations, the GMP "designated the light station complex a Historic Zone, which precluded any modern development in the site. This selection also committed the park to preserving the historic and archeological resources of the light station in perpetuity."[239]

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[235] Lisle, Lorance Dix, and Robert Dolan, University of Virginia. "Coastal Erosion at Cape Hatteras: A Lighthouse in Danger." U.S. Department of the Interior, National Park Service, Research/Resources Management Report SER-65. 1983. NPS Harpers Ferry Center library, CAHA 47.
[236] Lee Wan & Associates, Inc. "Preservation of Cape Hatteras Lighthouse Gallery." *8 Sheet Drawing Set.* February 1984. NPS DSC eTIC No. CAHA 603 80014.
[237] "Contract Specifications, Cape Hatteras Lighthouse Gallery, Cape Hatteras National Seashore, North Carolina." 1984. NPS DSC eTIC No. CAHA 603 D204.
[238] NPS Superintendent, Fiscal Year 1988 Budget Briefing Statement. February 9, 1987. Cape Hatteras National Seashore Archives, Manteo, NC, CAHA 5031 Cape Hatteras Light Station Briefing Book Collection (c. 1980s), Box 1, Folder 1: "Briefing Statements" 1982-1987.

On September 13, 1984, Hurricane Diana, a Category-3 hurricane, made landfall at Cape Fear, NC, with a 100-knot landfall intensity.[240] This likely caused a forty-pound piece of metal window trim to fall to the ground, which led to the lighthouse being closed again, until 1994.[241] A year later, on September 27, 1985, Hurricane Gloria, a Category-3 hurricane, made landfall on Hatteras Island, with a 100-knot landfall intensity.[242]

In May 1985 the ACOE completed final specifications for the seawall revetment plan which aligned with what was outlined in the July 1982 E.A.[243]

In October 1985, *Report of Subsurface Exploration and Geotechnical Evaluation* for the lighthouse was completed by STS Consultants, Inc. The report described the historic foundation in detail:

> Based on the test pit observations and the results of our angle borings, it appears the foundation of the lighthouse was constructed according to plan. As can be seen from vertical section on Plate 1 from 1869, the lighthouse was constructed on a granite block foundation. A well preserved wooden retaining wall was encountered approximately 2 feet below the existing ground surface at exactly 8 feet from the edge of the lighthouse. It appears that this wood retaining wall was used during construction dewatering and construction of the foundation. The timber platform was encountered at 80 inches below the existing ground surface, although it could not be determined whether there were two 6 inch layers of the platform.
>
> Granite was encountered on the interior of the building just below the brick surface and in the bottom of the pendulum well in the center of the lighthouse and the granite extended to a depth of 80 inches below the existing foundation in the test pit, underlain by wood timbers. Therefore, visual observations appear to confirm that the lighthouse foundation was built with granite blocks according to the plans of 1869.[244]

In November 1985, the ACOE completed *Seawall and Revetment Design for Long-Term Protection of Cape Hatteras Lighthouse North Carolina*. The report covered the background of interim attempts to that point, a report on the environmental setting, design of the revetment (fig. 72), constructability study, discussion of impacts on the lighthouse foundation, cost estimates, schedules for design and construction, and recommendations. The general description of the project was as follows:

> The seawall/revetment will completely encircle the lighthouse permitting the shoreline to continue its past retreat without endangering the historic structure. In plan view, the seawall/revetment forms an octagon which is symmetric with respect to the base of the lighthouse and surrounding granite fence base. Initially, only the six seawardmost faces of the seawall would be constructed leaving the landward faces open for visitor access.... These faces would eventually be closed off when erosion of the shoreline progressed to a point when public access was no longer practicable and complete protection of the lighthouse was required.
>
> The design is comprised of four major structural components including a mass concrete seawall, a sheetpile cutoff wall below the seawall, a stone revetment which fronts the seawall, and a compacted earth fill which backs the seawall [fig. 73].

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[239] NPS," Cape Hatteras Light Station CLR," p. 27.
[240] NOAA HRD. "Chronological List of All Hurricanes which Affected the Continental United States: 1851-2005."
[241] NPS," Cape Hatteras Light Station," *Website*.
[242] NOAA HRD. "Chronological List of All Hurricanes which Affected the Continental United States: 1851-2005."
[243] Baker, "Plan Approval and Finding of No Significant Impact, Cape Hatteras Lighthouse Protection Plan, Environmental Assessment, Cape Hatteras National Seashore."
[244] STS Consultants Ltd. "Report of Subsurface Exploration and Geotechnical Evaluation, Cape Hatteras Lighthouse, Dare County, North Carolina." *For Hasbrouck/Hunderman Architects.* October 22, 1985. Cape Hatteras National Seashore Archives, Manteo, NC, CAHA 3430/008 Preservation of Cape Hatteras Lighthouse Gallery (ca. 1985) Box 1, Folder 4.

The report estimated a total price tag of $5.575 million for the construction of the seawall and revetment, with a projected finish date of February 1988. [245]

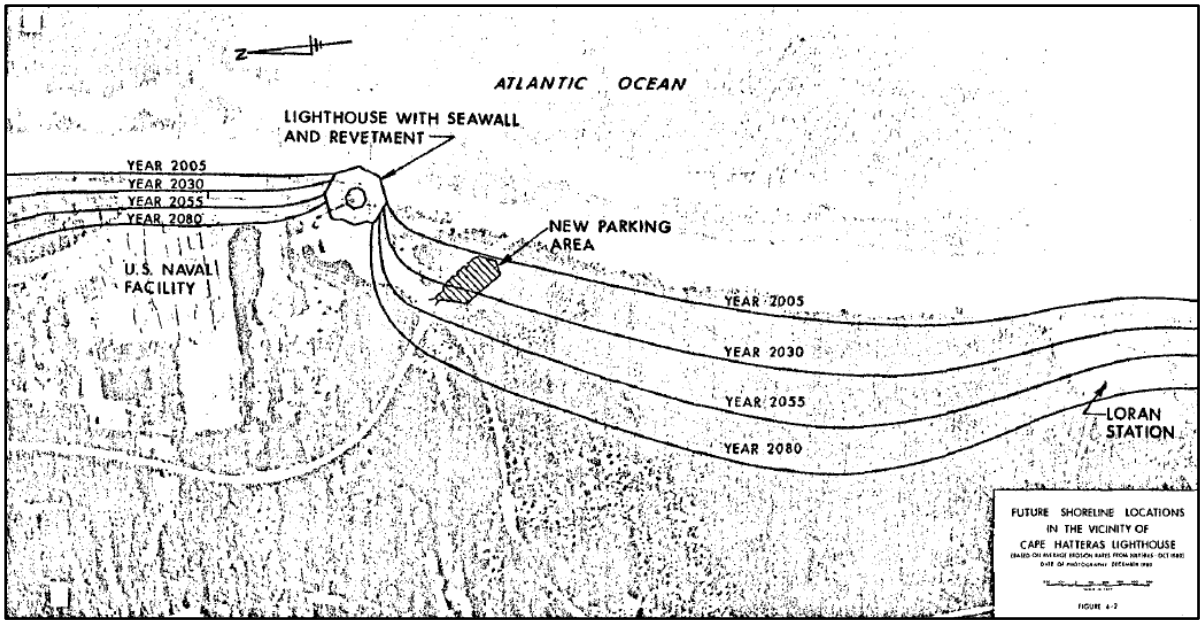


Figure 72. A 1985 plan by the ACOE showing the new revetment around the lighthouse and the predicted shorelines through year 2080. Drawing: NPS DSC eTIC No. CAHA 603 D160.

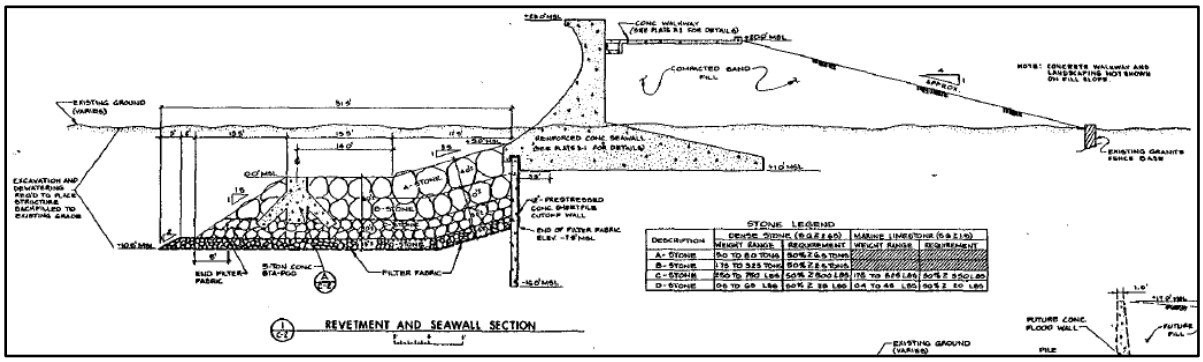


Figure 73. A cross section through the ACOE-designed revetment and seawall. The lighthouse would be located to the right. Drawing. NPS DSC eTIC No. CAHA 603 D160.

During the fall of 1985, the NPS contracted with Hasbrouck Hunderman Architects (HHA) and Wiss, Janney, Elstner Associates, Inc. (WJE) to complete to reports for the lighthouse.

The first report, *Comprehensive Structural Analysis Report*, was completed in March 1986.[246] The report reviewed the ACOE's 1985 seawall and revetment design, generally approved of the design, and suggested design modifications. The report also reviewed Lee Wan & Associates' 1984 cast iron repair specifications. While the report generally agreed with the recommendations, abundant design alterations were suggested. Discussion on climactic data, recommendations for scaffolding,

[245] USACOE, "Seawall and Revetment Design for Long-Term Protection of Cape Hatteras Lighthouse North Carolina," p. 4-1.
[246] Hasbrouck Hunderman Architects, and Wiss, Janney, Elstner Associates, Inc. "Cape Hatteras Lighthouse Comprehensive Structural Analysis Report for the National Park Service." March 1986. NPS DSC eTIC No. CAHA 603 D39. p. 1.

discussion on the soil boring report, and a verticality survey were also included. Finally, the field survey was discussed in length. A summary of findings are listed below:

- Granite Base:
  - Ornamental brackets that flank the entrance show cracks/repairs.
  - Mortar joints covered with white sealant.
  - Vertically cracking in plinth blocks which then were caulked.
  - Presence of surface-attached electrical conduit.
  - Ferric staining and minor cracks due to metal anchor points behind stone.
- Brick Shaft – Exterior:
  - Small areas of deteriorated or missing mortar.
  - Overall fair to good condition.
  - Inappropriate paint used to coat brick walls; does not allow masonry to breathe.
- Brick Shaft – Interior:
  - Recently had been cleaned via walnut shell blasting.
  - Masonry recoated with an acrylic-based whitewash, allowing the brick to breathe.
  - Significant paint failure, deteriorating brick, and deteriorating mortar joints in Service Room due to water infiltration at Lantern Room above.
  - Long vertical cracking on the north and south sides of the lighthouse from the first landing level to the sixth landing level.

    > "The cracks run through many of the points where stair stringers are anchored to the masonry walls.... The cracks also run through the sections of the lighthouse where the window openings exist. ... The existence of these long vertical cracks in the inner wall of the lighthouse has been documented in the literature since 1879."
    >
    > "Based on preliminary data from monitoring equipment..., the cause of these long vertical cracks appeared to be thermal expansion. Expansion of the cylindrical outer masonry wall induces high tensile stresses in the cylindrical inner masonry wall.... This occurs because the two walls are tied together with a series of large brick masonry ribs. The interior wall would be expected to crack under the tensile forces at and along its weakest vertical sections. Those weakest sections are along the north and south sides of the lighthouse where the window openings interrupt the masonry wall construction."

  - Vertical cracks between the Service Room floor and Watch Room floor which coincide with the location of the gallery support brackets, likely due to metal corrosion of the brackets.
  - Vertical cracks below the bearing points for stair landing support beams, likely due to thermal stresses.
- Cavity:
  - Thirteen one-inch-diameter holes were drilled through the inner wall into the cavities to measure temperature (relatively consistent with temperatures inside the lighthouse) and relative humidity (usually very high averaging 90%).
  - Inspection hole was cut through the inner wall to inspect the cavities. Inspection noted brickwork in good condition, solid mortar joints, and some efflorescence (figs. 74-75).
  - At least three to four feet of debris located at bottom of cavity.

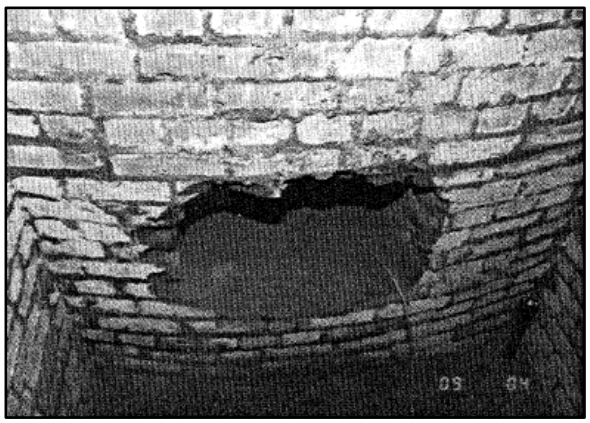


Figure 74. A 1985 view of the inspection opening from the inside of the wall cavity. Not efflorescence and solid joints. Photo: NPS DSC eTIC No. CAHA 603 D39.

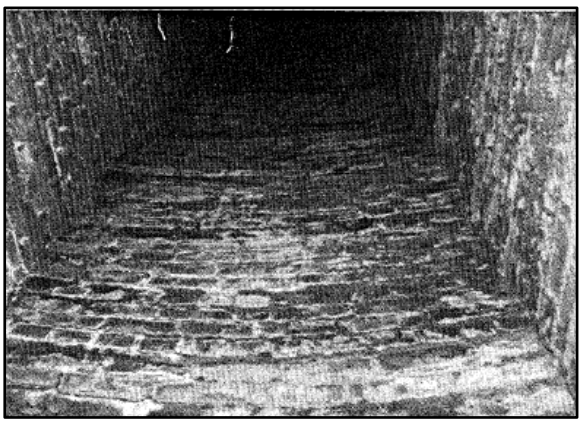


Figure 75. A 1985 view up the cavity shaft showing brickwork in good condition. Photo: NPS DSC eTIC No. CAHA 603 D39.

- Stairs and Landings:
    - Unit-by-unit inspection of every element of the iron stairs.
    - Stairs are generally in good condition; only a few elements require replacement or substantial repairs.
    - Wherever metal rests against metal, moisture gathers and corrosion develops. Pressure then increases and the brittle cast iron cracks.
    - Hanger rod assembly support system structurally sound.
    - Stair stringers immediately adjacent brick wall in good condition.
    - Anchorages into brick wall in good condition.
    - Stair risers exhibited cracking between it and the tread below.
    - Stair tread plates in generally good condition, except the top plate at each landing, which exhibits cracking.
    - 40% of brackets along the outside stringer cracked in at least one location, mostly at fastening points.
    - Stair landings deteriorating sue to exposure of cycles of wet and dry.
    - Iron beams supporting the edge of the landings corroding (not severe) where each penetrates and is supported by the inner wall.
- Windows and Doors:
    - Window frames and sash in fair condition overall.
    - Exterior pediments were removed because they had deteriorated.
    - Window sills and lintels in fair condition, some rusting and pitting can be seen.
    - Hardware of window frames and sash are in poor condition. Most hinges are rusting and frozen. Most windows cannot be properly closed.
    - Bronze doors are in good condition. Some hardware components deteriorated or missing.
    - Wood doors are in storage and are in good condition.
- Service Room:
    - Large amounts of water from the Lantern Room above leaking down into this room causing distress in several areas.
    - Cast iron support beam is corroded at either end where the beam penetrates the inner masonry wall.
- Watch Room:

    - Water leaking down the front and behind the iron wall plates causing corrosion to wall plates, deterioration of brickwork behind and below the wall plates, and corrosion of iron stringer which supports the stair.
    - Cast iron support beams are corroded at either end where the beam penetrates the inner masonry wall.
    - Cracks located in two of the large exterior support brackets.
- Gallery:
    - Vertical posts exhibiting cracks at their bases.
    - Gallery iron all plates show pitting .
    - Iron plate at base of the perimeter of the wall extensively horizontally cracked.
    - Gallery floor plates separating due to forces from the brackets below.
    - Cast iron belt course cracked in several locations likely due to thermal expansion.
    - Lintel grids above service room windows are in poor condition due to missing and cracked sections.
- Brackets:
    - All brackets in varying condition from good to very poor. Each exhibits varying issues, including cracking, pitting, corrosion, etc.
- Lantern:
    - Interior gallery deck has light corrosion on top surface.
    - Exterior gallery deck has pitting.
    - Handrail in good condition.
    - Window wall missing hardware pieces, poor caulking, cracked glass components.
    - Roof structure has deterioration and pitting.

The report also discusses the instrumentation which was placed in the lighthouse to measure the lighthouse's response to wind and solar radiation; these measurements were made as a benchmark for further documentation of the same nature. Finally, the report included results of laboratory testing of brick and mortar, iron, paint, and the southern yellow pine timber mat foundation.[247]

The second report by HHA and WJE, *Comprehensive Preservation Program Report*, was completed in July 1986. Its purpose was "to examine preservation issues and to define a program for the repair and preservation of the lighthouse." The report identifies two levels of priority: 'critical' and 'serious.' The components in critical condition, which were to be completed immediately, were the cast iron gallery and brackets, the lantern room, and windows. The components in serious condition, which were to be completed in the near future, were the interior masonry, stairs, granite, doors, and replacement of electrical wiring. In addition, the report included recommendations for maintenance and long-term care of the lighthouse.[248]

In August 1986, the ACOE completed drawings for the "Lighthouse Protection Project," or the seawall/revetment plans (figs 76-78).

[247] HHA/WJE, "Cape Hatteras Lighthouse Comprehensive Structural Analysis Report for the National Park Service."
[248] Hasbrouck Hunderman Architects with Wiss, Janney, Elstner Associates, Inc." Cape Hatteras Lighthouse Comprehensive Preservation Program Report." July 1986. NPS DSC eTIC No. CAHA 603 D159.

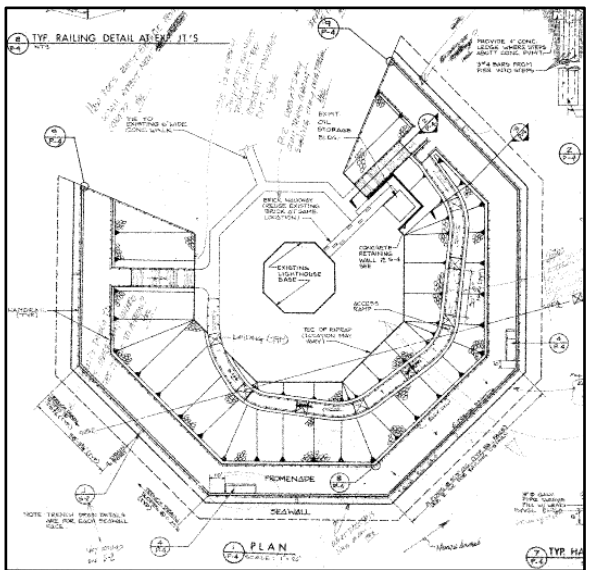


Figure 76. The plan of the seawall. Note the opening to the west, which would be later filled in once the ocean fully impeded on the site. Drawing: NPS DSC eTIC No. CAHA 603 41907.

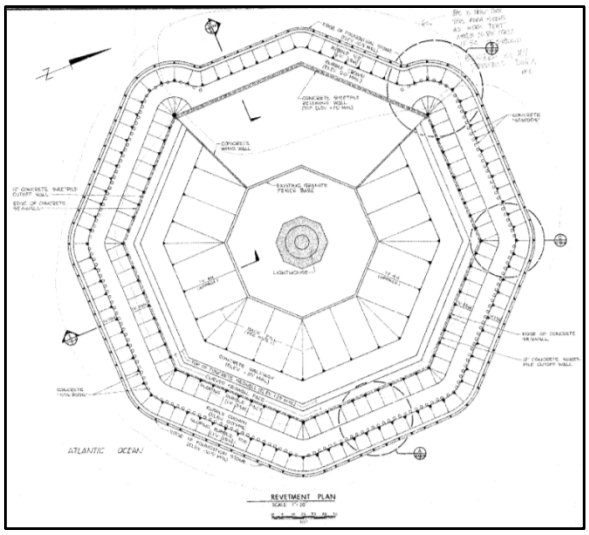


Figure 77. The plan of the concrete revetment. Drawing: NPS DSC eTIC No. CAHA 603 41907.

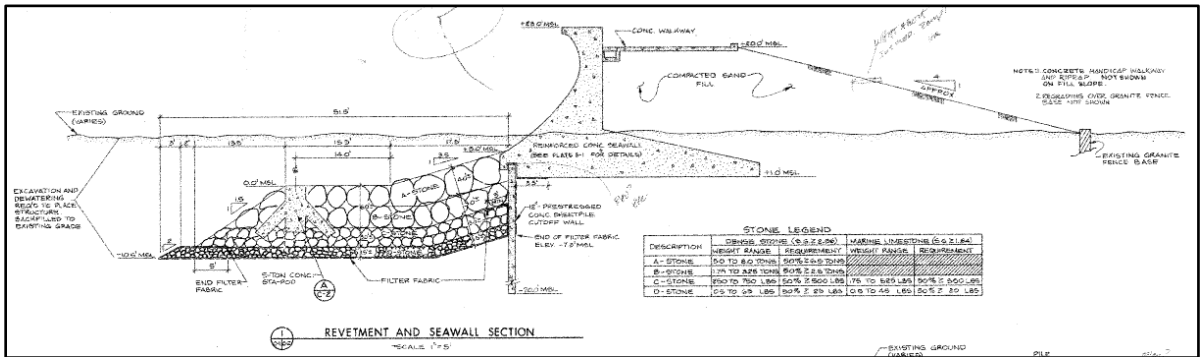


Figure 78. A section through the proposed seawall and revetment surrounding the lighthouse. Note: the lighthouse would be located to the right in the drawing. Drawing: NPS DSC eTIC No. CAHA 603 41907.

Also in 1986, David Fischetti, a North Carolina structural engineer, along with David Bush, a geologist and then-research associate for Duke University, Barrett Wilson, of the American Association of Cost Engineers, and Dr. Orin Pilkey, Jr., a geology professor at Duke University, established the "Move the Lighthouse Committee." The next year the committee, with Fischetti as president, suggested to the NPS, that the lighthouse could and should be moved.[249]

Despite having final developed plans and having secured the necessary funding for the seawall/revetment, the NPS requested the assistance of the National Academy of Sciences (NAS), a group of scientists and engineers who advise the federal government on technical matters, "for an independent review of all relevant information as to the best long term protection, considering risks, environmental impacts, visitor impacts and costs."[250] The National Research Council (NRC),

[249] Shelton-Roberts, Cheryl. "The Hatteras Move: A Century of Debate." August 2000. Outer Banks Lighthouse Society. Accessed at http://www.outerbankslighthousesociety.org/articles/article-hatteras-move-debate.html on August 21, 2015.
Yocum, Roberts, & Shelton-Roberts, "Cape Hatteras," p. 95.
NPS. "Synopsis: Study and Report, Cape Hatteras Lighthouse."
[250] NPS, "Synopsis: Study and Report, Cape Hatteras Lighthouse."

in conjunction with the NAS, formed the Committee on Options for Preserving Cape Hatteras Lighthouse in July 1987. The committee's mission was to…

> …evaluate the scientific, engineering, environmental impact, and policy aspects of alternative options for preserving the lighthouse from the encroachment of the sea. The feasibility, likelihood of success, long-term dependability and monetary cost of each option will be considered. The study will emphasize the broader context of national policy concerning preservation versus conservation and coastal issues….[251]

Their interim report, due within three months of the formation of the committee, admittedly could not be an all-inclusive document for every option available. A later report, due in April 1988, would be all-inclusive. For the interim report, the committee "considered nine principal options for preserving the lighthouse." The "options were evaluated against 21 criteria…. Four options were judged to merit more detailed evaluation than the others:

1) Construction of a seawall with revetment;
2) Relocation of the lighthouse in one piece;
3) Rehabilitation of the groin field without a revetment; and
4) Rehabilitation of the groin field, together with the construction of a partial revetment."[252]

The option to construct a seawall/revetment was deemed unfavorable for many reasons, including:

- Risk of damage to the lighthouse during construction,
- Likely not a long-term,
- 100-year solution,
- Adverse impact on historic and visual integrity,
- Many adverse environmental impacts,
- Conflict of governmental policies,
- High initial cost with unknown maintenance costs.[253]

The option to relocate the lighthouse was deemed the most favorable for many reasons, including:

- Minimal risk of damage to lighthouse during implementation,
- Reliable long-term solution,
- Little impact on historic and visual integrity,
- Few adverse environmental impacts,
- Few conflicts of governmental policies,
- Lower initial cost with no other risk-related maintenance costs.[254]

The other two options were not considered viable options for various reasons.[255]

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[251] Committee on Options for Preserving the Cape Hatteras Lighthouse, Board on Environmental Studies and Toxicology, Commission on Physical Sciences, Mathematics, and Resources, National Research Council. "Options for Preserving the Cape Hatteras Lighthouse: Interim Report." n.d. (likely September 1987). NPS Harpers Ferry Center library, CAHA 26. p. 1.
[252] Ibid, p. 2.
The other five options included: sinking ships offshore, offshore breakwaters and groin field rehabilitation, deployment of artificial seagrass, continuing beach nourishment, and no action. Ibid, p. 7.
The 21 criteria included (1) Technical Feasibility, (2) Long-Term Reliability, (3) Short-Term Reliability, (4) Initial Cost, (5) Long-Term Cost, (6) Protection of Natural Resources, (7) Aesthetic Impact, (8) Local Public Preferences, (9) Protection of Historical Values, (10) Public Access and Recreation, (11) Risk of Damage to the Lighthouse During Implementation, (12) Preservation of Other Options—Short Term, (13) Preservation of Other Option—Long Term, (14) Construction Time, (15) Coastal Barrier Resources Act, (16) NPS Shoreline Management Policies, (17) North Carolina Coastal Policies , (18) Flood hazard Mitigation, (19) Wetlands Impacts, (20) Fisheries, (21) Navigation. Ibid, pp. 8-9.
[253] Ibid, p. 2.
[254] Ibid, p. 2.
[255] Ibid, pp. 2-3.

A *September/October 1987 Briefing Statement* by the park superintendent reiterated the findings of HHA in 1986 and outlined critical and serious intervention tasks which had to occur. The superintendent stated that no further work would be completed on the interior of the lighthouse until a decision had been made concerning the protection of the structure.[256]

In early 1988, the Fresnel lens on display in the Museum of the Sea, located in the Double Keepers' Quarters, was removed for treatment by Harpers Ferry Center (NPS).[257] It is likely that the lens was cleaned in 1989.

In March 1988, final drawings for "Preservation of Cape Hatteras Lighthouse" were completed by Hasbrouck Peterson Associates with Wiss, Janney, Elstner Associates (figs 59-60).[258] Construction specifications included the following description of work:

A. Fabrication of sixteen (16) new, replacement cast-iron lintel grid sections to be installed at the top of the existing lower cast-iron wall plate sections.
B. Fabrication of elevation (11) new cast-iron combination top gridwork and partial top ornamental cylinder sections for installation on Gallery support brackets [1, 3-6, 10-12, 14-16].
C. Fabrication of five (5) new cast-iron combination top gridwork and complete ornamental cylinder sections for installation on Gallery support brackets [2, 1-9, 13].
D. Fabrication of sixteen (16) new cast-iron anchor nuts for installation at the base of the ornamental cylinder on all sixteen Gallery support brackets.
E. Fabrication of sixteen (16) new replacement cast-iron Gallery deck floor plate sections.
F. Fabrication of the following replacement cast-iron components for the Gallery handrail system:
    1. Three replacement ornamental baluster posts, and two spare ornamental baluster posts.
    2. An ornamental top rail cover for the entire perimeter of the Gallery handrail system.
    3. Sixteen (16) new cast-iron ornamental tops for the sixteen gallery handrail baluster posts.
G. Fabrication of six (6) new cast-iron window pediments and six (6) pairs of new cast-iron pediment support brackets.
H. Fabrication of five (5) new cast-iron stair treads for use in the interior spiral staircase, (three scheduled for use; two as spares for future use).
I. Fabrication of seven (7) new cast-iron stair treads for use at the top tread positions on the seven stair landings.
J. Fabrication of seven (7) new cast-iron stair treads for use of the lower foot-plate tread positions on the seven stair landings.
K. Fabrication of three (3) new cast-iron ventilator panels to be located above the three Service Room level windows.
L. Fabrication of the following new cast-iron replacement elements for the Service Room level windows:
    1. One apron
    2. Two vertical jamb casings
    3. One cheek wall

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[256] September/October 1987 Briefing Statement from Superintendent, Cape Hatteras Group, to Southeast Region Regional Director. Cape Hatteras National Seashore Archives, Manteo, NC, CAHA 5031 Cape Hatteras Light Station Briefing Book Collection (c. 1980s) Box 1, Folder 1: "Briefing Statements" 1982-1987.

[257] Woody, Bebe B. (CRM Specialist). "Lighthouse Lens on Exhibit at the Double Keeper's [sic] Quarters" Letter to Acting South District Interpreter, Through Chief of Interpretation. January 13, 1988.
Object Treatment Request. US DOI NPS, Branch of Conservation Laboratories, Division of Museum Services, HFC. Object: Fresnel Lens.: Date of Request: April 11, 1988 by Bebee Woody, CR Management Specialist at Caper Hatteras National Seashore.
Wrenn, Warren R., Park Ranger. "Fresnel Lens Project." *Memorandum to CRM Specialist thru S.*D. Interpreter and Chief of Interpretation. January 31, 1989. Cape Hatteras National Seashore Archives, Manteo, NC, Box: CAHA Lighthouse Fresnel Lens, HA284, Folder: Moving the Fresnel Lens.

[258] Hasbrouck Peterson Associates with Wiss, Janney, Elstner Associates. "Preservation of Cape Hatteras Lighthouse, Cape Hatteras National Seashore, North Carolina." March 10, 1988. NPS DSC eTIC No. CAHA 603 80020.

M. Fabrication of new cast-iron nosing sections at the seven stair landings.
N. Fabrication of seven pairs of new ductile cast-iron casement window sash and cap frames, with integral hinge knuckles.
O. Fabrication of new ductile cast-iron inner and outer main entry door transom sash pieces (outer to receive bronze operating hardware).
P. Fabrication of sixteen (16) each, new cast-iron ladder support rods and support rod sockets for use at roof cornice.[259]

A later revised drawing set, dated October 1989, made alterations to the above work, most notably the removal of items G and N as listed above (figs. 79-80).[260]

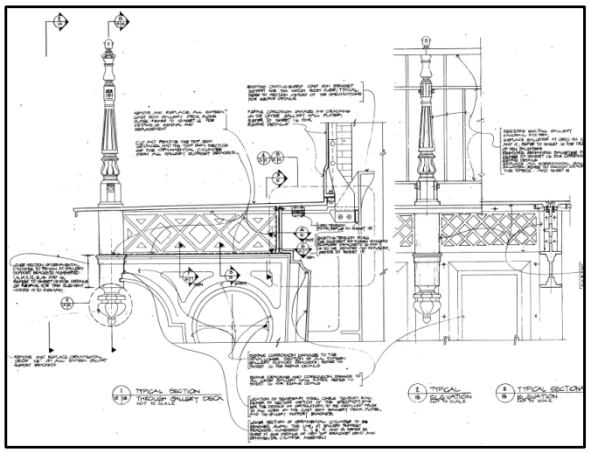


Figure 79. Preservation details for the gallery level cast-iron brackets, handrail, floor, etc. Drawing: NPS DSC eTIC No. CAHA 603 80020. Cropped by author.

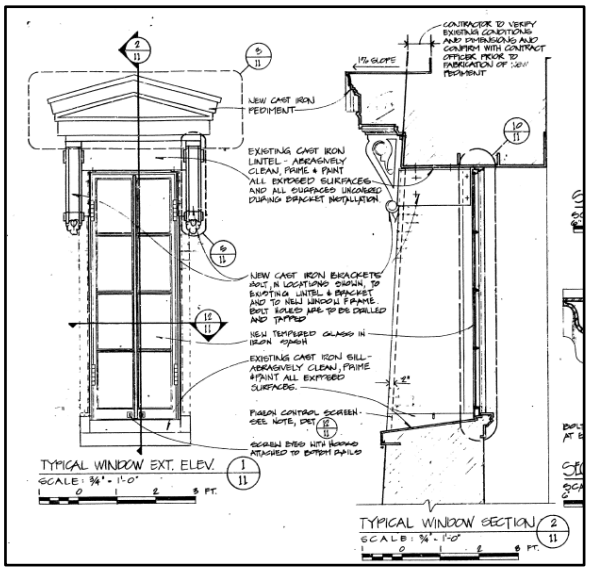


Figure 80. Details for the preservation of the exterior windows, including the hoods. Drawing: NPS DSC eTIC No. CAHA 603 80020. Cropped by author.

In April 1988, the NAS report, *Saving Cape Hatteras Lighthouse from the Sea: Options and Policy Implications*, investigated ten alternatives for the lighthouse, but ultimately recommended relocation as the most cost-effective method of protection.[261] The other alternatives considered were the ACOE's recommendation of construction of a seawall and revetment around the lighthouse, rehabilitation of the groin field only, and rehabilitation of the groin field with a partial revetment. All of the options were considered against the *National Historic Preservation Act of 1966*, the *Coastal Barriers Resources Act of 1982*, the N*ational Flood Insurance Act of 1968*, the *National Environmental Policy Act of 1969*, and other related policies.[262]

In August 1988, the NPS completed a draft study entitled *Protection Alternatives for Cape Hatteras Lighthouse Complex*. The preferred alternative was relocation, but the document also considered other alternatives. The following summary is provided in the report:

[259] Hasbrouck Peterson Associates with Wiss, Janney, Elstner Associates. "Construction Specifications for Preservation of the Cape Hatteras Lighthouse, Cape Hatteras National Seashore, North Carolina." n.d. NPS DSC eTIC No. CAHA 603 D201.
[260] Hasbrouck Peterson Associates with Wiss, Janney, Elstner Associates." Preservation of Cape Hatteras Lighthouse, Cape Hatteras National Seashore, North Carolina. October 13, 1989. NPS DSC eTIC No. CAHA 603 80020A.
[261] NPS, "Cape Hatteras Light Station," *Website*.
[262] NPS, "Cape Hatteras Light Station CLR," p. 30.

> This report documents the National Park Service's…decision to protect the Cape Hatteras lighthouse and associated structures by relocating them to an area approximately [2,900] feet to the southwest and 1,500 feet from the shoreline. The report also describes other alternatives for protection and their environmental consequences, and presents concepts for interpretation, reclamation of the existing site, and development at the proposed site. All historic structures will be relocated into the same configuration relative to themselves and the coastline as now exists, and an eight-acre area will be maintained open to relate to the existing historic scene. Parking for over 100 vehicles, toilet facilities, and paved walkways will be provided at the new site. The existing site will be rehabilitated to provide parking, toilet/shower facilities, and access for recreational beach users, and for those wishing to visit remnants of the historic site. The estimated cost of the proposal is $7,056,000, with no further annual costs to protect the lighthouse complex from damage by ocean processes for more than 100 years. The existing groinfield will be rehabilitated at an estimated cost of $500,000 to provide interim protection for the lighthouse for at least 2 years, until the complex is moved.[263]

In April 1989, the ACOE released a report entitled *Subsurface Investigation Report.* It concluded:

> The information that was obtained from the limited number of borings taken along the proposed relocation path indicates that it would be feasible to move the lighthouse from its present location to the proposed site. However, additional subsurface investigations, including drilling, geophysical information and soil laboratory tests, would be required along the proposed movement path in order to design a method of movement and to design a foundation bearing surface along the path. The additional subsurface information would be required in order to determine the type of footing and foundation or bedding to be used for such a track. The extent and method of foundation modification, if required, would need to be determined in order to provide a safe and stable platform for any pathway that would be used to transport the lighthouse from its present location to the proposed site.[264]

Concurrently, the NPS prepared the joint *Protection Alternatives, Development Concept Plan, Environmental Assessment* (DCP/EA). The June 1989 draft was distributed for public review. The following summary was provided in its introduction section, which was quite similar to the NPS' 1988 *Protection Alternatives* draft study discussed above:

> This report documents the National Park Service's (NPS) consideration to protect the Cape Hatteras lighthouse and associated structures from damage or destruction due to coastal processes. On the basis of past studies, and particularly that completed by the National Academy of Science (NAS) in 1987-88, the NPS preferred method of protecting the structures is by relocating them to an area approximately [2,900] feet southwest of their original locations and 1,600 feet from the shoreline [figs. 81-82]. The report also describes other alternatives for protection and their environmental consequences, and presents concepts for interpretation, reclamation of the existing site, and development at the proposed site [figs.83-86]. All historic structures will be relocated into the same configuration relative to themselves and the coastline as now exists, and an eight-acre area will be maintained as open space to approximate the historic scene. Additional major development at the proposed site consists of toilet facilities and parking for 110 vehicles. Reclamation and new development at the existing site will consist of toilet facilities with exterior showers, parking for 120 vehicles, and pedestrian access for recreational beach users and for those wishing to visit remnants of the historic site. The estimated cost of the proposal, including associated new site development, existing site reclamation, and interpretation, is $8,775,000, including gross construction costs, and advance and project planning costs. There would be no further annual costs to protect the lighthouse complex from damage by ocean processes for at least 100 years. After appropriate testing to determine its condition, the existing groinfield may be rehabilitated to provide interim

[263] National Park Service. "Protection Alternatives for Cape Hatteras Lighthouse Complex, Cape Hatteras National Seashore, North Carolina." *Draft Study.* August 1988. NPS DSC eTIC No. CAHA 603 D205.
[264] US Army Corps of Engineers, Wilmington District. "Cape Hatteras Lighthouse Subsurface Investigation Report." April 1989. NPS DSC eTIC No. CAHA 603 D138.

protection for the lighthouse for at least 2 years, while a decision is being made and implemented for long term protection. Emergency protection utilizing sandbags may also be required.

If relocation was chosen as the ultimate treatment, it was noted that the "proposed new location and setting must be reviewed by the Keeper of the National Register as required in 36 CFR, Part 60.14(b). If the structures are no longer to be eligible, NPS will proceed to have the complex delisted. If the structures remain eligible, NPS will amend the National Register form to reflect the move and describe them at their new location."[265]

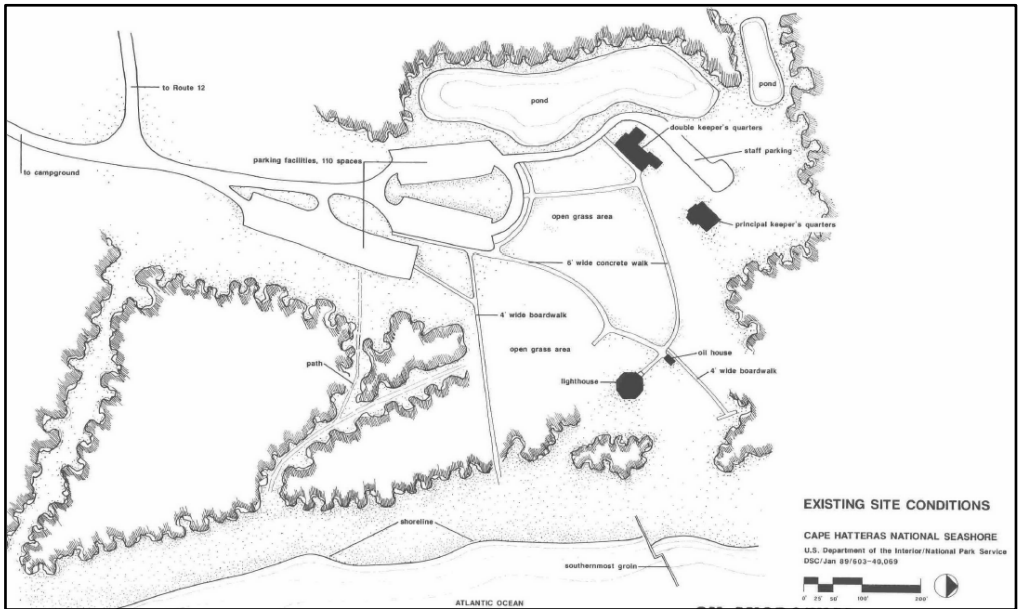


Figure 81, above. The existing site conditions in January 1989. Drawing: NPS DSC eTIC No. CAHA 603 D47A.

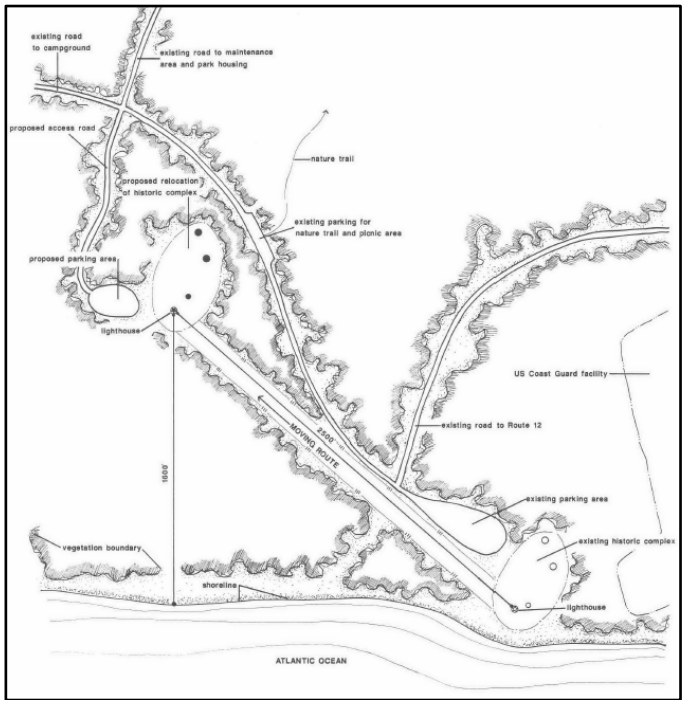


Figure 82, left. The proposed plan for relocation, as of January 1989. Drawing: NPS DSC eTIC No. CAHA 603 D47A. Cropped by author.

[265] National Park Service. "Protection Alternatives, Development Concept Plan/Environmental Assessment. Cape Hatteras Lighthouse Complex. Cape Hatteras National Seashore. North Carolina." June 1989.

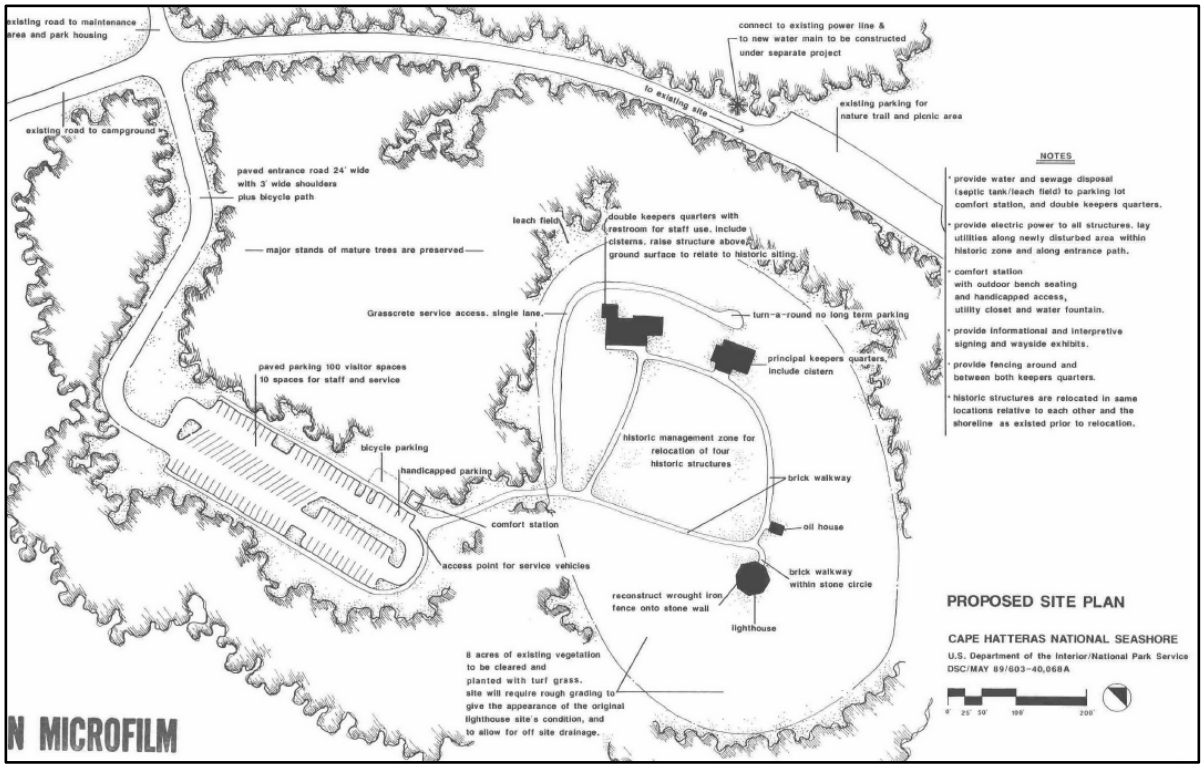


Figure 83. The proposed site plan, as of May 1989, after the move. Drawing: NPS DSC eTIC No. CAHA 603 D47A.

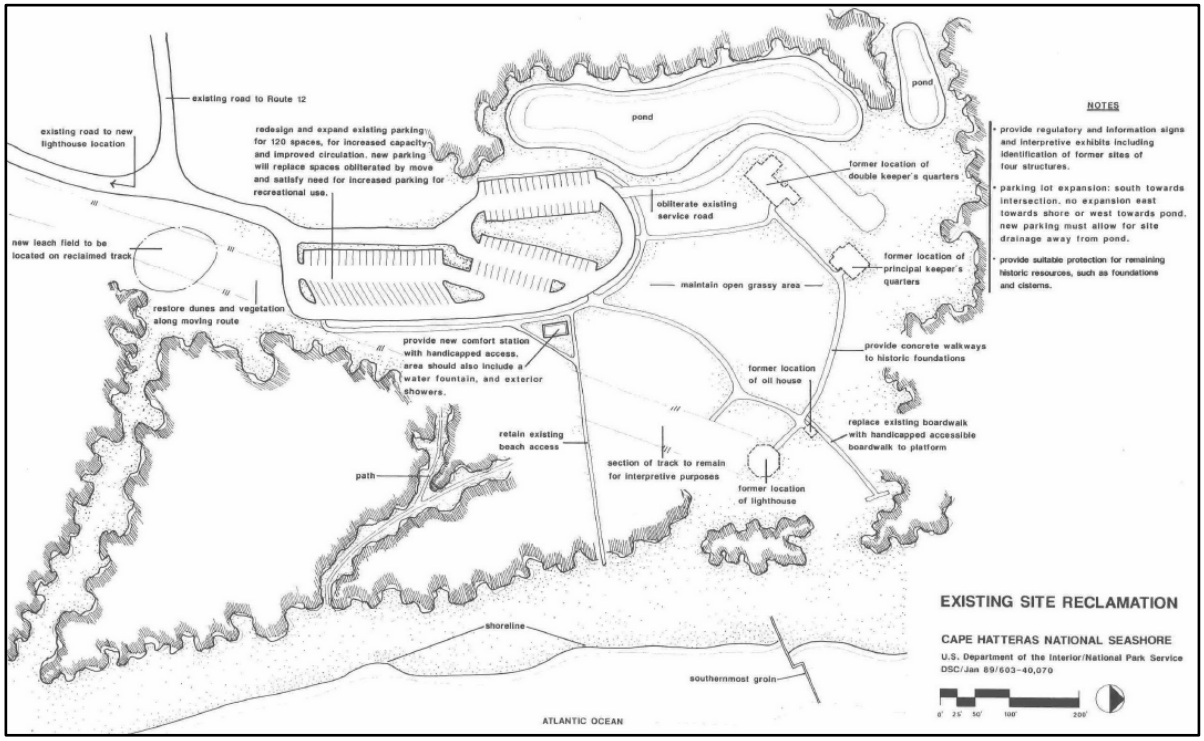


Figure 84. The proposed old lighthouse site after the move, as of January 1989. Drawing: NPS DSC eTIC No. CAHA 603 D47A.

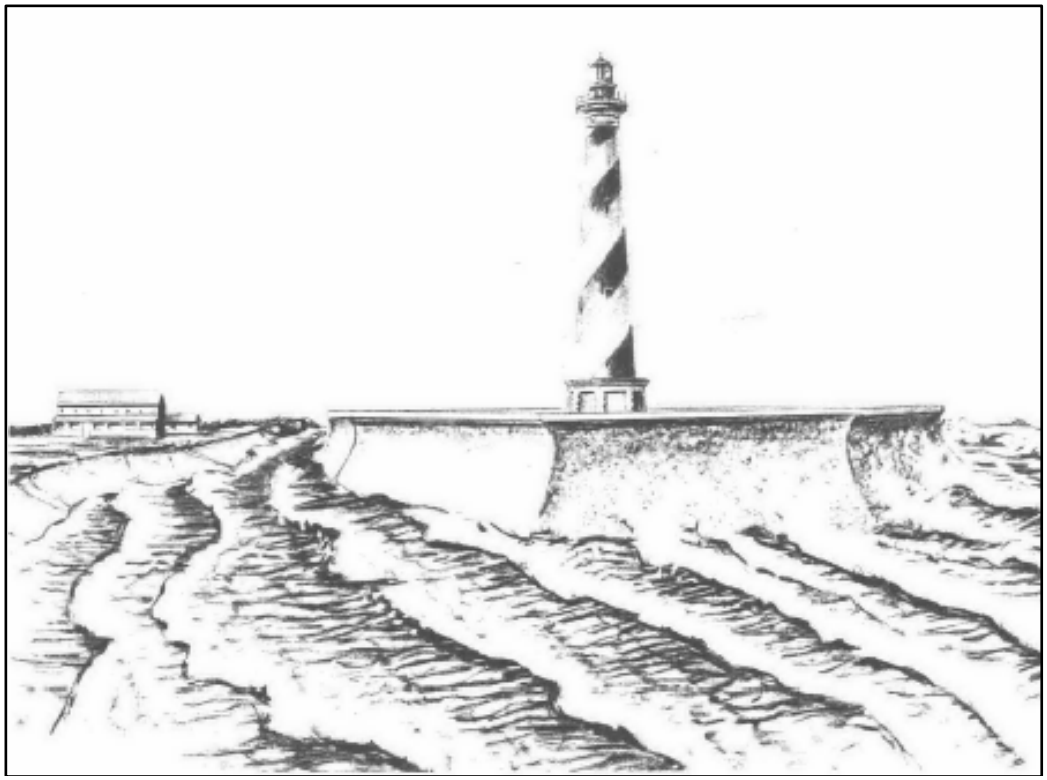


Figure 85, above. Rendering of the lighthouse and its seawall/revetment once the ocean overtakes the site. Drawing: NPS DSC eTIC No. CAHA 603 D47A.

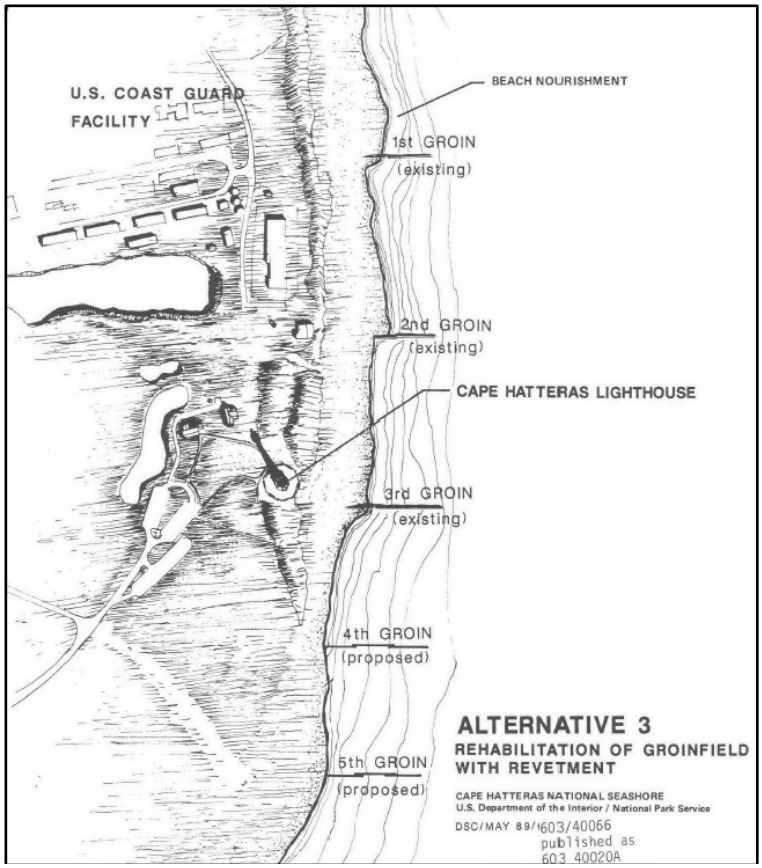


Figure 86, left. Alternative 3 included the installation of two new groins to the south, beach nourishment to the north, and a revetment around the lighthouse. Drawing: NPS DSC eTIC No. CAHA 603 D47A.

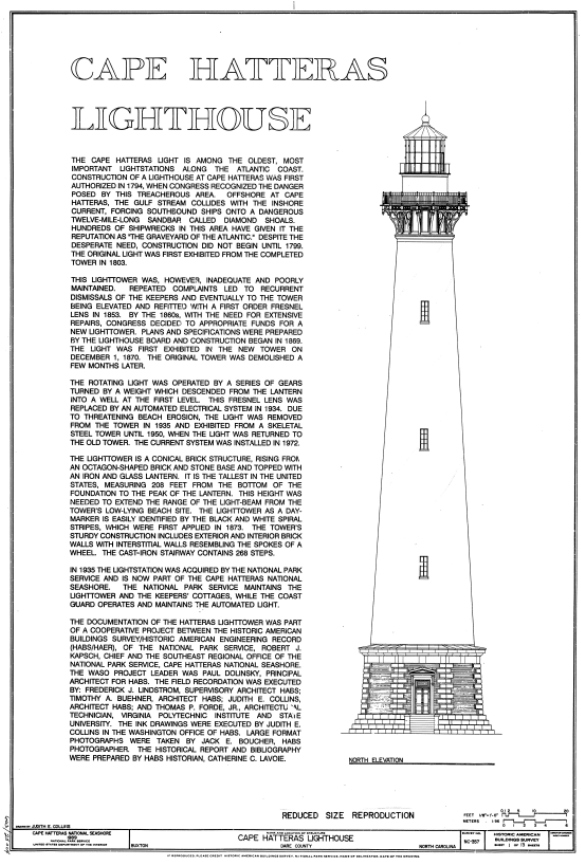
Public comment on the PA/DCP/EA was received through August 1989. Responses were divided. Forty-eight responses favored the move (including one with sixteen signatures). Fifty-six responses opposed the move (including one with 4,516 signatures). Seven responses had no opinion.[266]

In late October 1989, the Southeast Regional Director of the NPS signed the *Plan Approval and Finding of No Significant Impact* (FONSI) for the June PA/DCP/EA. It concluded that the NPS had chosen relocation of the light station as "the most appropriate action of long-term preservation." The NPS intended to move forward with planning and design for the chosen option. In addition, it stated that "the move will not be implemented until the risk of loss by erosion or rise in sea level equals or exceeds the risk of loss by a move, and until Congress has provided adequate funding. Under this scenario, the move alternative would not be implemented for a number of years." Because of the scheduled interim period before the move would occur, the NPS planned to:

1. Prepare specifications for the move in advance in order to receive contract bids more quickly later.
2. Investigate and implement low-impact dune management and erosion protection with comply with applicable laws.
3. Complete preservation work on the lighthouse.
4. Continue public outreach regarding coastal erosion and the lighthouse's status.[267]

In December 1989, several months after the EA was distributed, the Southeast Regional Director of the NPS officially announced they had selected the NAS's recommended alternative to relocate the lighthouse.[268]

Also in 1989, the Historic American Building Survey (HABS), an entity of the National Park Service Heritage Documentation Services, completed measured drawings for the lighthouse as well as photographs and a cumulative history of the site and the buildings of the light station (fig. 87).[269]


CAPE HATTERAS
LIGHTHOUSE

THE CAPE HATTERAS LIGHT IS AMONG THE OLDEST, MOST IMPORTANT LIGHTSTATIONS ALONG THE ATLANTIC COAST. CONSTRUCTION OF A LIGHTHOUSE AT CAPE HATTERAS WAS FIRST AUTHORIZED IN 1794. WHEN CONGRESS RECOGNIZED THE DANGER POSED BY THIS TREACHEROUS AREA. OFFSHORE AT CAPE HATTERAS, THE GULF STREAM COLLIDES WITH THE INSHORE CURRENT, FORCING SOUTHBOUND SHIPS ONTO A DANGEROUS TWELVE-MILE-LONG SANDBAR CALLED DIAMOND SHOALS. HUNDREDS OF SHIPWRECKS IN THIS AREA HAVE GIVEN IT THE REPUTATION AS "THE GRAVEYARD OF THE ATLANTIC." DESPITE THE DESPERATE NEED, CONSTRUCTION DID NOT BEGIN UNTIL 1799. THE ORIGINAL LIGHT WAS FIRST EXHIBITED FROM THE COMPLETED TOWER IN 1803.

THIS LIGHTTOWER WAS, HOWEVER, INADEQUATE AND POORLY MAINTAINED. REPEATED COMPLAINTS LED TO RECURRENT DISMISSALS OF THE KEEPERS AND EVENTUALLY TO THE TOWER BEING ELEVATED AND REFITTED WITH A FIRST ORDER FRESNEL LENS IN 1853. BY THE 1860s, WITH THE NEED FOR EXTENSIVE REPAIRS, CONGRESS DECIDED TO APPROPRIATE FUNDS FOR A NEW LIGHTTOWER. PLANS AND SPECIFICATIONS WERE PREPARED BY THE LIGHTHOUSE BOARD AND CONSTRUCTION BEGAN IN 1869. THE LIGHT WAS FIRST EXHIBITED IN THE NEW TOWER ON DECEMBER 1, 1870. THE ORIGINAL TOWER WAS DEMOLISHED A FEW MONTHS LATER.

THE ROTATING LIGHT WAS OPERATED BY A SERIES OF GEARS TURNED BY A WEIGHT WHICH DESCENDED FROM THE LANTERN INTO A WELL AT THE FIRST LEVEL. THIS FRESNEL LENS WAS REPLACED BY AN AUTOMATED ELECTRICAL SYSTEM IN 1934. DUE TO THREATENING BEACH EROSION, THE LIGHT WAS REMOVED FROM THE TOWER IN 1935 AND EXHIBITED FROM A SKELETAL STEEL TOWER UNTIL 1950, WHEN THE LIGHT WAS RETURNED TO THE OLD TOWER. THE CURRENT SYSTEM WAS INSTALLED IN 1972.

THE LIGHTTOWER IS A CONICAL BRICK STRUCTURE, RISING FROM AN OCTAGON-SHAPED BRICK AND STONE BASE AND TOPPED WITH AN IRON AND GLASS LANTERN. IT IS THE TALLEST IN THE UNITED STATES, MEASURING 208 FEET FROM THE BOTTOM OF THE FOUNDATION TO THE PEAK OF THE LANTERN. THIS HEIGHT WAS NEEDED TO EXTEND THE RANGE OF THE LIGHT-BEAM FROM THE TOWER'S LOW-LYING BEACH SITE. THE LIGHTTOWER AS A DAY-MARKER IS EASILY IDENTIFIED BY THE BLACK AND WHITE SPIRAL STRIPES, WHICH WERE FIRST APPLIED IN 1873. THE TOWER'S STURDY CONSTRUCTION INCLUDES EXTERIOR AND INTERIOR BRICK WALLS WITH INTERSTITIAL WALLS RESEMBLING THE SPOKES OF A WHEEL. THE CAST-IRON STAIRWAY CONTAINS 268 STEPS.

IN 1935 THE LIGHTSTATION WAS ACQUIRED BY THE NATIONAL PARK SERVICE AND IS NOW PART OF THE CAPE HATTERAS NATIONAL SEASHORE. THE NATIONAL PARK SERVICE MAINTAINS THE LIGHTTOWER AND THE KEEPERS' COTTAGES, WHILE THE COAST GUARD OPERATES AND MAINTAINS THE AUTOMATED LIGHT.

THE DOCUMENTATION OF THE HATTERAS LIGHTTOWER WAS PART OF A COOPERATIVE PROJECT BETWEEN THE HISTORIC AMERICAN BUILDINGS SURVEY/HISTORIC AMERICAN ENGINEERING RECORD (HABS/HAER), OF THE NATIONAL PARK SERVICE, ROBERT J. KAPSCH, CHIEF AND THE SOUTHEAST REGIONAL OFFICE OF THE NATIONAL PARK SERVICE, CAPE HATTERAS NATIONAL SEASHORE. THE WASO PROJECT LEADER WAS PAUL DOLINSKY, PRINCIPAL ARCHITECT FOR HABS. THE FIELD RECORDATION WAS EXECUTED BY: FREDERICK J. LINDSTROM, SUPERVISORY ARCHITECT HABS; TIMOTHY A. BUEHNER, ARCHITECT HABS; JUDITH E. COLLINS, ARCHITECT HABS; AND THOMAS P. FORDE, JR., ARCHITECTU *L TECHNICIAN, VIRGINIA POLYTECHNIC INSTITUTE AND STA\E UNIVERSITY. THE INK DRAWINGS WERE EXECUTED BY JUDITH E. COLLINS IN THE WASHINGTON OFFICE OF HABS. LARGE FORMAT PHOTOGRAPHS WERE TAKEN BY JACK E. BOUCHER, HABS PHOTOGRAPHER. THE HISTORICAL REPORT AND BIBLIOGRAPHY WERE PREPARED BY HABS HISTORIAN, CATHERINE C. LAVOIE.

NORTH ELEVATION

REDUCED SIZE REPRODUCTION

CAPE HATTERAS LIGHTHOUSE

Figure 87. The cover sheet of the HABS 1989 drawing set for the lighthouse. Drawing: NPS DSC eTIC No. CAHA 603 25004.

During the summer of 1990, a combination of NPS funding ($59,000) and a donation from the Save the Cape Hatteras Lighthouse Committee ($16,000) financed rehabilitation of the sandbag

[266] Baker, Robert, Regional Director, Southeast Region. "Plan Approval and Finding of No Significant Impact, Protection Alternatives/ Development Concept Plan/Environmental Assessment. Cape Hatteras National Seashore, North Carolina." October 31, 1990. NPS DSC eTIC No. CAHA 603 D47A.
[267] Ibid.
[268] NPS, "Synopsis: Study and Report, Cape Hatteras Lighthouse."
[269] Historic American Building Survey, National Park Service. "Cape Hatteras Lighthouse, Point of Cape Hatteras, access road from Route 12, Buxton, Dare County, NC." *Drawings from Survey HABS NC-357.* 1989. Accessed at http://www.loc.gov/resource/hhh.nc0432.sheet?st=gallery on August 24, 2015.

revetment.[270]

The same year, a $946,380 contract was awarded to International Chimney Corporation (ICC) for the restoration of the lighthouse in preparation for the rigors of the move.[271] ICC began the following restoration work 1991:

- Removal of portions of the stair to make new castings from the old pieces.
- Removal of the cast-iron handrail for preservation work.
- Removal of the Service Room windows, casting of new pieces, and reinstallation with 0'-1" safety glass.
- Completion restoration of the Lantern with new 5/16" safety glass.
- Construction of a temporary 7'-0"-wide, circular work deck under the gallery deck.
- Removal of gallery handrail and deck components, casting of new custom pieces to fit the slightly out-of-round tower, and reinstallation.
- Preservation work of the brackets, including some new cast components.
- Removal of the cast iron belt course, repair to the underlying brick masonry, and reinstallation of the cast iron.
- Deteriorated masonry was cut out and repainted.
- Rehabilitation of the exterior doors.
- Replacement of the seven tower windows (not Service Room windows).[272]

By 1991, the NPS Southeast Regional Office was finalizing the required environmental assessments and studies regarding the lighthouse move. Meanwhile, the NPS Denver Service Center (DSC) formed a team of people to prepare a Request for Proposals for the move.[273]

In November 1991, a preliminary report, *The Relocation of the Cape Hatteras Lighthouse: A Potential Optional Relocation Method that illustrates our Project Approach, i.e., the Analysis of Potential Optional Methods,* was completed by Howard, Needles, Tammen & Bergendoff (HNTB). The report described their method of moving the lighthouse in two separate sections, the main body and the base, in the following steps:

1. Prepare and grade the route
2. Manufacture and construct runway from high-strength pre-cast concrete, post-tensioned, and covered with stainless steel plate applied with Teflon (fig. 88).
3. Underpin the main structure of the lighthouse at the first internal floor level, insert needle beams fitted with diaphragm stiffeners, connected on their perimeter to lateral support beams to form a substantial base. Installation of anchorage points.
4. Fabricate the main structure protection module which surrounds the lighthouse (fig. 89).
5. Transfer the lighthouse, complete with the protection module, onto the runways, using jacks and two beams supported by four towers to support guy wires (fig. 90).
6. Construction of new lighthouse foundation.
7. Installation instrumentation and monitoring on lighthouse.
8. Pull lighthouse using jacks.
9. Remove, transport, and relocate base.
10. Remount the main structure of the lighthouse onto the base using gantry
11. Remove needle beams and equipment, and restore masonry.[274]

[270] NPS, "Synopsis: Study and Report, Cape Hatteras Lighthouse."
[271] Ibid.
[272] National Park Service, United States Lighthouse Society. *Historic Lighthouse Preservation Handbook*. 1997. Accessed at http://www.nps.gov/maritime/nhlpa/handbook.htm on October 14, 2015. Part V.B, pp. 7-8.
[273] NPS, "Synopsis: Study and Report, Cape Hatteras Lighthouse."

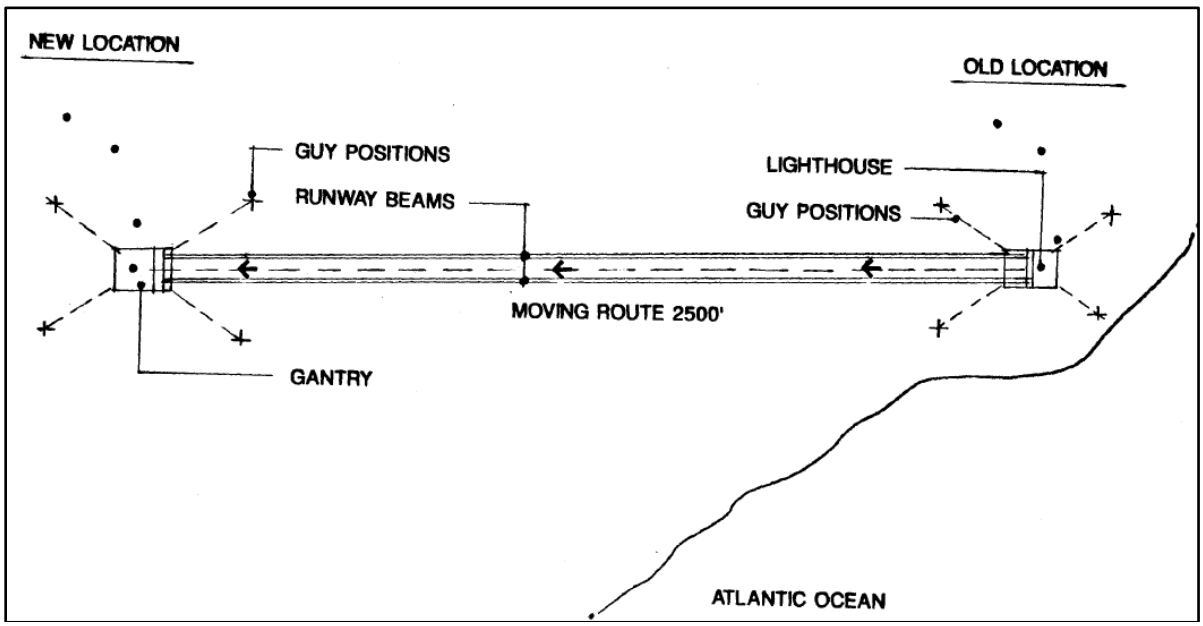


Figure 88, above. The location of the runway, gantry, and guy tower positions as proposed in November 1991 by HNTB. Drawing: NPS DSC eTIC No. CAHA 603 D118. Cropped by author.

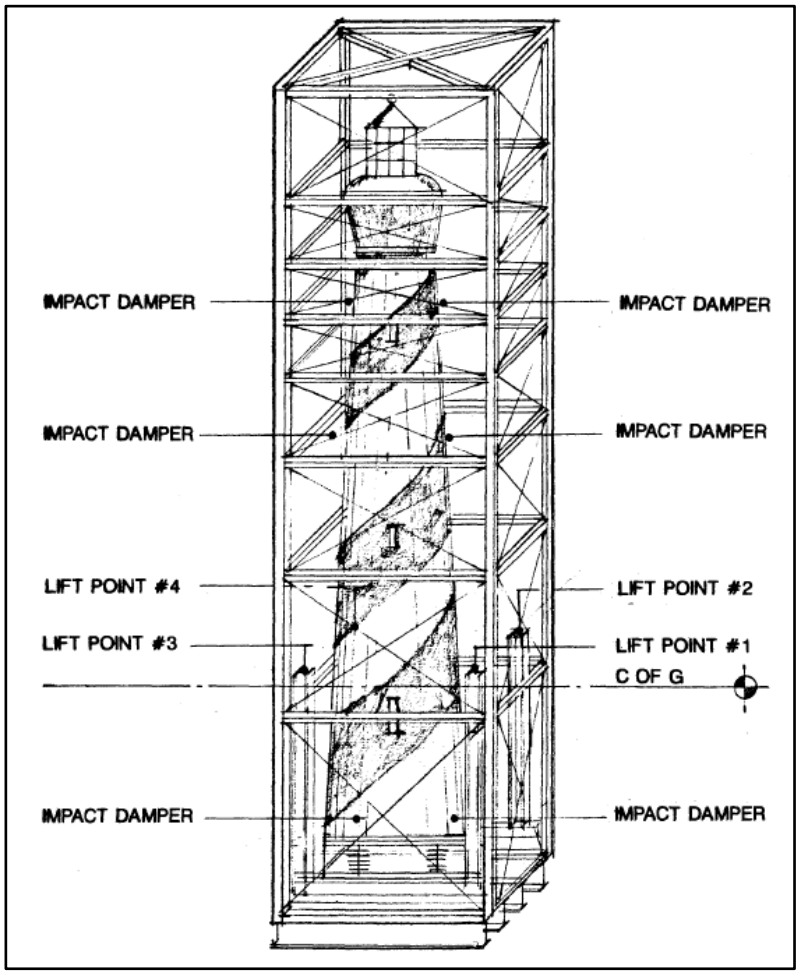


Figure 89, left. A drawing of the protection module as proposed in November 1991 by HNTB. Drawing: NPS DSC eTIC No. CAHA 603 D118. Cropped by author.

[274] Howard, Needles, Tammen & Bergendoff. "Preliminary Report: The Relocation of the Cape Hatteras Lighthouse: A Potential Optional Relocation Method that illustrates our Project Approach, i.e., the Analysis of Potential Optional Methods, Cape Hatteras National Seashore, North Carolina." November 6, 1991. NPS DSC eTIC No. CAHA 603 D118.

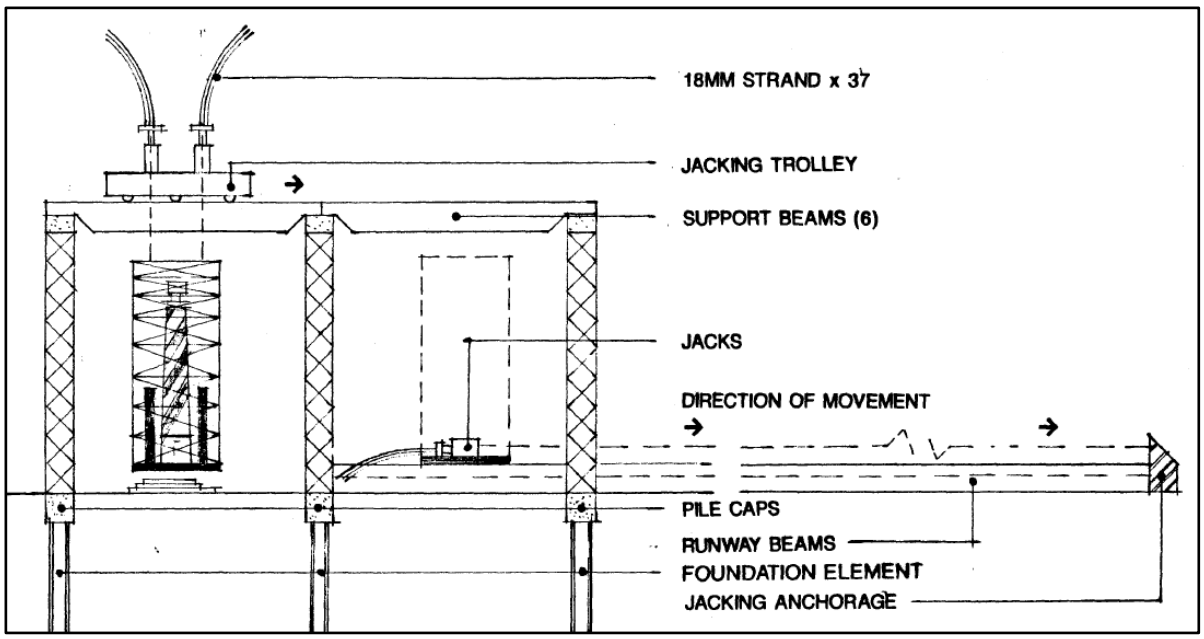


Figure 90. A drawing of the general arrangement of the gantry system as proposed in November 1991 by HNTB. Drawing: NPS DSC eTIC No. CAHA 603 D118. Cropped by author.

Work performed in 1992 included:

- Rehabilitation contract for the sandbag revetment damaged on October 31, 1991.
- DSC-awarded contract to HNTB development of the new lighthouse site.
- Contract negotiations between DSC and a prospective contractor regarding relocation specifications.
- Regional Chief Scientist-appointed committee assessment on beach erosion, the risk to the lighthouse, and interim protection recommendations.[275]
- HNTB submitted *Start-Up Report* for the relocation of the lighthouse. It included confirmation of the development program, establishment of the project approach, and the continuation on to the separate "Lighthouse Move Project."[276]

On August 8, 1993, Hurricane Emily, a Category-3 hurricane, made landfall near Hatteras Island, with a 100-knot landfall intensity.[277] The NPS used anything they could find, including riprap from an old road nearby, to protect the lighthouse.[278]

In 1993, despite contracting work in process, the Southeast Regional Director asked DSC to temporarily stop the contract for development of the relocation specifications in order for those funds to be used for emergency interim protection measures. The following year, the south groin, which had been damaged over the past several years, was repaired (fig. 91).[279]

[275] NPS, "Synopsis: Study and Report, Cape Hatteras Lighthouse."
[276] Howard, Needles, Tammen & Bergendoff. "Relocation of the Cape Hatteras Lighthouse, Start Up Report, Work Order No. 1." June 4, 1992. NPS DSC eTIC No. CAHA 603 D112.
[277] NOAA HRD. "Chronological List of All Hurricanes which Affected the Continental United States: 1851-2005."
[278] Yocum, Roberts, & Shelton-Roberts, "Cape Hatteras," pp. 96-98.
[279] NPS, "Synopsis: Study and Report, Cape Hatteras Lighthouse."

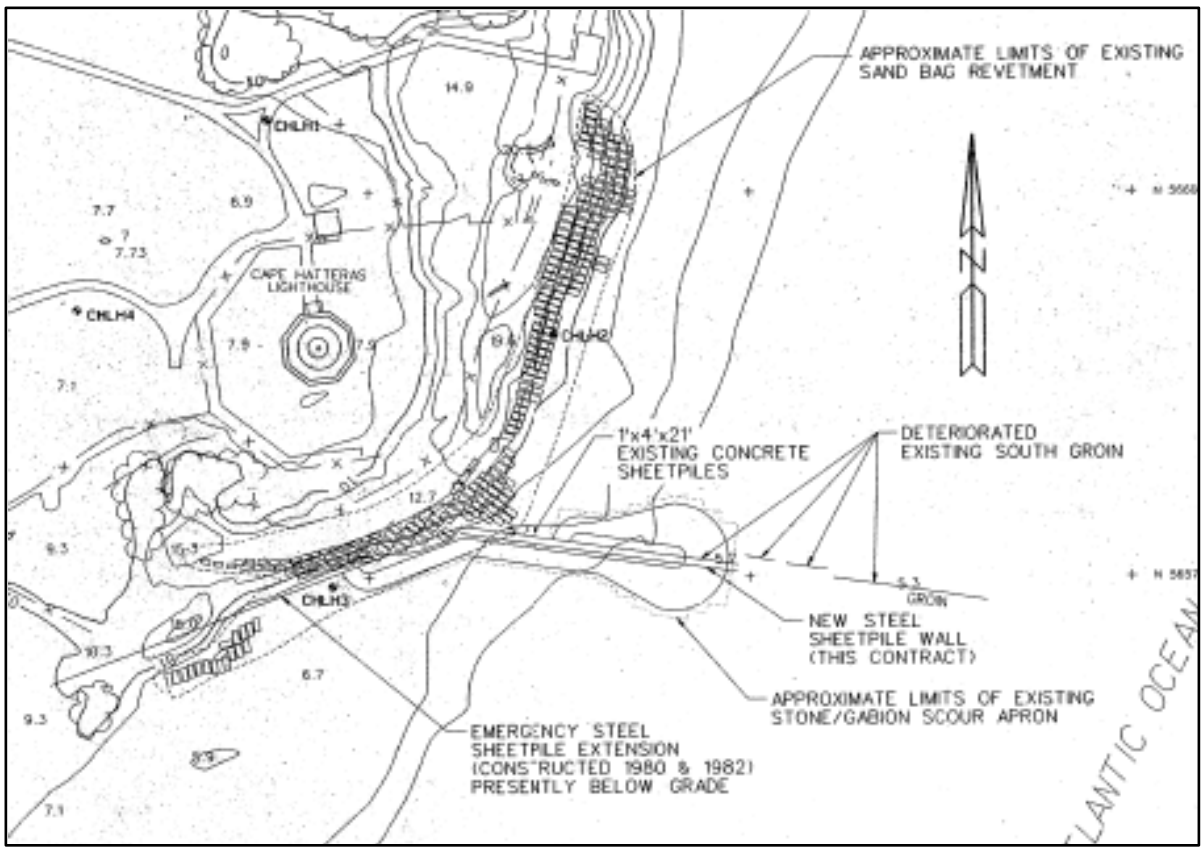


Figure 91. Plans for the repair of the south groin. Drawing: NPS DSC eTIC No. CAHA 603 80052. Cropped by author.

ICC completed the contracted lighthouse restoration work by the fall of 1993. A hurricane damaged three of the Lantern windows and removed a portion of the Lantern handrail (not replaced during original scope of work). ICC completed these repairs during the spring of 1994.[280] When the Save the Cape Hatteras Lighthouse Committee donated an additional $10,000 to fund repairs to the lighthouse roof, ICC also performed this work.[281]

In 1994, the exterior of the lighthouse was painted. In addition, the lighthouse was reopened for climbing that spring, having been closed since 1984 (it would stay open until 1998 prior to the move).[282] Most importantly, however, the park superintendent declared that the risk of leaving the lighthouse where it was outweighed the risk of moving it.[283]

In 1995, the ACOE prepared specifications and an "impact analysis associated with installation of a new fourth groin to be added south of the existing groin field."[284] The additional groin was requested by the NPS superintendent as the second step of three-step preservation. (The first step was to install protective sandbags around the lighthouse; the third step was to move the lighthouse.)[285] The groin would be removed once the lighthouse had been relocated. However, in 1996, it was denied by the North Carolina Natural Resources Commission who did not want to

[280] NPS/USLS. *Historic Lighthouse Preservation Handbook.* Part V.B, p. 8.
[281] NPS, "Synopsis: Study and Report, Cape Hatteras Lighthouse."
[282] NPS/USLS. *Historic Lighthouse Preservation Handbook.* Part V.B, p. 8.
[283] NPS, "Cape Hatteras Light Station," *Website.*
[284] NPS, "Synopsis: Study and Report, Cape Hatteras Lighthouse."
[285] Shelton-Roberts. "The Hatteras Move: A Century of Debate."

weaken state coastal laws. Local newspaper *Outer Banks Sentinel*, the Outer Banks Lighthouse Society, and NPS Cape Hatteras National Seashore officials made the news public. As a result, elected state officials began to support relocation of the lighthouse."[286]

Meanwhile, Marc Basnight, North Carolina Senate President *pro tempore*, who was responsible for promoting the move initially, asked a team of North Carolina State University professors to form an *ad hoc* committee to study the 1988 NAS study.[287] Their report, *Saving the Cape Hatteras Lighthouse from the Sea*, released in January 1997, confirmed the NAS study's findings, and recommended the NPS begin as soon as possible to obtain the funding necessary for the move.[288]

Senator Basnight also asked for President Bill Clinton's support for the moved during his visit to the state in spring 1997.[289] The president was amenable and appointed his Chief of Staff, Erskine Bowles, to provide support from the White House.[290]

Sean Callinicos, the Chief Legal Aide for U.S. Senator Lauch Faircloth, from North Carolina, a strong supporter of the relocation project, yielded significant support for the move. The senator was instrumental in receiving $2 million on July 22, 1997, through approval of his influential Senate Appropriations Committee.[291] The fiscal year 1998 appropriation allowed the NPS to proceed with soliciting and awarding a Design-Build contract. (The design portion would was awarded in 1998, with the build portion pending a fiscal year 1999 appropriation.)

In 1997, the metal handrails on either side of the exterior front stairs at the lighthouse were installed. The installation was granted SHPO approval in April of that year.[292]

Moving a Landmark Light Station

In late 1997, DSC issued a Request for Qualification for firms interested in bidding on the Design-Build project. A total of six firms responded. In January 1998, after a technical evaluation panel of three evaluating DSC employees and two non-evaluating advisors chose two firms to respond to the Request for Proposal (RFP). The RFP was issued in February 1998. Six amendments were issued between March and May of that year. The final scope of work, as amended, follows:

1. Inspect all structures prior to any disturbance. Provide documentation of pre-move conditions.... Documentation will provide:
    - Basis for documentation of required repairs under this contract of damage resulting from move (e.g., cracked plaster, opened mortar joints, etc.)
    - Basis for precise reconstruction of dismantled components, if any, under this contact.
    - Basis for future reconstruction of granite fence footing by others. Specifically document the location of each granite block and mark blocks accordingly for future reconstruction.

[286] Yocum, Roberts, & Shelton-Roberts, "Cape Hatteras," p. 98.
[287] Ibid.
[288] NPS, "Cape Hatteras Light Station," *Website*.
[289] Shelton-Roberts, "The Hatteras Move: A Century of Debate."
[290] Yocum, Roberts, & Shelton-Roberts. "Cape Hatteras, p. 99.
[291] Shelton-Roberts, "The Hatteras Move: A Century of Debate."
[292] Cape Hatteras National Seashore Archives, CAHA 5578: CAHA Compliance-Install Hand railing, CAHA Light Station, 1995-2000.

2. Determine (within one tenth of a foot) physical relationship (horizontal coordinates and elevation of all (Lighthouse, Principal Keepers [sic] Quarters and Double Keepers [sic] Quarters, cisterns, fence footing and oil house) to one another.
3. Design support systems in preparation of moving each structure.
4. Design transportation system for lighthouse, other buildings and cisterns. Dismantling and reconstruction of cisterns may be considered. However, the preference is that the contractor should move the buildings intact to greatest extent feasible. Granite fence footing will be dismantled and placed in storage.
5. Specify techniques for clearing along move corridor and new site clearing (Historic Management Zone). This is approximately a total of 10 acres. Clean fill should be wasted within the project area to the maximum extent possible. Excess clean fill may be disposed of at a site available within 1 mile of project site. Unsuitable material and grubbing debris may be disposed of at a nearby landfill (within 80-90 miles of site.
6. Design new foundations at new site. Use the designated lighthouse position as base for locating other structures. New locations for buildings to match within one tenth of a foot existing relative positions (horizontal coordinates, vertical elevation and orientation relative to true north). Relocate all structures to finish elevations to avoid building flooding. Specific finish elevations will be determined during the design process. Provide design for rough grading at new site that will minimize wind and water erosion. Final grading will be included in a separate contract.
7. Submit design development and construction documents for all design work. NPS will review for compliance with proposal evaluation factors and contract requirements.
8. Secure the work site.
9. Schedule lighthouse move to minimize risk of exposure during move to nor'easters and hurricanes (late March to late May safest period for move). Schedule other moves at contractor's convenience within contract time frame. Schedule all other work (including demolition of most of the light house transportation system) so that contractor is clear of site by September 30, 1999.
10. Prepare old site for relocating the buildings. Cap and abandon existing connected utilities. Relocate (or demolish) existing aerial utilities at existing site as needed to accomplish work. Remove and salvage sidewalk material (from gate to lighthouse) and provide to the Park for storage.
11. Prepare route for move.
12. Implement stabilization system in preparation of moving each structure.
13. Construct move pathway and assemble equipment for transportation system for lighthouse and other buildings. Sand dunes may be removed as needed to accomplish the move. Rebuilding of the dunes will be accomplished by others. . . .
14. Document locations and top face elevation above grade of each block of granite footing surrounding the lighthouse. Remove footing and store at park where directed…for reinstallation under a separate contract. All portions of the granite block footing shall be removed, including the portion under the sand dune. Sand dunes may be removed as needed to accomplish the move.
15. Move lighthouse. At a minimum, move all portions of the lighthouse exposed at and above existing grade line.
16. Move Double Keeper's [sic] Quarters, Principal Keeper's Quarters, and Oil House. At a minimum, move all building portions exposed at and above existing grade line. The concrete pedestal in the oil house is to be removed by the contractor and provided to the Park for storage. The floor in the oil house is to be relocated intact, if feasible. If not, reconstruct with existing salvaged materials. If material cannot be salvaged, reconstruct with similar new material. Piers under the Double Keepers [sic] Quarters are to be moved intact, if feasible. If not, the piers should be dismantled, salvaged, and reconstructed with salvaged materials. If material cannot be salvaged, reconstruct with new material to achieve similar appearance.
17. Move two rain water cisterns associated with the Double Keeper's [sic] Quarters and the one cistern associated with Principal Keeper's Quarters. At a minimum, remove all portions of the cisterns, including all portions below grade. It is the Government's preference to relocate cisterns intact. If this is not feasible, reconstruct with existing or similar materials. Offeror's proposal should reflect if it is not feasible or unreasonable to relocate the cisterns

intact and demonstrate means of reconstructing the cisterns in kind. Grades around relocated cisterns may be left rough and full exposure of cistern is acceptable.

18. Construct new foundations at new site and set structures onto them. Use the designated lighthouse position as base for locating other structures within one tenth of a foot of existing conditions (horizontal coordinates and elevation). New locations for all structures to match existing orientation to each other and to true north.
19. Provide final documentation of the condition of the Light Station after the move.
20. Closely inspect all buildings for damage occurring as result of preparation, moving, and placement on new foundation. Pre-move inspection, documentation will be baseline for determination of damages. The contractor shall repair all such damage under this contract.
21. Demolish and remove . . .most of the lighthouse transportation system. NPS may choose to retain a representative portion of the transportation system, (approximately 100 feet) adjoining the old lighthouse site for future interpretation. NPS will make this determination after considering if system is suitable for this purpose.
22. Leave any below-grade foundation remnants in place at old site. Back fill and level excavations at old site. Leave old site in safe condition. NPS expects damage to existing parking lots. Existing parking lots need not be rebuilt. Contractor will be required to leave existing park lot areas in a safe condition after the relocation has been accomplished.
23. Provide electrical service to lighthouse at new site. This may be a temporary aerial service. Connect service and make light functional. Design and construction for the electrical service entry into the lighthouse will be concealed. Remove existing exterior conduit mounted on the exterior of the lighthouse.
24. Provide a permanent lightning protection system for the lighthouse. Provide temporary lightning protection to the lighthouse during the move.
25. Provide as-built record drawings of move preparations, move pathway construction, and new foundations.
26. Provide temporary aircraft lighting during the move and permanent after the move.[293]

As part of the RFP process, DSC released solicitation-for-bid drawings (four-sheet set) entitled "Existing Conditions/Proposed Building Relocation" (figs. 92-94).[294] Remaining design work and specifications for the move would be provided by the contractor.

[293] The following resources were supplied by Paul Cloyd, NPS DSC Historical Architect and Project Supervisor for the move:
National Park Service, Denver Service Center. "Relocate the Cape Hatteras Light Station, Package CAHA 175." *Request for Proposal.* February 20, 1998.
National Park Service, Denver Service Center. "Minutes of Cape Hatteras Light Station Pre-Proposal Conference/Site Visit." March 4, 1998.
National Park Service, Denver Service Center. "Amendment/Modification No. 1." *Amendment of Solicitation/Modification of Contract.* March 16, 1998.
National Park Service, Denver Service Center. "Amendment/Modification No. 2." *Amendment of Solicitation/Modification of Contract.* March 24, 1998.
National Park Service, Denver Service Center. "Amendment/Modification No. 3." *Amendment of Solicitation/Modification of Contract.*
National Park Service, Denver Service Center. "Amendment/Modification No. 4." *Amendment of Solicitation/Modification of Contract.* April 9, 1998.
National Park Service, Denver Service Center. "Amendment/Modification No. 5." *Amendment of Solicitation/Modification of Contract.* May 12, 1998.
National Park Service, Denver Service Center. "Amendment/Modification No. 6." *Amendment of Solicitation/Modification of Contract.* May 20, 1998.
[294] Denver Service Center, National Park Service. "Existing Conditions/Proposed Building Relocation." March 1998. NPS DSC eTIC No. CAHA 603 25005.

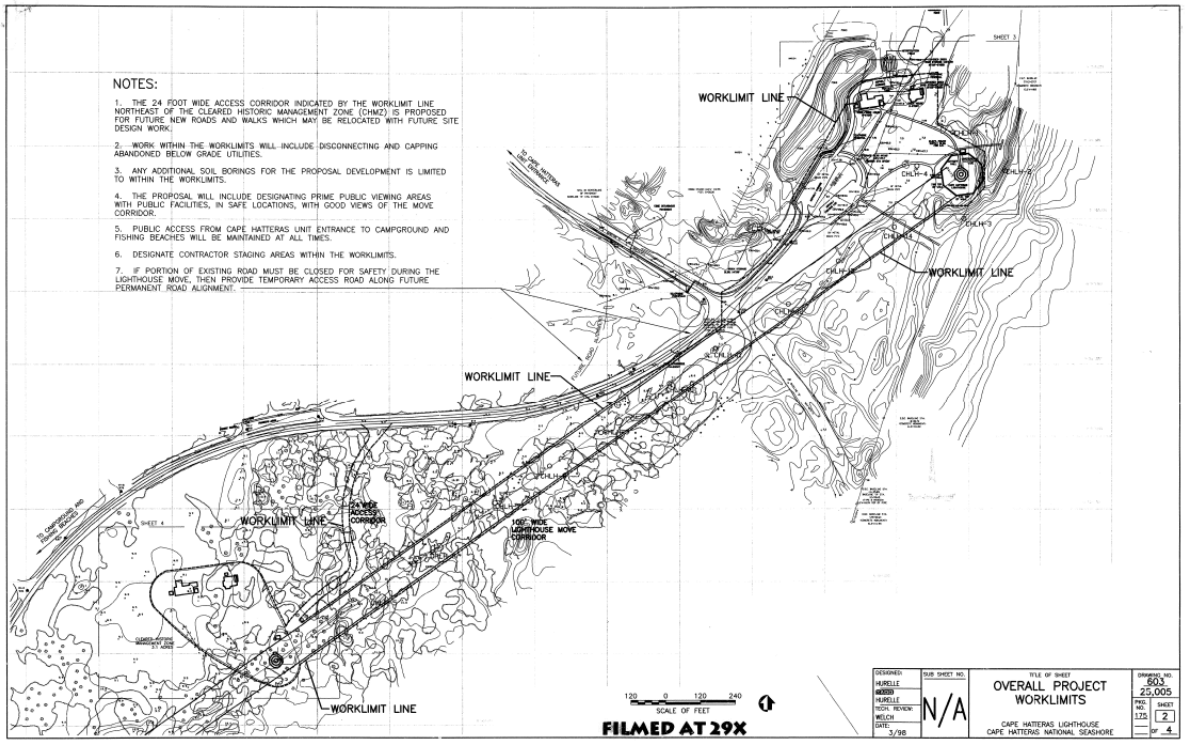


Figure 92. The overall project work limits in the solicitation for bid drawings, March 1998. Drawing: NPS DSC eTIC No. CAHA 603 25005.

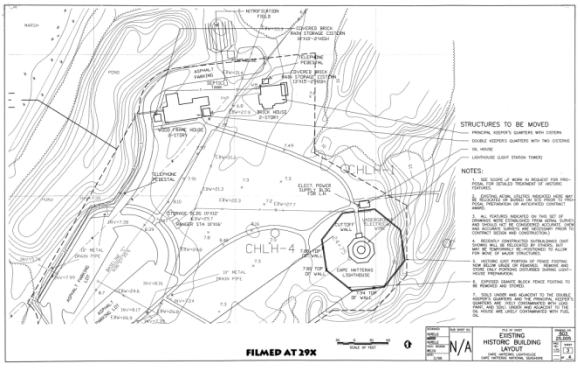


Figure 93. The existing historic building layout. Drawing: NPS DSC eTIC No. CAHA 603 25005.

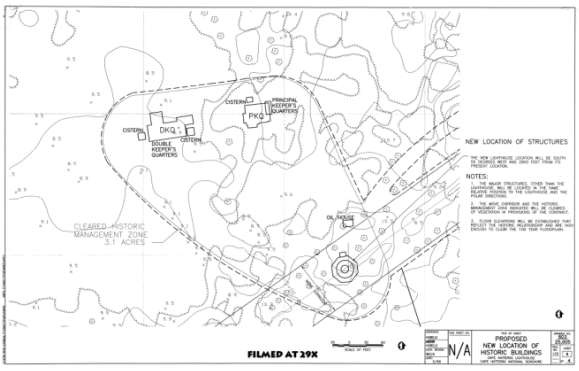


Figure 94. The proposed new location of historic buildings. Drawing: NPS DSC eTIC No. CAHA 603 25005.

About this time, State Representative Walter Jones, a former supporter of the move, re-aligned his stance with his Buxton-area constituency, and began to speak out against the relocation. Legal aide Callinicos replied in March 1998:

> The lighthouse has become an ideological lightning rod. By the time the [debates] are over, the lighthouse could be a pile of bricks. Then, wouldn't we look foolish? Everybody is concerned that if this topples, North Carolina will look idiotic, a state that can't protect its heritage….[295]

Because of the local resistance, Senator Faircloth and House Representative Walter Jones hosted a public hearing on April 9, 1998. Testimony for both sides was heard that day. Joan Weld, speaking

[295] Shelton-Roberts, "The Hatteras Move: A Century of Debate."

on behalf of North Carolina Governor James Hunt, urging the move be supported.[296] Six months later, on October 16, 1998, Senator Faircloth announced that he was able to secure $9.8 million from Congress to move the lighthouse.[297]

International Chimney Incorporated (ICC) won the contract to move the light station for their familiarity with the lighthouse and "significant advantages in their move technology."[298] Their final proposal supplementation for the move was submitted in May 1998.[299] Several additional studies and reports were completed in the fall of the same year.

In early September 1998, WJE completed *Structural Materials Investigation Report* for ICC. The investigations were completed to assist the design team in making structural decisions. Investigations performed included granite foundation cores, brickwork and granite testing (compressive strengths, unit weights, and moduli of elasticity), and depth of debris within wall cavities.[300]

A number of reports were completed by LAW Engineering and Environmental Services, Inc. for ICC. *Geotechnical Investigation Report* expounds on LAW's soil test borings. The results of the borings confirmed the designed move route, in addition that the new locations for the lighthouse and keepers' quarters were suitable for shallow foundations and that settlement of 0'-1" to 0'-2" should be expected.[301]

Hazardous Materials Investigation Report found no asbestos-containing materials in the lighthouse. Lead-based paint was only found in the exterior red paint at the base of the lighthouse and in the interior grey paint in the lighthouse lantern.[302]

Design Quality Assurance and Control Plan presented "a procedure that provides for the definition, control, verification and approval of information obtained for design and design documents obtained and created by the project team member firms during the design development and final design phases of the relocation…."[303]

Also in September 1998, DSC conducted a preliminary structural assessment on the lighthouse stairs and landings. Due to the complexity of and inconsistencies within the structure, the report

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[296] Harrison, Timothy. "Meeting on Hatteras Draws Emotional Crowd." *Lighthouse Digest Magazine.* May 1998. Accessed at http://www.lighthousedigest.com/Digest/StoryPage.cfm?StoryKey=259 on October 5, 2015.
[297] Ibid.
[298] Cloyd, Paul C., PE/RA. "Cape Hatteras Lighthouse HSR 100% draft review." January 2016.
[299] International Chimney Corporation. "Supplemental Technical and Price Proposal: Final Proposal – Design and Construction (Design/Build) Contract to Relocate Cape Hatteras Light Station, Cape Hatteras National Seashore, Dare County, North Carolina, package CAHA 175/Request for Proposal." May 29, 1998. NPS DSC eTIC No. CAHA 603 D156.
[300] International Chimney Corporation with Wiss, Janney, Elstner Associates. "Structural Materials Investigation Report: Design and Construction (Design/Build) Contract to Relocate Cape Hatteras Light Station, Cape Hatteras National Seashore, Dare County, North Carolina." September 2, 1998. NPS DSC eTIC No. CAHA 603 D150.
[301] International Chimney Corporation with Law Engineering and Environmental Services, Inc. "Geotechnical Investigation Report: Design and Construction (Design/Build) Contract to Relocate Cape Hatteras Light Station, Cape Hatteras National Seashore, Dare County, North Carolina." September 4, 1998. NPS DSC eTIC No. CAHA 603 D151.
[302] International Chimney Corporation with Law Engineering and Environmental Services, Inc. "Hazardous Materials Investigation Report: Design and Construction (Design/Build) Contract to Relocate Cape Hatteras Light Station, Cape Hatteras National Seashore, Dare County, North Carolina." September 4, 1998. NPS DSC eTIC No. CAHA 603 D148.
[303] International Chimney Corporation with Law Engineering and Environmental Services, Inc. "Design Quality Assurance and Control Plan: Design and Construction (Design/Build) Contract to Relocate Cape Hatteras Light Station, Cape Hatteras National Seashore, Dare County, North Carolina." September 1998. NPS DSC eTIC No. CAHA 603 D156.

recommended performing *in situ* load testing of the stairs in landings in order to determine their live-load capacity.[304]

In October, the first draft Design Development Drawings for the relocation were completed by DSC,[305] *Soil/Site Evaluation, and Site Loading Capacity for a Large Subsurface Wastewater System at the Cape Hatteras Lighthouse* was completed by Soil and Environmental Consultants, Inc.,[306] and *Health and Safety Plan for Construction* was completed by LAW Engineering and Environmental Services, Inc. for ICC.[307]

In April 1999, Final Construction Drawings for the relocation were completed (figs. 95-111).[308]

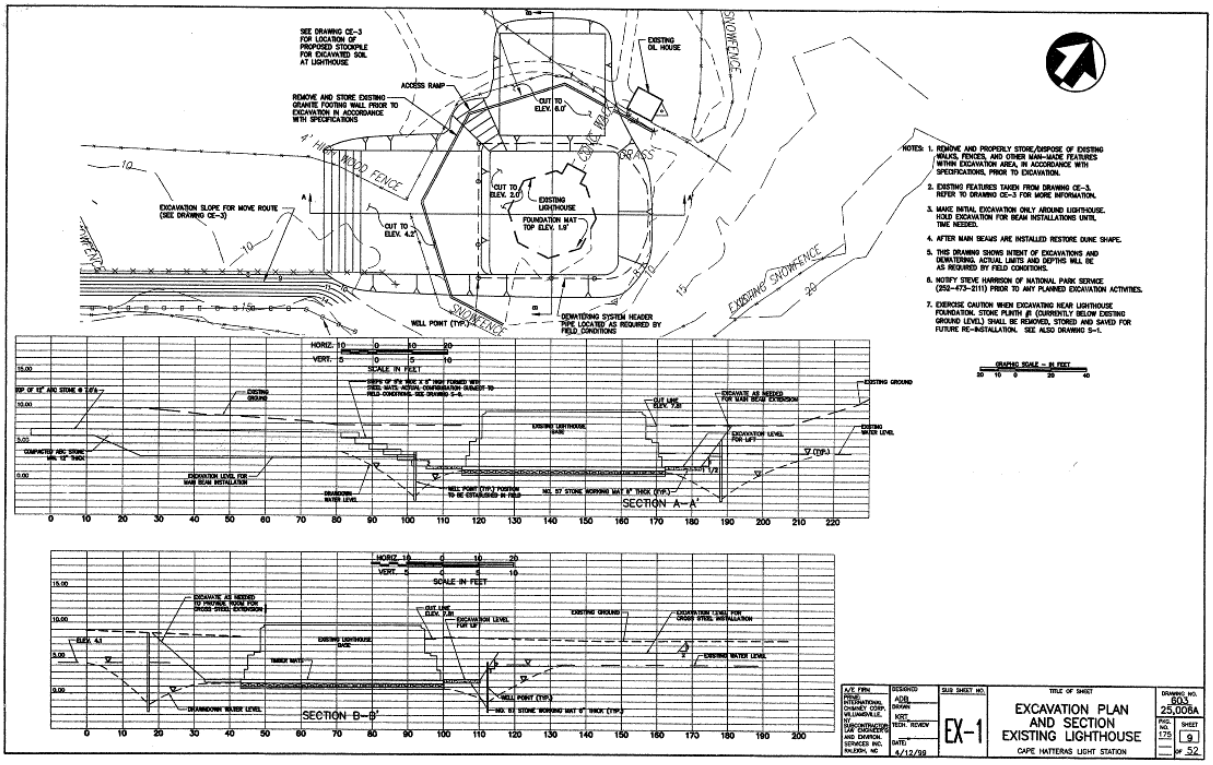


Figure 95. The excavation plan and sections for the lighthouse in its existing location. Drawing: NPS DSC eTIC No. CAHA 603 25006A.

[304] Chalk, Jana, Denver Service Center, National Park Service. "Preliminary Structural Assessment, Cape Hatteras Lighthouse Stairs and Landings, Cape Hatteras National Seashore." September 1998. NPS DSC eTIC No. CAHA 603 D144.
[305] Denver Service Center, National Park Service. "Relocate the Cape Hatteras Light Station." *Design Development Drawings.* October 1, 1998. NPS DSC eTIC No. CAHA 603 25006.
[306] Soil and Environmental Consultants, Inc. "Soil/Site Evaluation, and Site Loading Capacity for a Large Subsurface Wastewater System at the Cape Hatteras Lighthouse, Dare County, North Carolina." October 1998. NPS DSC eTIC No. CAHA 603 D152.
[307] International Chimney Corporation with Law Engineering and Environmental Services, Inc. "Health & Safety Plan for Construction: Design and Construction (Design/Build) Contract to Relocate Cape Hatteras Light Station, Cape Hatteras National Seashore, Dare County, North Carolina." October 28, 1998. NPS DSC eTIC No. CAHA 603 D149.
[308] Denver Service Center, National Park Service. "Relocate the Cape Hatteras Light Station." *Final Construction Drawings.* October 1, 1998. NPS DSC eTIC No. CAHA 603 25006A.

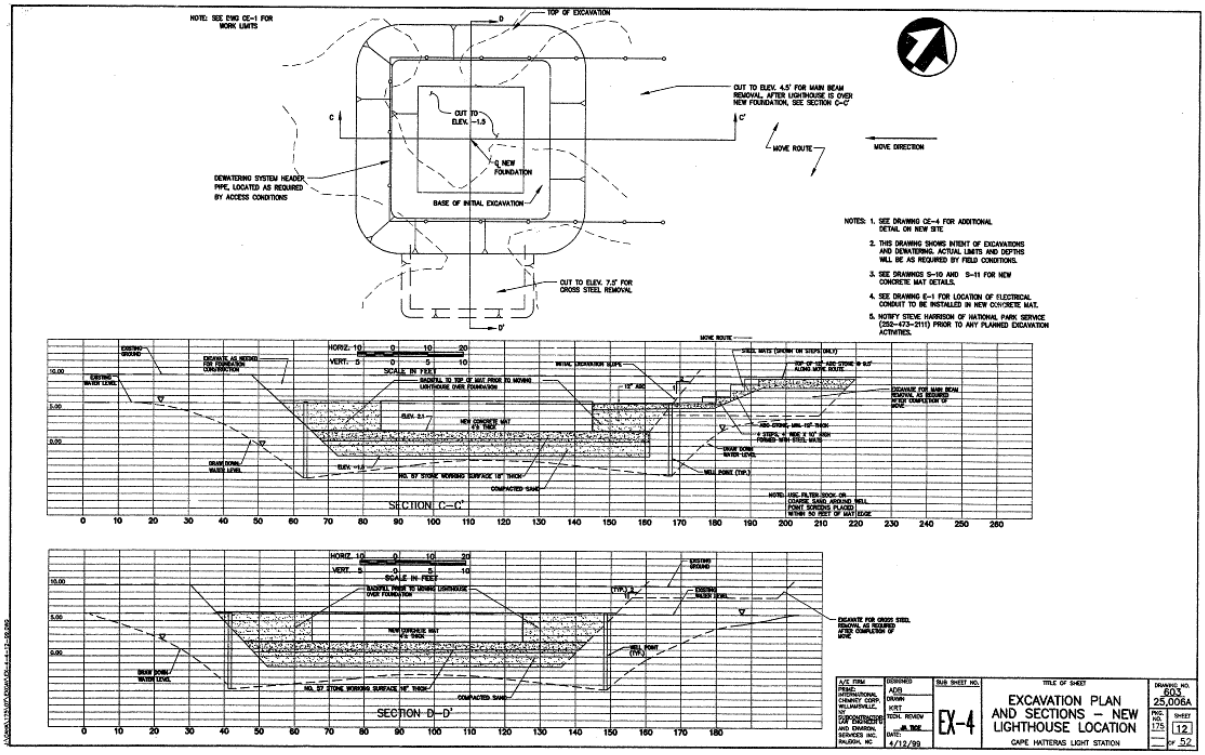


Figure 96. The excavation plan and sections for the new foundation for the lighthouse. Drawing: NPS DSC eTIC No. CAHA 603 25006A.

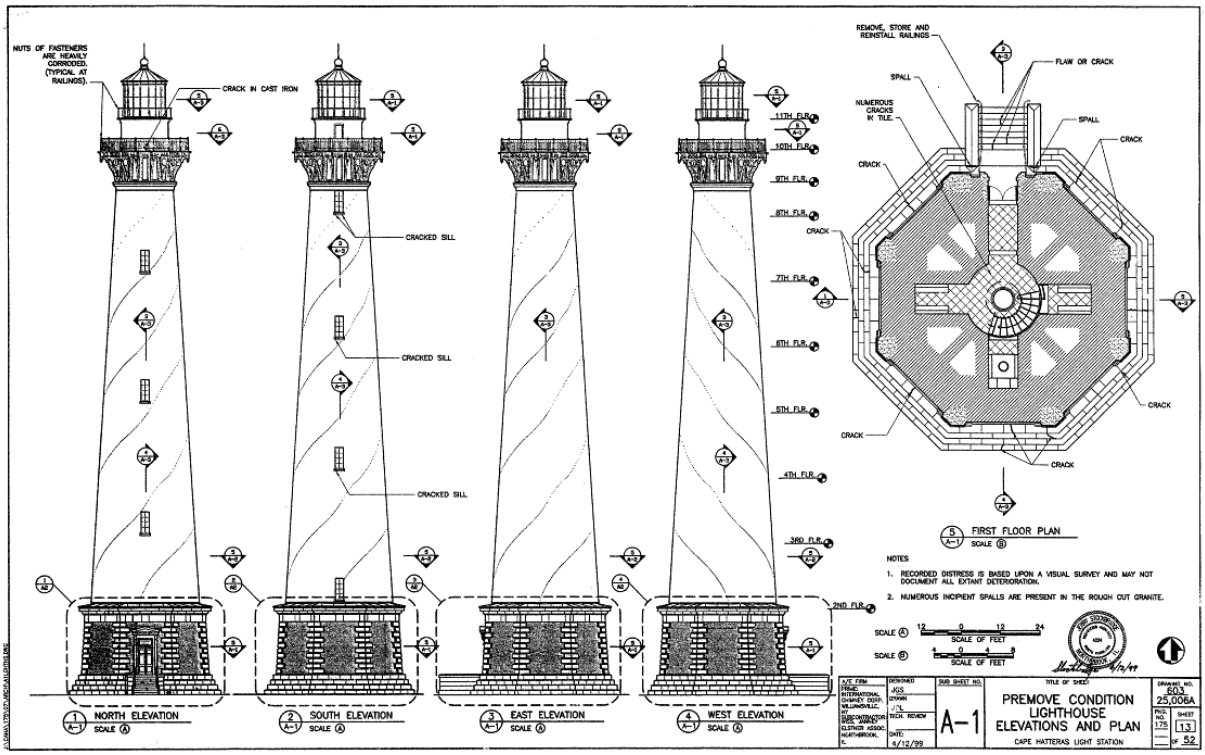


Figure 97. The pre-move conditions of the lighthouse – elevations and first-floor plan. Drawing: NPS DSC eTIC No. CAHA 603 25006A.

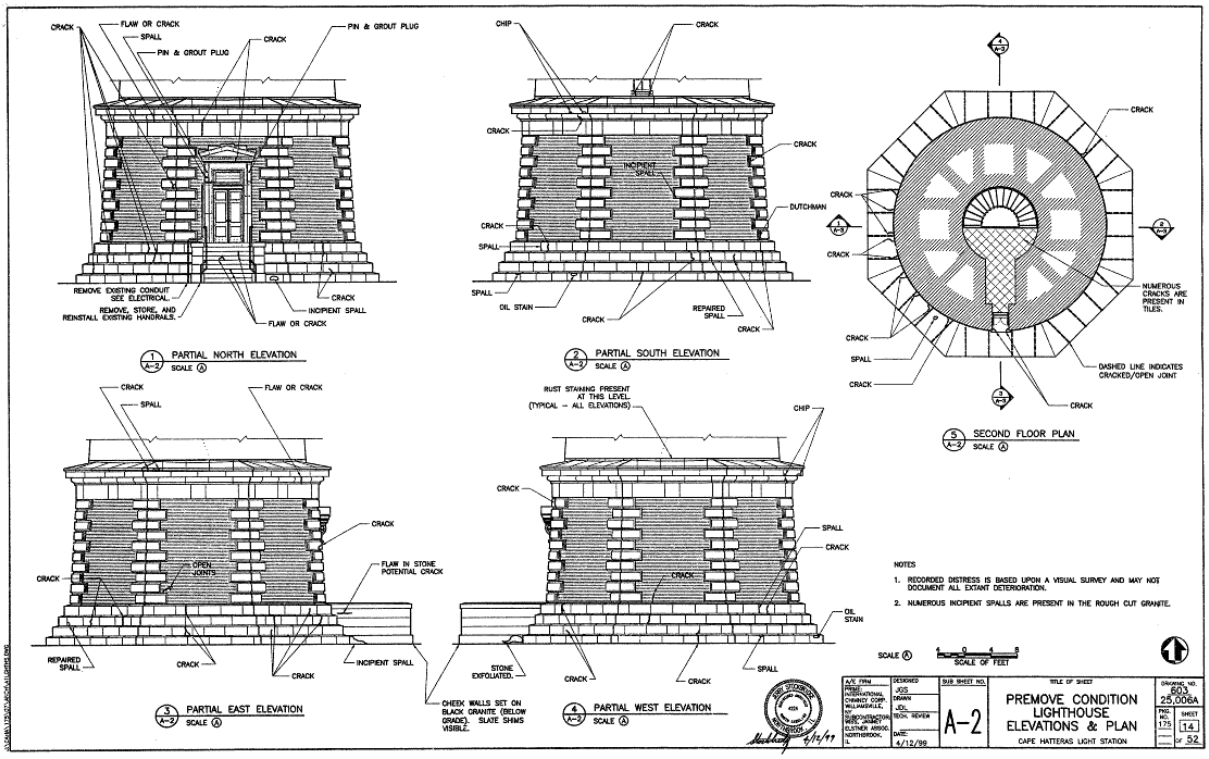


Figure 98. The pre-move conditions of the lighthouse base – elevations and second-floor plan. Drawing: NPS DSC eTIC No. CAHA 603 25006A.

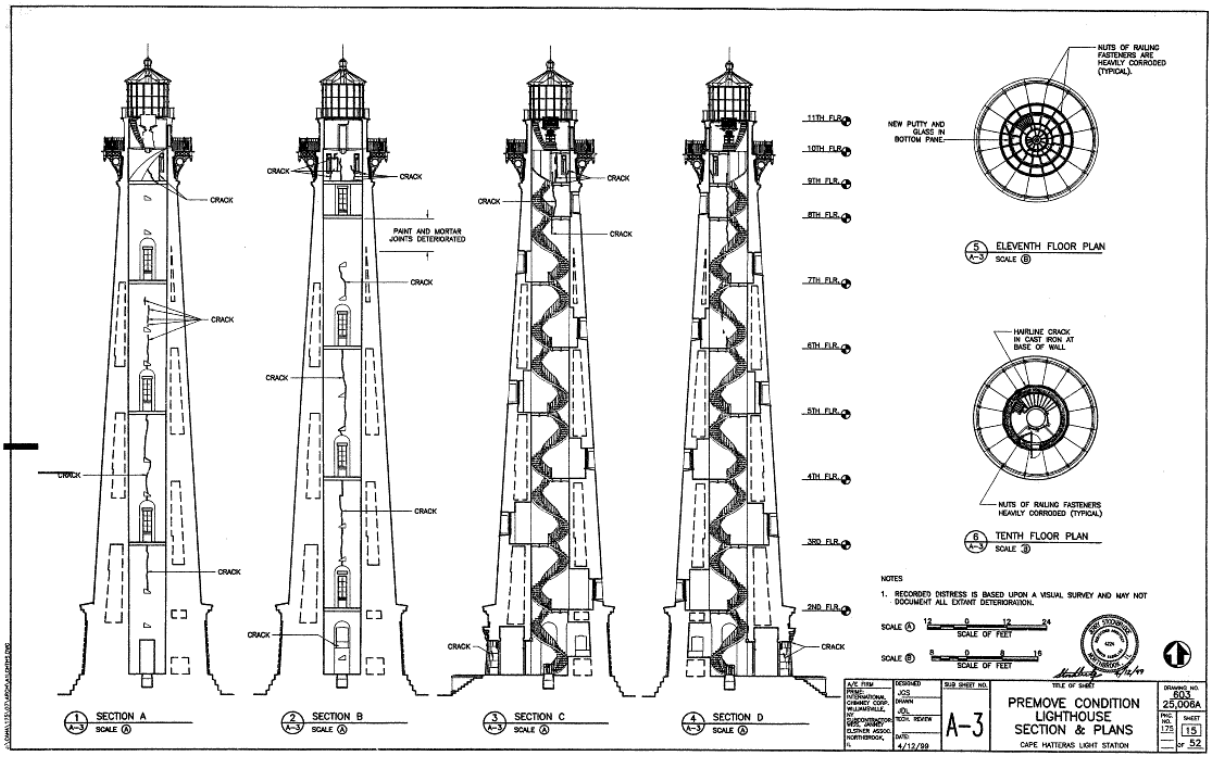


Figure 99. The pre-move conditions of the lighthouse – interior elevations and tenth- and eleventh-floor plan. Drawing: NPS DSC eTIC No. CAHA 603 25006A.

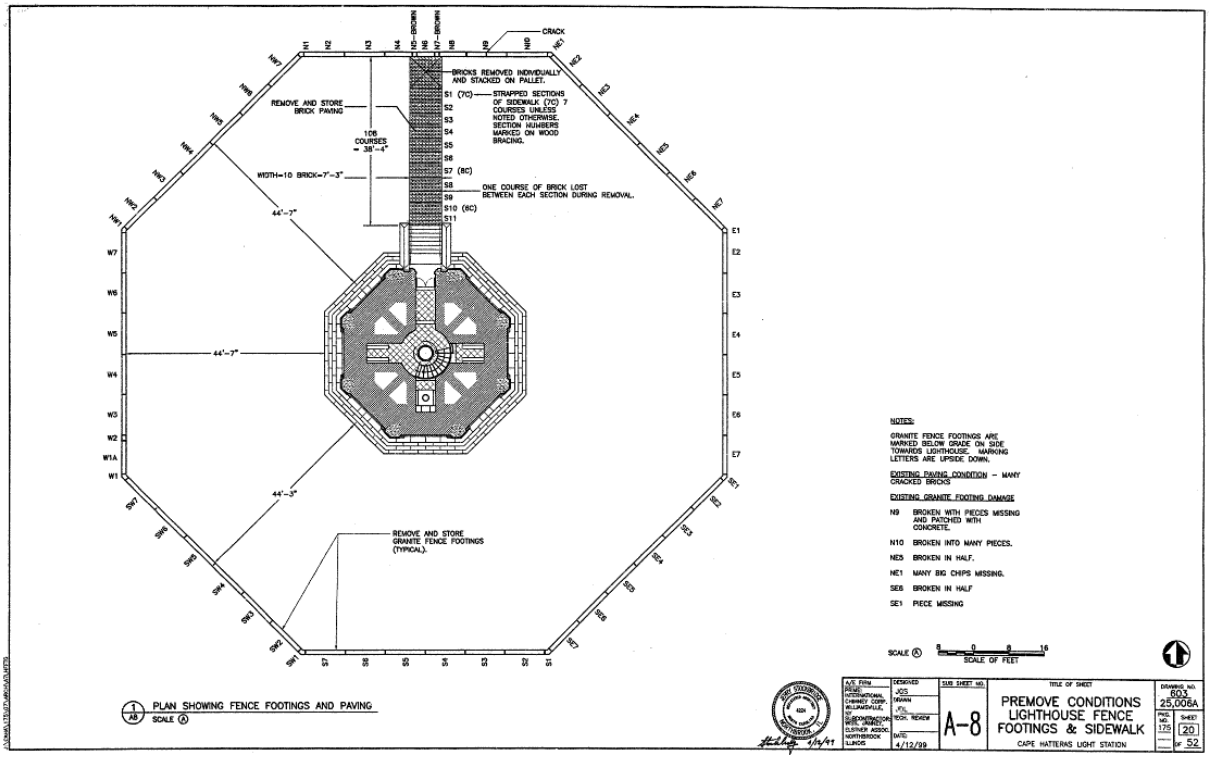


Figure 100. The pre-move conditions of the lighthouse fence footings and sidewalk. Drawing: NPS DSC eTIC No. CAHA 603 25006A.

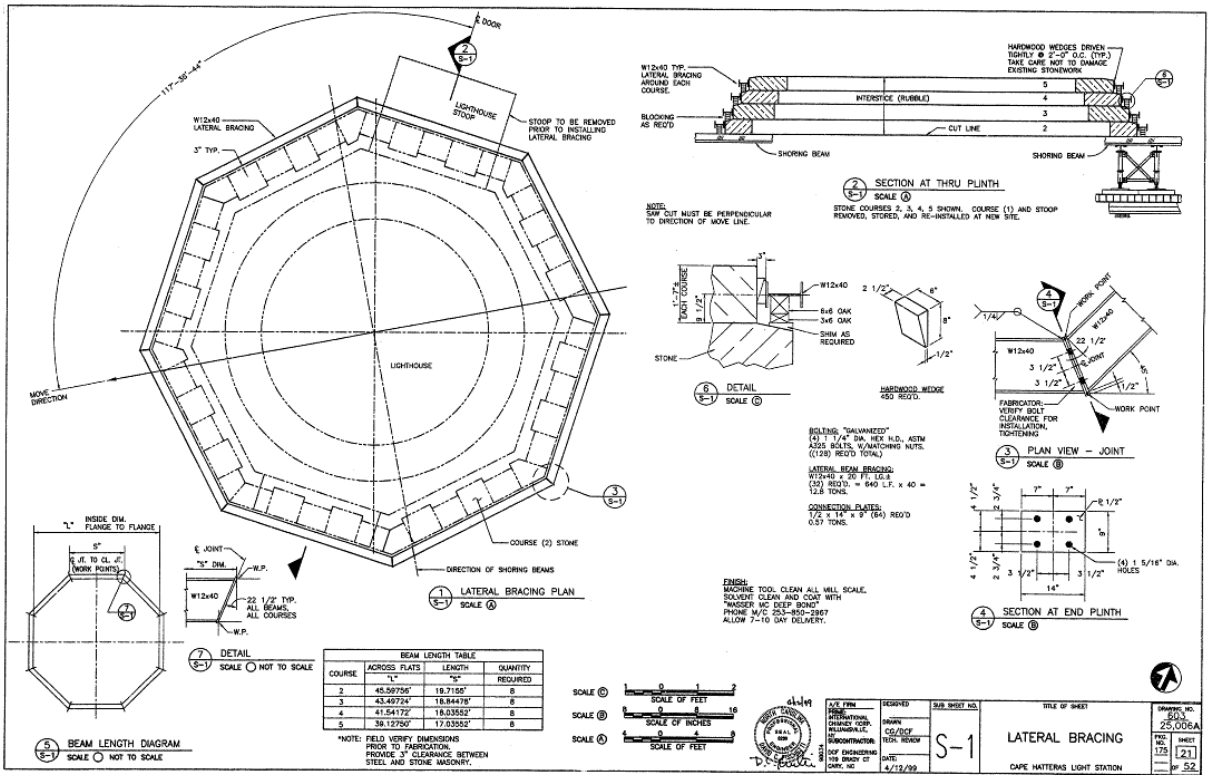


Figure 101. The design for the lateral bracing at the lighthouse foundation. Drawing: NPS DSC eTIC No. CAHA 603 25006A.

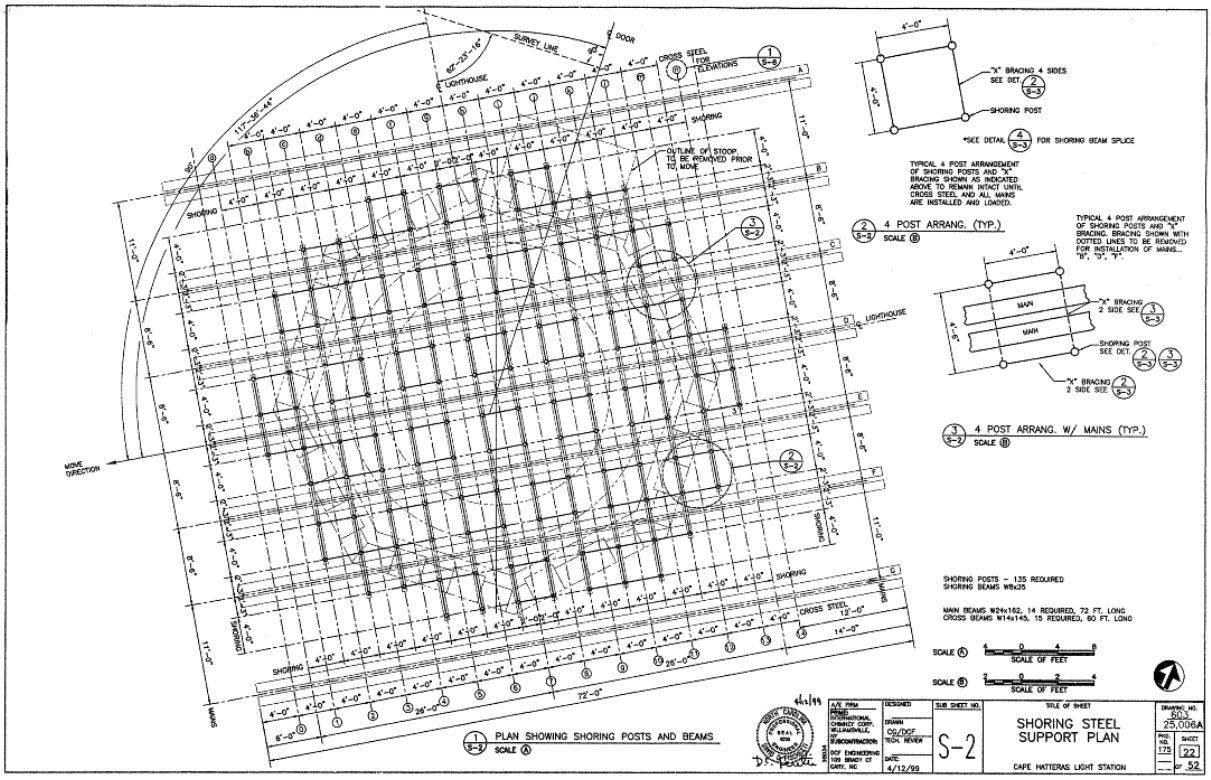


Figure 102. The design for the shoring steel support under the lighthouse (plan). Drawing: NPS DSC eTIC No. CAHA 603 25006A.

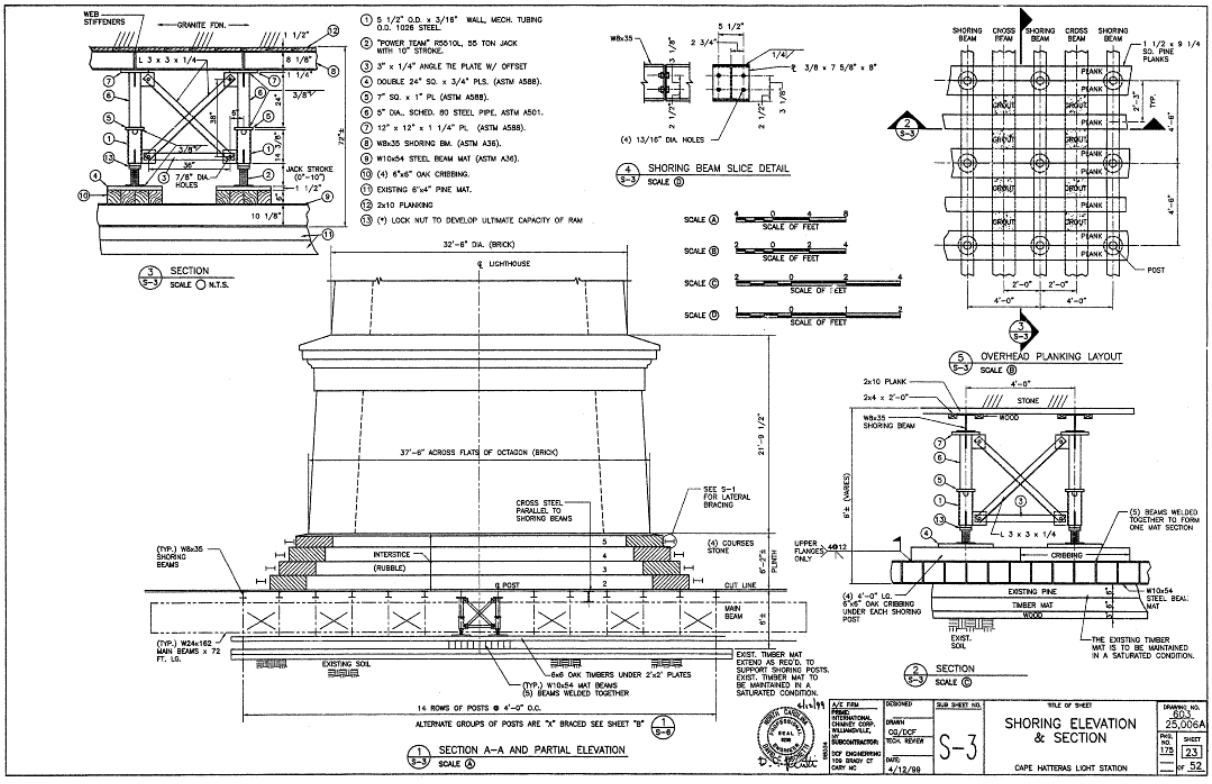


Figure 103. The design for the shoring steel support under the lighthouse (elevation and section). Drawing: NPS DSC eTIC No. CAHA 603 25006A.

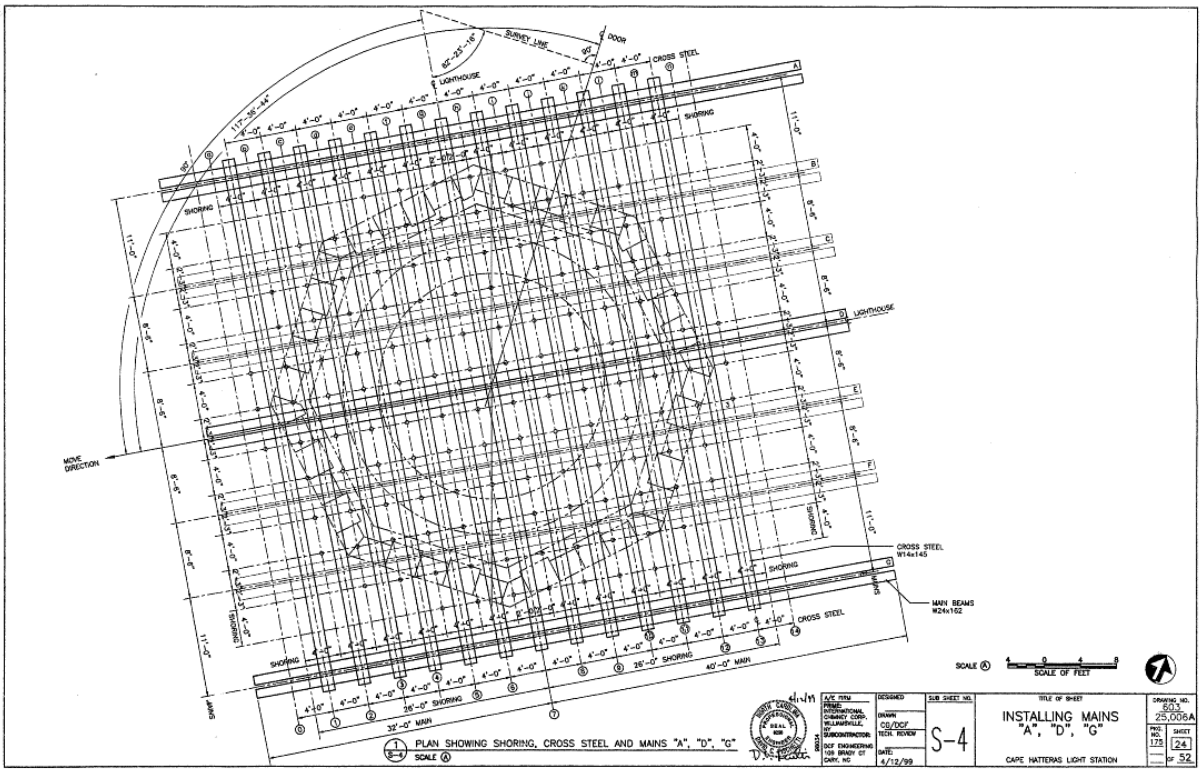


Figure 104. The design for installation the mains A, D, and G (plan). Drawing: NPS DSC eTIC No. CAHA 603 25006A.

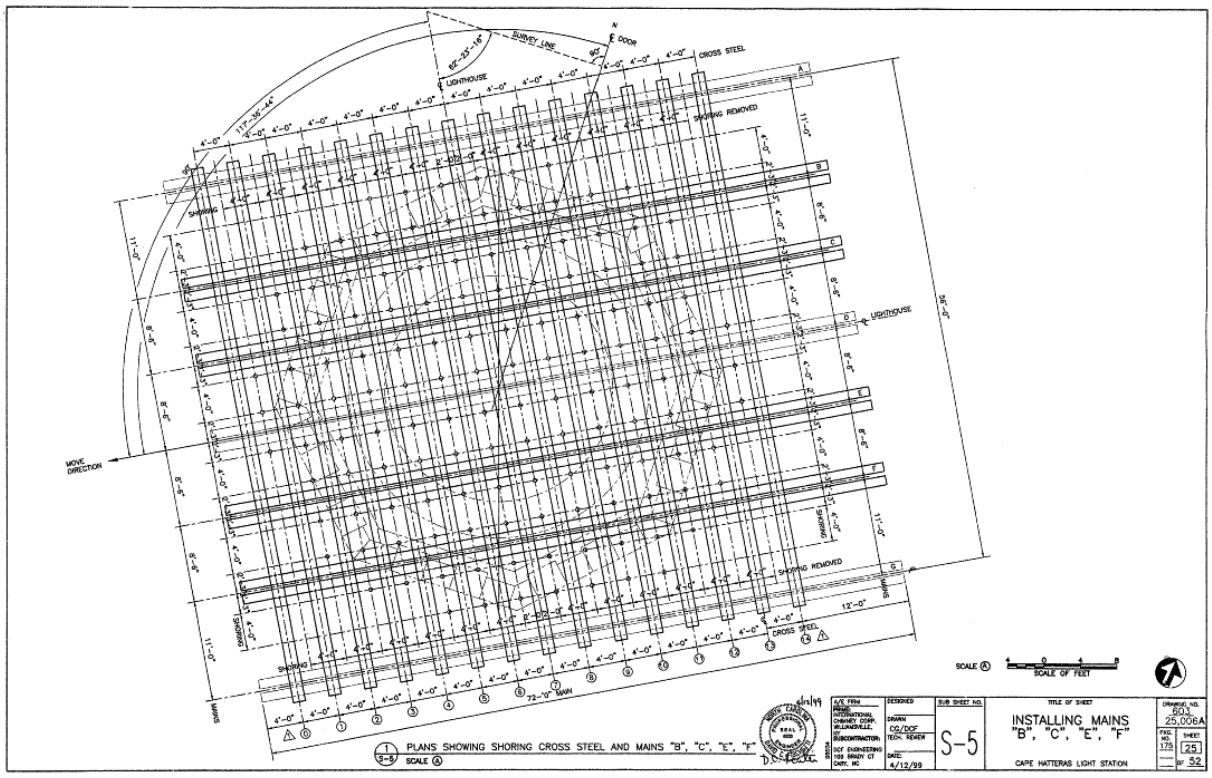


Figure 105. The design for installation the mains B, C, E, and F (plan). Drawing: NPS DSC eTIC No. CAHA 603 25006A.

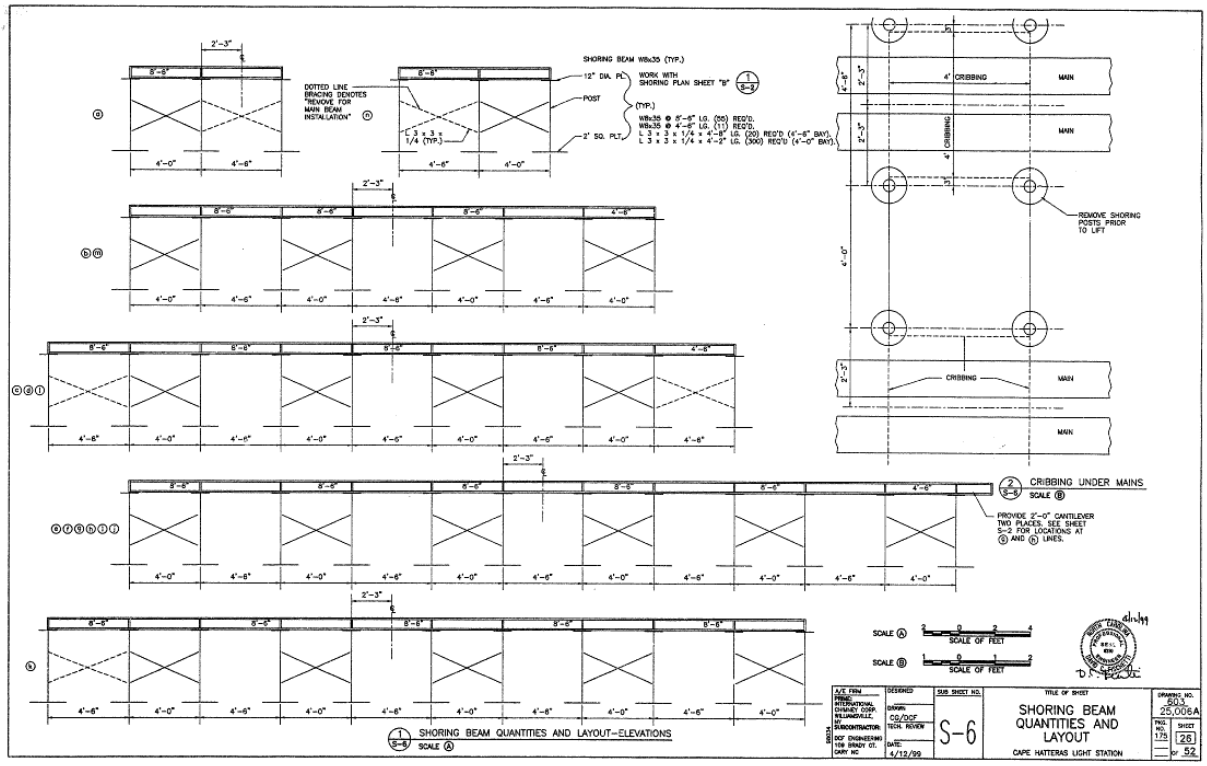


Figure 106. The design for installation of the shoring beams. Drawing: NPS DSC eTIC No. CAHA 603 25006A.

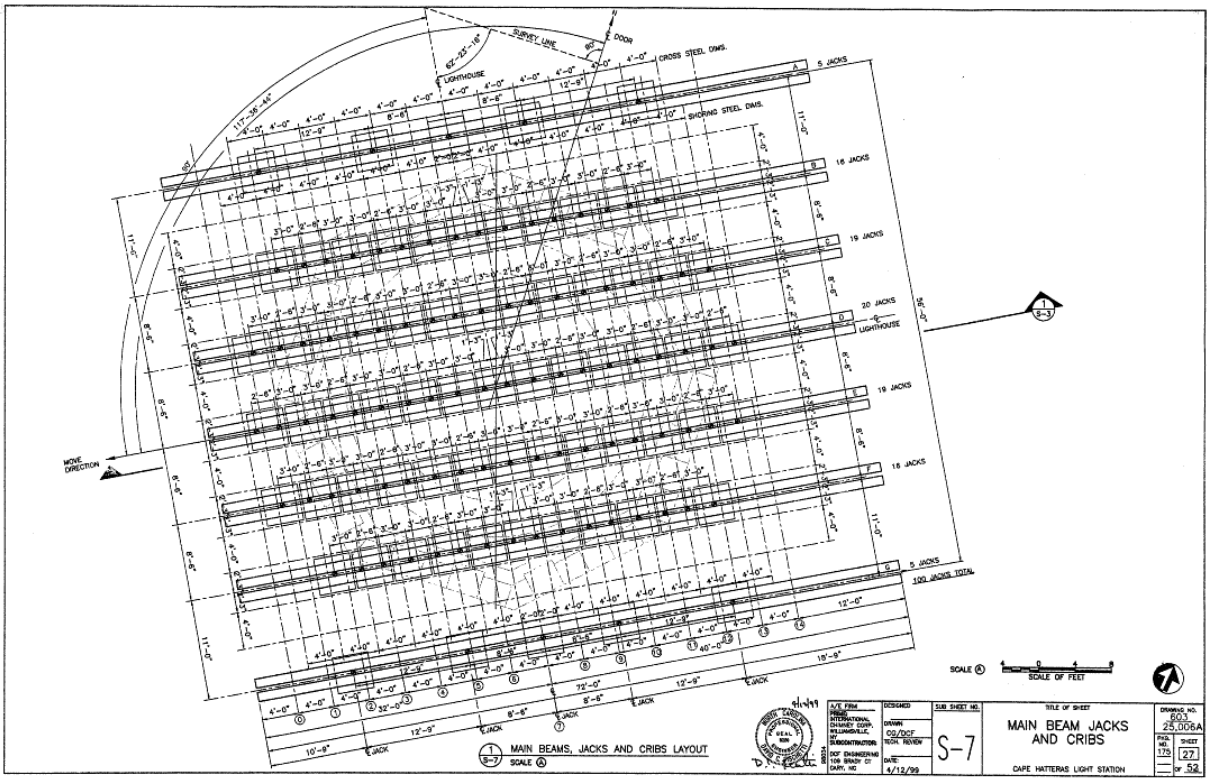


Figure 107. The design for installation of the main beam jacks and cribs. Drawing: NPS DSC eTIC No. CAHA 603 25006A.

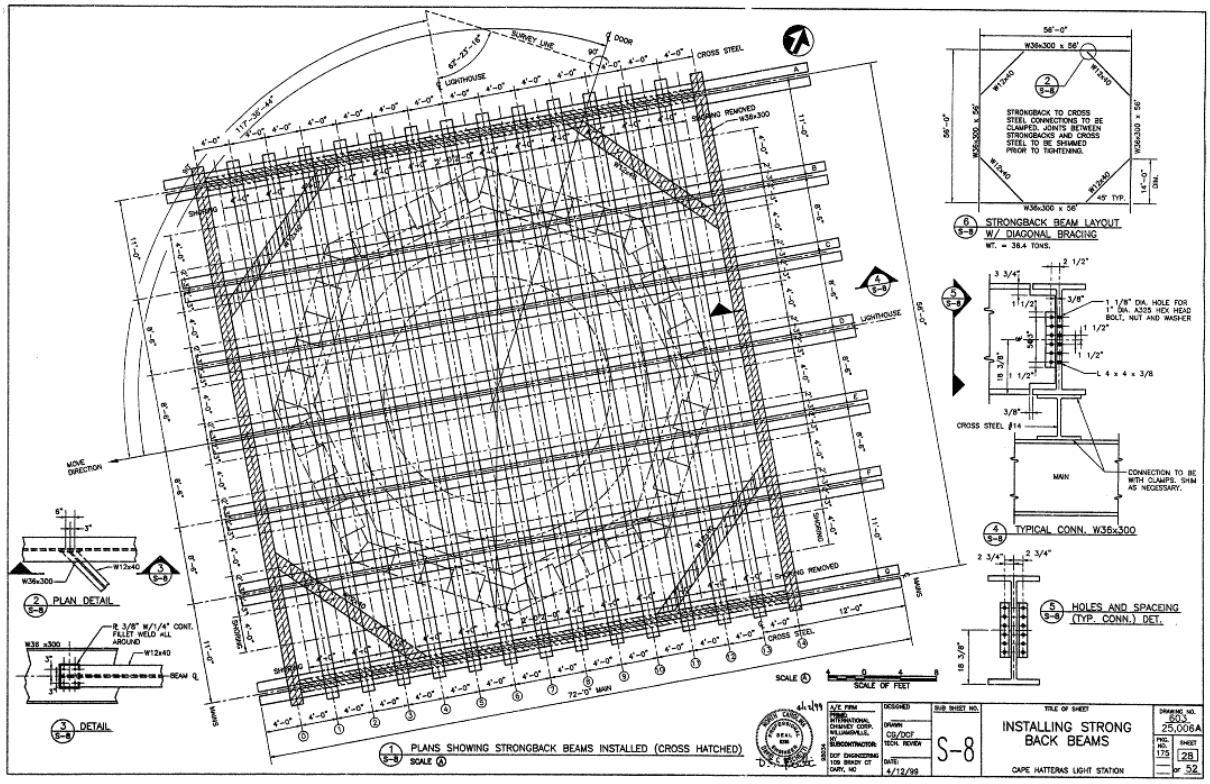


Figure 108. The design for installation of the strong back beams. Drawing: NPS DSC eTIC No. CAHA 603 25006A.

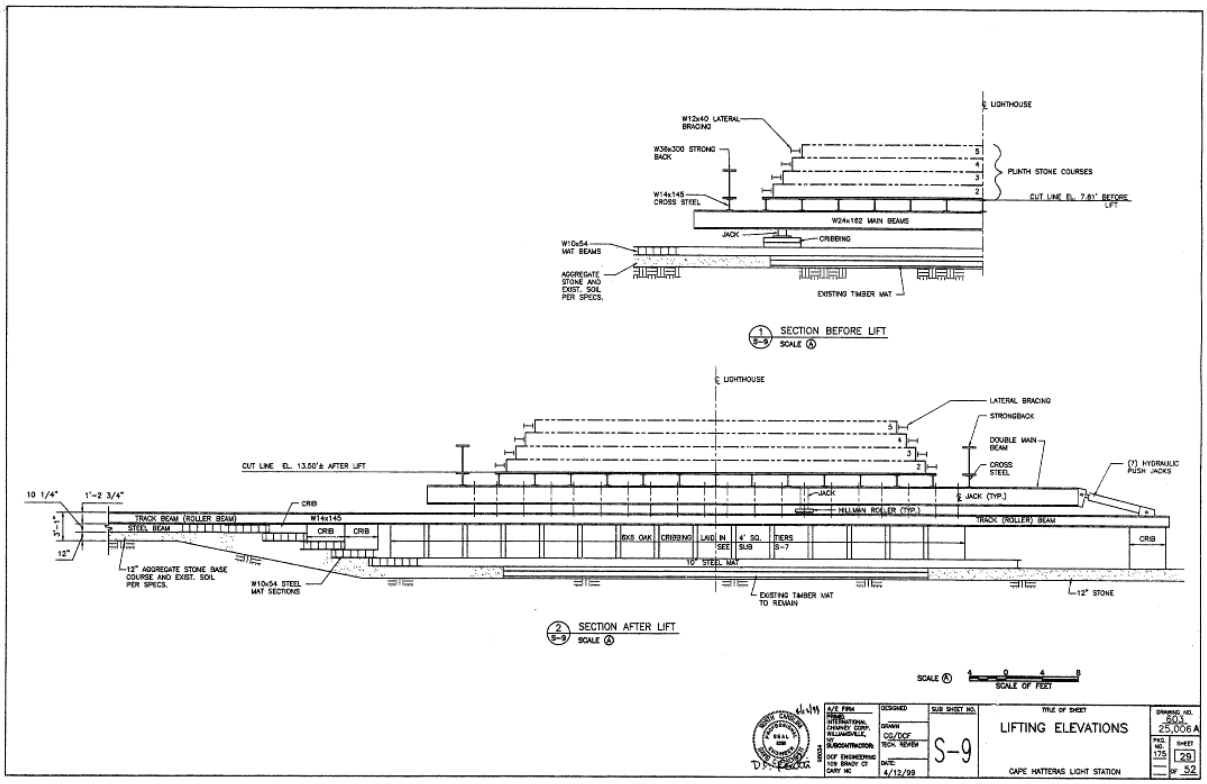


Figure 109. The design for lifting the lighthouse. Drawing: NPS DSC eTIC No. CAHA 603 25006A.

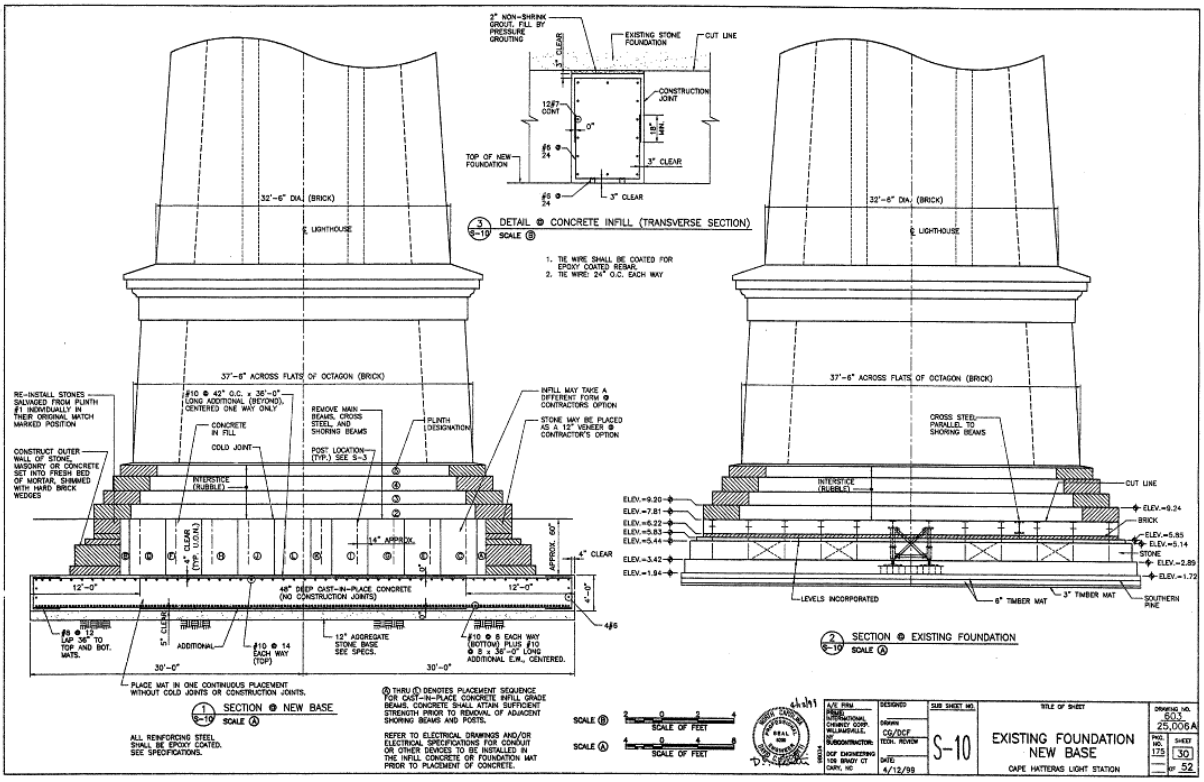


Figure 110. Sections through the existing foundation and new base. Drawing: NPS DSC eTIC No. CAHA 603 25006A.

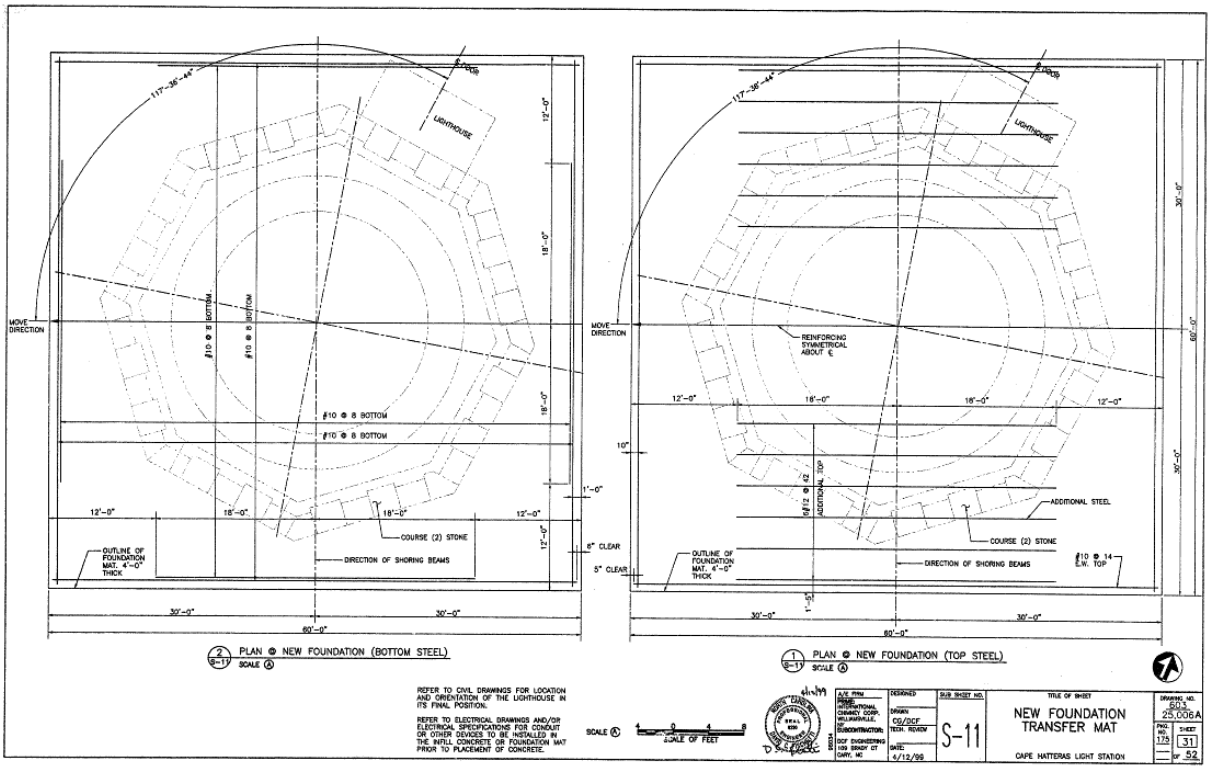


Figure 111. The plan of the new foundation (top and bottom). Drawing: NPS DSC eTIC No. CAHA 603 25006A.

ICC worked with Expert House Movers, Inc. of Maryland (John Matyiko, Sr. with sons John, Jr., Joe, Jim, Jerry and consultant Pete Friesen) to develop a plan and execute the work, with the help of architects, structural engineers, and other experts.

On September 6, 1998, Hurricane Fran, a Category-3 hurricane, made landfall at Cape Fear, NC, located south of Hatteras, with a 100-knot landfall intensity.[309]

ICC first arrived at Cape Hatteras on December 15, 1998 to begin preparations for moving the lighthouse.[310] In January 1999 "work began in earnest." The first step was to ready the site for excavation. The historic granite fence stones were documented, marked, and removed (fig. 112). The brick walkway was documented, marked, and removed in large sections (fig. 113). NPS archeologists were on site every day in order to monitor the proceedings, especially once excavation began (fig. 114). By late January, the entrance stairs and their foundation had been removed (fig. 115) and steel beams had been installed around the top four granite plinth rows (fig. 116). Meanwhile, sixty sensors were installed on the interior and exterior of the structure to monitor the lighthouse's stability and weather conditions; later, a plumb bob was hung down the center of the interior of the tower, where the clockworks once hung, for use in case the sensors malfunctioned or ceased to work. In order to create a temporary roadway, or "move corridor," trees were removed (fig. 117). The road would eventually be graded, laid with gravel, compacted, and rolled in preparation for the steel beam mat to be laid down and the lighthouse to ride over it.



Figure 112. Excavation around the perimeter fence foundation. Photo: Cape Hatteras National Seashore Archives, 01/14/99.



Figure 113. Removal of the brick path in sections. Photo: Cape Hatteras National Seashore Archives, 01/13/99.

[309] NOAA HRD. "Chronological List of All Hurricanes which Affected the Continental United States: 1851-2005."
[310] The creation of the this section of the move narrative was developed from several sources:
Cape Hatteras National Seashore Archives.
Duffus, Kevin (producer). "Move of the Century: Cape Hatteras Light." *Film.* Looking Glass Productions, Inc.: 2004.
Shelton-Roberts, Cheryl, and Bruce Roberts. "Moving Hatteras: Relocating the Cape Hatteras Light Station to Safety." Lighthouse Publications, 2015.
Cloyd, Paul C., PE/RA. "Cape Hatteras Lighthouse HSR 100% draft review." January 2016.



Figure 114. NPS employee Rob Bolling looks over found archeological items. Photo: Cape Hatteras National Seashore Archives, 01/03/99.



Figure 115. The front entrance stair has been removed. Photo: Cape Hatteras National Seashore Archives, 01/22/99.



Figure 116. The installation of steel beams surrounding each of the four levels of plinth left in place. Photo: Cape Hatteras National Seashore Archives, 01/27/99



Figure 117. The move corridor is cleared. Photo: Cape Hatteras National Seashore Archives, 01/08/99.

In early February, the oil house was lifted (fig. 118), placed on a flatbed trailer, and transported down the move corridor to sit on temporary cribbing (fig. 119); it would not be placed at its new site until August 5, after the lighthouse was moved.

At the same time, the excavation around the exterior of the lighthouse foundation was completed. On February 13, a diamond-tipped cable saw began cutting through the foundation between the fourth and fifth plinth courses (from the top) (fig. 120). As a portion of the plinth was cut apart, workers would then use pneumatic air hammers and chisels to chip away at the granite rubble foundation held together with cement mortar (fig. 121).

Preparations for the move of the Double Keepers' Quarters and the Principal Keeper's Quarters were completed in March, this included work on the new foundations (fig. 122). On March 24, the Principal Keeper's Quarters was lifted and moved into place via a tractor trailer (fig. 123). The Double Keepers' Quarters followed along in the same manner two days later (fig. 124).



Figure 118. The oil house is lifted and supported by steel beams. Photo: Cape Hatteras National Seashore Archives, 02/04/99.



Figure 119. The oil house is transported to its new temporary site via flatbed trailer. Photo: Cape Hatteras National Seashore Archives, 02/05/99.



Figure 120. The cable saw cuts through a portion of the plinth stone. Photo: Cape Hatteras National Seashore Archives, 02/13/99.

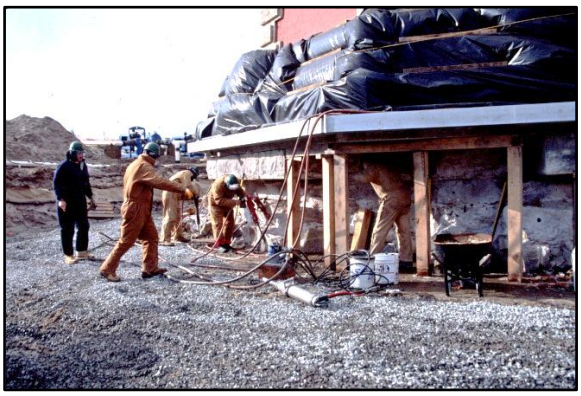


Figure 121. Workers chisel away at the granite rubble foundation. Photo: Cape Hatteras National Seashore Archives, 02/22/99.



Figure 122. The new foundation is poured for the Double Keepers' Quarters. Photo: Cape Hatteras National Seashore Archives, 03/18/99.



Figure 123. The Principal Keeper's Quarters is moved into placed (top) while the Double Keepers' Quarters waits. Photo: Cape Hatteras National Seashore Archives, 03/23/99.



Figure 124. The Double Keepers' Quarters, left, and Principal Keeper's Quarters, right, sitting atop their new foundations. Photo: Cape Hatteras National Seashore Archives, 06/03/99.

Back at the lighthouse site, once a section of granite rubble foundation was removed, steel mats were laid down and steel shoring towers, each equipped with feet jacks, were slid underneath (with steel beams above) to temporarily support the lighthouse between the mats below and plinth above (fig. 125). Each shoring tower was composed of four steel posts with cross braces between for lateral support (fig. 126). Work progressed below the lighthouse in segments like this until the last column of granite was separated from the plinth above May 5 (fig. 127-28). This proved to be more difficult than expected, due to the solid construction of the foundation in 1870. Finally, on May 6, the lighthouse was fully supported by the temporary shoring towers (fig. 129).

Meanwhile, preparations for the new foundation at the new site began. Once excavation was complete at the new site, workers began constructing the formwork and setting the massive web of epoxy-coated metal rebar which would serve as reinforcement for the concrete once set (figs. 130-31). On May 1, 540 cubic yards of 5,000-psi concrete was poured into the new forms. The forms were removed on May 7 to reveal a 60'-0" square by 4'-0" deep concrete mat (fig. 132). The foundation would then eventually get backfilled, once the concrete had fully cured.

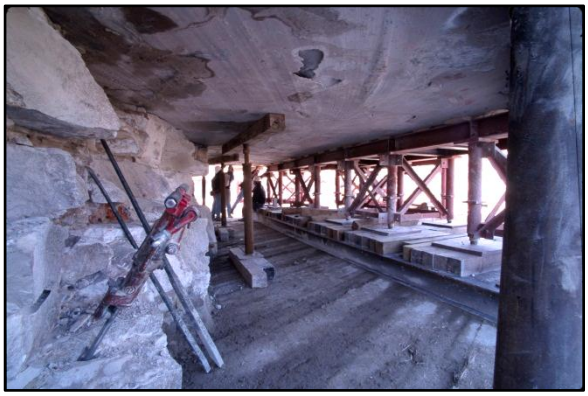


Figure 125. Workers continue to remove granite as steel shoring towers are installed behind them. Photo: Cape Hatteras National Seashore Archives, 03/18/99.



Figure 126. A shoring tower before installing. This tower is upside down so that it could be equipped with feet jacks. Photo: Cape Hatteras National Seashore Archives, 03/01/99.



Figure 127. Another row of shoring towers with steel beams above is installed under the tower. Photo: Cape Hatteras National Seashore Archives, 04/08/99.



Figure 128. The final column of granite foundation is separated from the granite plinth above. Photo: Cape Hatteras National Seashore Archives, 05/05/99.



Figure 129. The lighthouse fully supported by temporary shoring towers. Photo: Cape Hatteras National Seashore Archives, 05/06/99.



Figure 130. Once the formwork had been completed and all of the rebar had been installed, concrete could be poured. Photo: Cape Hatteras National Seashore Archives, 04/30/99.



Figure 131. Pouring 540 yards of marine-grade concrete into the formwork. Photo: Cape Hatteras National Seashore Archives, 05/01/99.



Figure 132. The newly revealed concrete pad. Photo: Cape Hatteras National Seashore Archives, 05/07/99.

Back at the lighthouse site, once the granite foundation was completely separated from the plinth and fully removed, the lateral cross braces in the shoring towers were removed. This allowed room for seven 70'-0"-long, 11-ton steel "main beams" to be slid between the shoring towers (and perpendicular to the steel beams already in place) (figs. 133-34). The "main beams" were installed on hydraulic jacks with rollers (figs. 135-36). Above, and perpendicular to, the "main beams," fifteen steel "cross beams" were installed, to replace the temporary steel beams sitting between the plinth and the shoring towers (fig. 137). Above the "cross beams," in a square surrounding the lighthouse's plinth, "strongback beams" were installed to tie the entire steel support system together and provide rigidity (fig. 138).

Once the entire steel support structure was completely installed, hydraulic jacks, connected to hydraulic lines and controlled by one panel, were pressurized. The steel grid was pressed against the bottom of the lighthouse in order to raise it 5'-4". The "unified jacking system" would raise the structure about 0'-1" per minute, however the entire process took three days so that wood cribbing could be added under the "main beams" and then under each foot, switching back and forth until the full height was reached (figs. 139-40).



Figure 133. The first "main beam" about to be installed between the shoring towers, and perpendicular to the beams above. Photo: Cape Hatteras National Seashore Archives, 05/13/99.



Figure 134 All seven "main beams" installed. Photo: Cape Hatteras National Seashore Archives, 05/23/99.

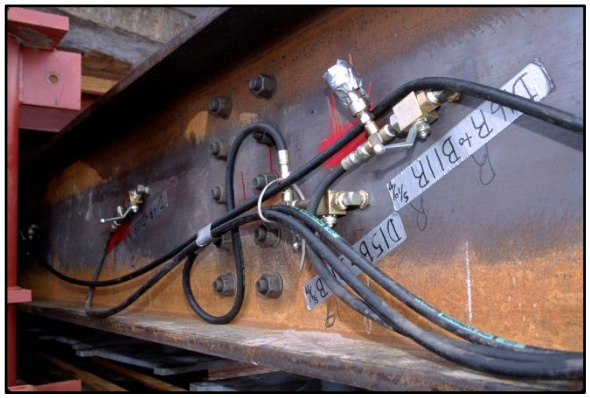


Figure 135. The "main beams" were equipped with hydraulic jacks. Shown here are some of the oil lines. Photo: Cape Hatteras National Seashore Archives, 05/14/99.



Figure 136. The underside of a "main beam" showing a series of jacks in their 'up' position. Rollers will eventually be installed under the jacks' feet. Photo: Cape Hatteras National Seashore Archives, 05/14/99.



Figure 137. Fifteen "cross beams" installed above and perpendicular to the "main beams." Photo: Cape Hatteras National Seashore Archives, 05/24/99.



Figure 138, right. "Strongback beams" surrounding the plinth, which tie the steel support structure together. Photo: Cape Hatteras National Seashore Archives, 05/31/99.



Figure 139. Cribbing installed under a "main beam" and some of its jacks. Photo: Cape Hatteras National Seashore Archives, 06/08/99.



Figure 140. Sliding more cribbing under a "main beam." Photo: Cape Hatteras National Seashore Archives, 06/09/99.

At its proper height, the jacks were raised so that rollers could be added to the undersides (figs. 141-42). One "main beam" section at a time, the wood cribbing was removed to slide a "travel beam" directly underneath, and parallel to, the "main beam" and jacks with rollers attached (fig. 143). Out from under the lighthouse, additional "travel beams" were installed to those already installed under the tower, to form a track (fig. 144). Five horizontal push jacks, hydraulically clamped to the "travel beams" on one end and permanently attached to the corresponding "main beam" above, were then installed (fig. 145). Ivory soap was used to coat the tops of the "travel beams."

After decades of studies, debates, and planning, moving began on June 17. That day, the lighthouse moved 10'-6" (fig. 146).



Figure 141. The jacks in their lowered position. Photo: Cape Hatteras National Seashore Archives, 06/13/99.



Figure 142. The jacks in their upper, non-supporting position, in preparation for installation of "travel beam" and rollers. Photo: Cape Hatteras National Seashore Archives, 06/12/99.

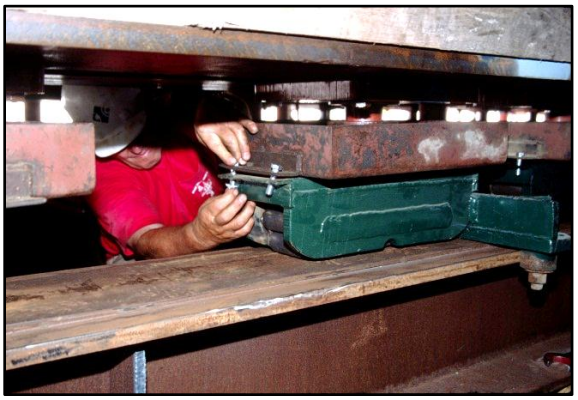


Figure 143. A "travel beam" has been installed under a "main beam." A roller is being attached to the underside of a jack. Photo: Cape Hatteras National Seashore Archives, 06/14/99.



Figure 144. "Travel beams" butted together to form a track. Photo: Cape Hatteras National Seashore Archives, 06/12/99.

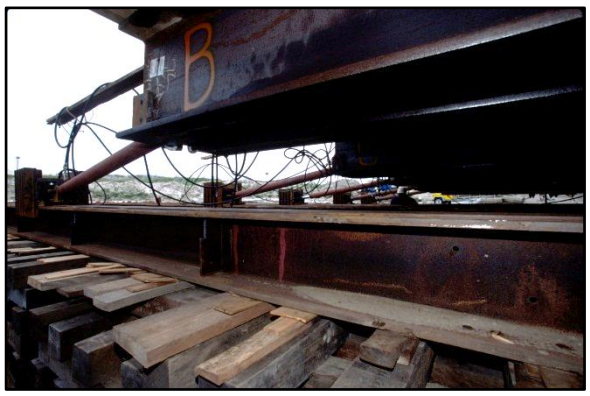


Figure 145. Push jacks installed at the rear. Photo: Cape Hatteras National Seashore Archives, 06/18/99.



Figure 146. On the first day, the lighthouse moved 10′-6″. Photo: Cape Hatteras National Seashore Archives, 06/17/99.

The push jacks could only push the lighthouse approximately 5'-0" at a time before the rams became fully extended (fig. 148). Once extended, the "travel beam" clamp was released, the ram was retracted pulling the "travel beam" with it, and the "travel beam" clamp was hydraulically attached to the "travel beam" in order to continue with the move. Additionally, once the lighthouse had progressed to the end of the steel mats covering the roadway, movement was halted so that the mats from behind could be repositioned ahead of the lighthouse (fig. 149).

The lighthouse continued to slowly progress down its temporary road, until July 9, when it moved its last 79'-0" (figs. 150-55). Since its construction 129 years prior, the lighthouse was once again safe from the encroaching ocean and beach erosion!

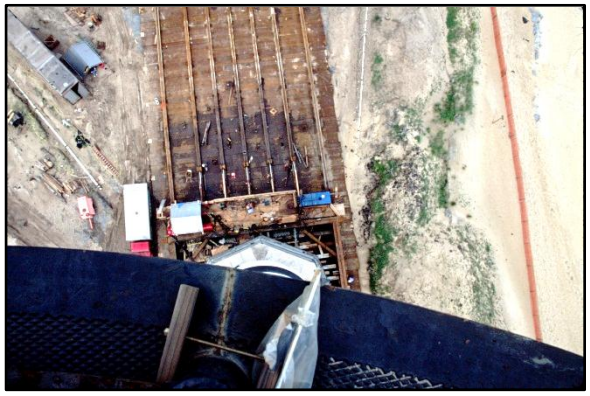


Figure 147. The extended push rams from above. Photo: Cape Hatteras National Seashore Archives, 06/21/99.



Figure 148. Steel mats are transferred from behind the lighthouse to the front so that it may continue on its journey. Photo: Cape Hatteras National Seashore Archives, 06/23/99.

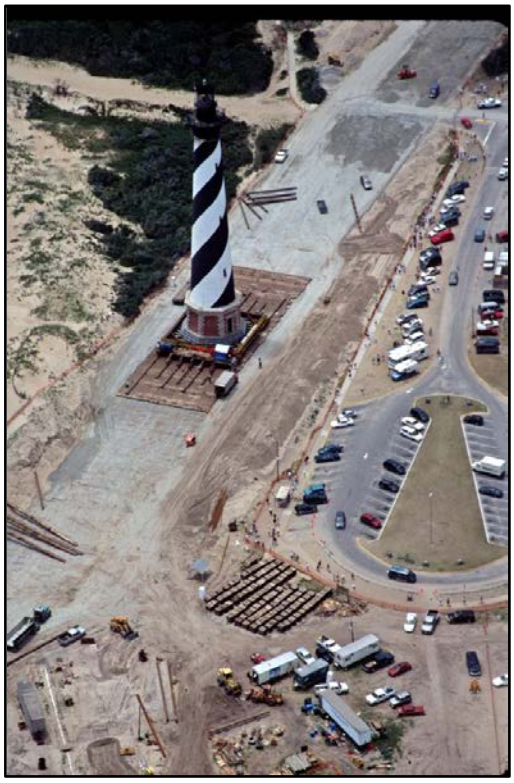




Figure 150, above. At the end of the day on June 25, the lighthouse had moved a total of 898'-0". Photo: Cape Hatteras National Seashore Archives, 6/25/99.

Figure 149, left. At the end of the day on June 24, the lighthouse had moved a total of 625'-0". Photo: Cape Hatteras National Seashore Archives, 06/24/99.



Figure 151. On June 30, the lighthouse was over half way to its final destination. Photo: Cape Hatteras National Seashore Archives, 06/30/99.

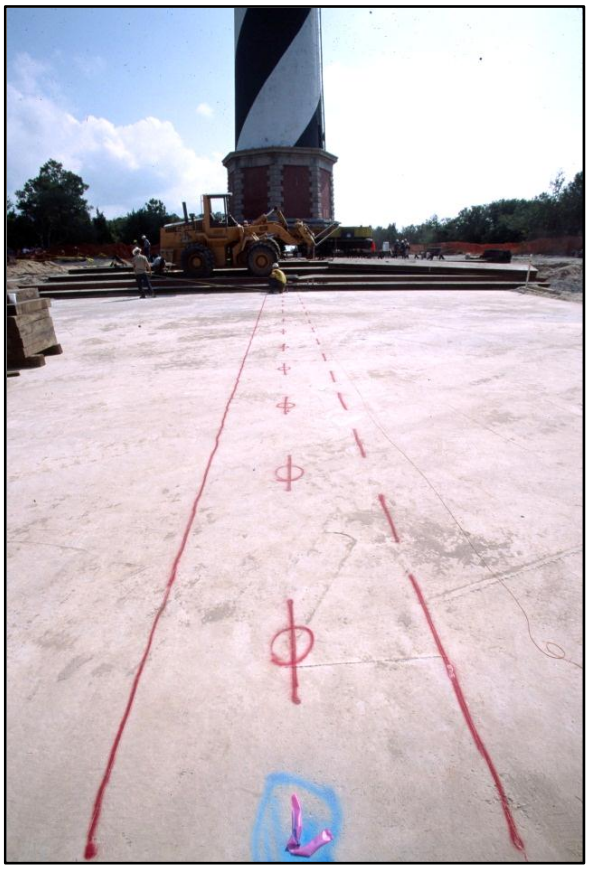


Figure 152, right. The blue circle on the new concrete mat foundation must be located directly below the center of the lighthouse. The bottom of the lighthouse has a similar blue circle. Photo: Cape Hatteras National Seashore Archives, 07/07/99.



Figure 153. "Travel beams" being placed above the concrete mat foundation. Photo: Cape Hatteras National Seashore Archives, 07/08/99.



Figure 154. The lighthouse must reach the stop sign to end its journey. Photo: Cape Hatteras National Seashore Archives, 07/09/99.

The final placement of the lighthouse on the concrete foundation occurred in reverse of its removal from the original foundation. Once the lighthouse was centered over the center point, wood cribbing was built up to meet and support the "travel beams." One beam at a time, the jacks were depressurized in order to remove the beam. The jacks were then lowered onto the cribbing (fig. 155). Once all the "travel beams" were removed and the jacks were sitting directly on the cribbing, the unified jacking system lowered the lighthouse down to its new elevation, approximately 2'-0" above its previous elevation (the three other buildings were also placed at their original elevations relative to the new lighthouse elevation). The new elevation was to provide additional protection against flooding and shoreline erosion. As a result, the distance at which the light could be seen at sea also increased.

Once at its new elevation, the "strong back beams" were removed (fig. 156). As the "cross beams" and "main beams" were removed, the steel shoring towers with beams above were reinstalled under the tower (fig. 157). In late July, masons began laying a center spine and ribs of brick masonry around the shoring towers (fig. 158). Once this portion was complete, sections of the shoring towers could be removed, allowing brick masonry to be installed it their place. Eventually, the entire space between the concrete foundation and the granite plinth above would be infilled with solid brick masonry (figs. 159-60). The new brick foundation was completed on September 14 (fig. 161).

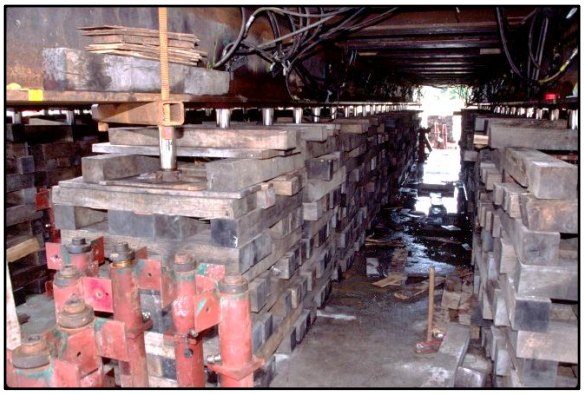


Figure 155. The jacks resting on wood cribbing once again. Photo: Cape Hatteras National Seashore Archives, 07/16/99.



Figure 156. The "strongback beams" being removed. Photo: Cape Hatteras National Seashore Archives, 07/25/99.



Figure 157. The shoring towers back under and supporting the lighthouse. Photo: Cape Hatteras National Seashore Archives, 07/26/99.



Figure 158. The installation of the brick masonry foundation begins. Photo: Cape Hatteras National Seashore Archives, 07/28/99.



Figure 159, left. Solid brick masonry fills the void between the concrete foundation and the granite plinth above. Photo: Cape Hatteras National Seashore Archives, 08/02/99.



Figure 160, above. The brick spine and ribs projecting out from under the lighthouse between the shoring towers. Photo: Cape Hatteras National Seashore Archives, 08/16/99.



Figure 161. The last section of shoring towers to be removed and replaced with brick masonry. Photo: Cape Hatteras National Seashore Archives, 09/09/99.



Figure 162. Chief of Interpretation, Bob Woody (left), assisted with laying the last bricks in the new foundation. Photo: Cape Hatteras National Seashore Archives, 09/14/99.

In late September the final work began. The area around the foundation was backfilled. The metal beams surrounding each level or the plinth were removed (fig. 163). The lowest level of plinth blocks, which were originally whole granite blocks, were cut and veneered onto the brick foundation (fig. 164). Once installed, this course was also backfilled. The front stair was then reinstalled (fig. 165). Finally, after all site work was completed, the lighthouse was re-lit in a ceremony the night of November 13, 1999 (fig. 166).



Figure 163. Metal beams around the plinth are removed. Photo: Cape Hatteras National Seashore Archives, 09/27/99.



Figure 164. The bottom plinth row reinstalled as a veneer. Photo: Cape Hatteras National Seashore Archives, 09/29/99.



Figure 165. The front stair is reinstalled. Photo: Cape Hatteras National Seashore Archives, 10/14/99



Figure 166. The relighting ceremony. Photo: Cape Hatteras National Seashore Archives, 11/13/99.

The final inspection occurred on October 1, 1999. Very few punch list items remained to be completed. The Letter of Final Acceptance was issued in July 2000. [311]

The final cost for relocating the Cape Hatteras Light Station totaled $9,518,042. This figure included the following:

$1,454,000	Design Services (combined)
$7,507,000	Relocation (all buildings)
$480,000	New Foundations (all buildings)
$20,000	Lightning Protection System (lighthouse)
$28,000	Temporary Electrical Service
$24,020	Public Viewing Area (change order)
$4,872	Disposal of Fuel Tank Contents & Contaminated Soil (change order)[312]

In 1999, the American Society of Civil Engineers (ASCE) designated the Cape Hatteras Lighthouse a Historic Civil Engineering Landmark. In 2000, the Cape Hatteras Light Station Relocation Project received the Outstanding Civil Engineering Achievement (OCEA) award from the ASCE. Annually, an OCEA Award is presented to a "project that best illustrates superior civil engineering skills and represents a significant contribution to civil engineering progress and society." Because the award honors "an overall project rather than an individual,"[313] ASCE believed the outstanding team effort between ICC, Expert House Movers, the NPS, and others deserved recognition. Cape Hatteras National Seashore Superintendent Francis Peltier received the award in May 2000.

In November 1999, the design drawings were updated to include as-built conditions (fig. 167).[314]

Phase II of the project, which included development of the new site and redevelopment of the old site, was completed by August 2000 by JHC Construction, Inc. (fig. 168).[315] Afterwards, the lighthouse was reopened to the public for climbing (fig. 169).

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[311] Cloyd, Paul C., PE/RA. "Cape Hatteras Lighthouse HSR 100% draft review." January 2016.

[312] Cloyd, Paul C., Contracting Officer's Representative/Project Manager, DSC, NPS. "Relocate Cape Hatteras Light Station , Phase 1." *Fact Sheet for Completion Report.* December 22, 1999.
Cloyd, Paul C., Project Supervisor, DSC, NPS. "Relocate Cape Hatteras Light Station." *Lump Sum Price Contract*. August 21, 2000.

[313] American Society of Civil Engineers. "Outstanding Civil Engineering Achievement. (OCEA) Award." *Website.* Accessed at http://www.asce.org/oceakit/ on February 29, 2016.

[314] Denver Service Center, National Park Service. "Relocate the Cape Hatteras Light Station." *Project Record Drawings.* November 8, 1999. NPS DSC eTIC No. CAHA 603 25006.

[315] Denver Service Center, National Park Service. "Lighthouse Move Phase II." *As-Constructed Drawings.* December2000. NPS DSC eTIC No. CAHA 603 41024C.
In September 1997, DSC finalized drawings for the Phase II of the lighthouse move project. Phase II outlined the development of the area around the relocated historic district and redevelopment of the area where the light station had been. (Denver Service Center, National Park Service. "Lighthouse Move Phase II." *8 sheets*. September 1997. NPS DSC eTIC No. CAHA 603 41024.) On December 9-11, 1997, DSC conducted a value study for the Phase II drawings in order to provide guidance to the design team (also DSC) on the final drawings of the preferred design alternative. The value study suggested many alternatives, none of which directly affected the lighthouse or its move. (Denver Service Center, National Park Service. "Value Analysis Study for Cape Hatteras Lighthouse Site Redevelopment." *Final Report.* n.d. (likely early 1998). NPS DSC eTIC No. CAHA 603 D146.) Based on these suggestions, the DSC design team edited their Phase II design, which was re-released in June 1998. (Denver Service Center, National Park Service. "Lighthouse Move Phase II." *15 sheets*. June 1998. NPS DSC eTIC No. CAHA 603 41024A.) A final design analysis for the Phase II work was completed in August 1998 with final drawings being completed in January 1999. (Unknown. "Design Analysis: Lightstation Move – Phase II, Historic District Contact Station & Site Development, Cape Hatteras National Seashore." May 1998, Rev. June 1998, Rev. August 1998. NPS DSC eTIC No. CAHA 603 D145. -- Denver Service Center, National Park Service. "Lighthouse Move Phase II." *Construction Drawings.* January 1, 1999. NPS DSC eTIC No. CAHA 603 41024B.) Phase II work would cause little impact to the lighthouse structure itself.

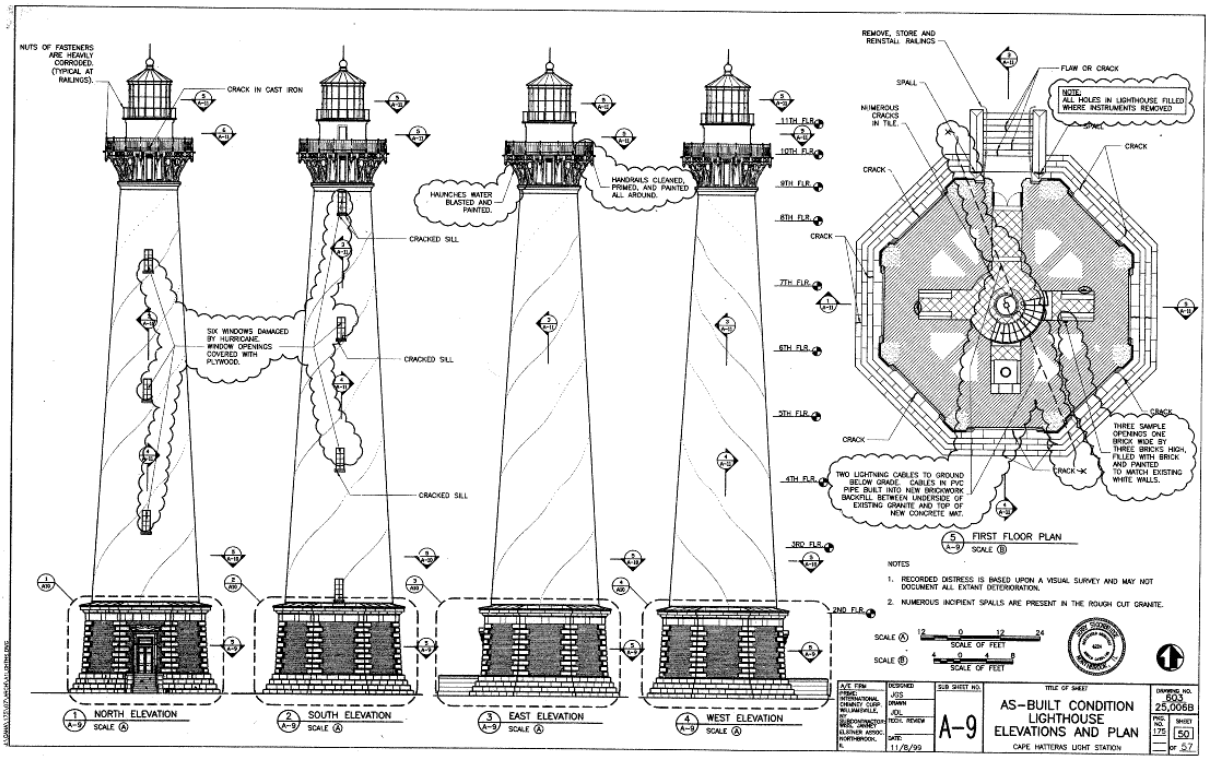


Figure 167. As-built drawings of the elevations and first-floor plan, dated November 1999, showing the only changes to the design for the lighthouse. Drawing: NPS DSC eTIC No. CAHA 603 2500B.

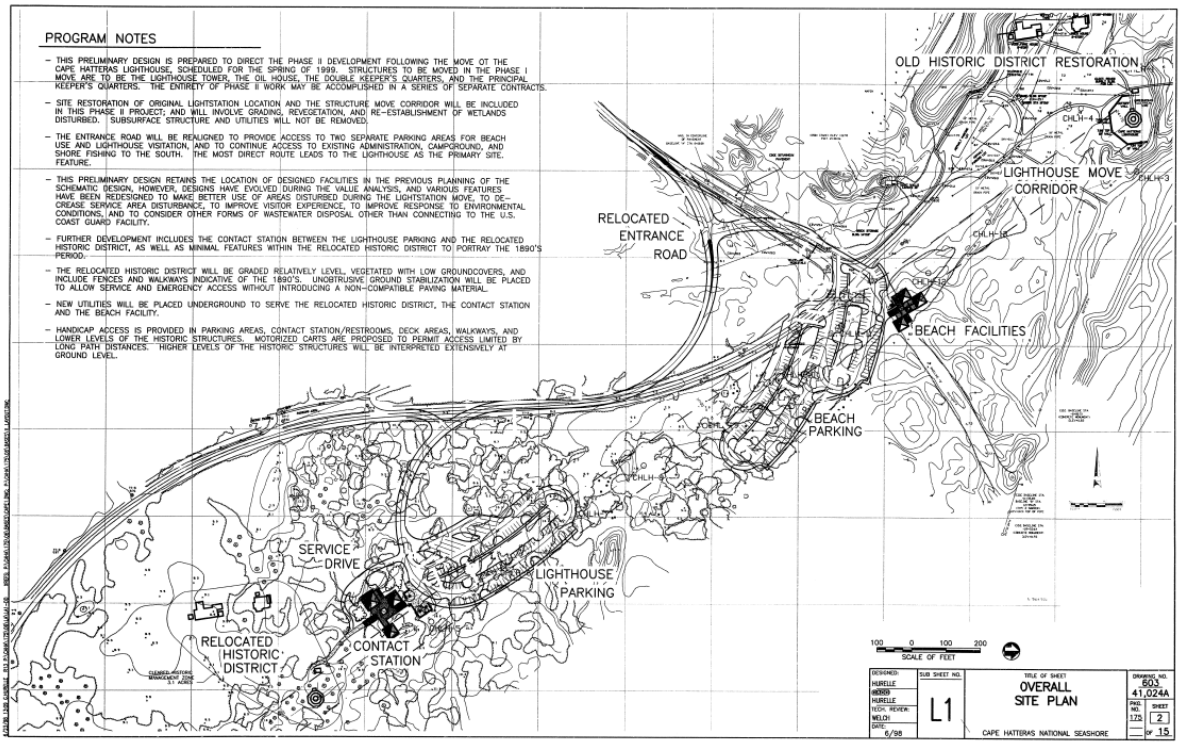


Figure 168. A site plan for Phase II (redevelopment) of the project as submitted in June 1998. Drawing: NPS DSC eTIC No. CAHA 603 41024.



Figure 169. The lighthouse about a year after the move project is complete. Photo: Cape Hatteras National Seashore Archives, 09/00.

Continuing Its Service

In April 2001 the white vinyl fence was installed around the base of the lighthouse. It was deemed "no adverse effect" as it pertained to the exclusions in the Programmatic Agreement.[316]

On June 11, 2001, the lighthouse was closed to make needed repairs to the interior metal spiral stairs. It would stay closed until 2003.[317]

A July 2001 report entitled *Structural Assessment of Cape Hatteras Lighthouse Stairs* by Pond & Company was released. The report compared the extant conditions of the stairs to those recorded in 1988. Based on the comparison, the report discussed several options, including complete replacement of the stairs structure, unrestricted use of existing stairway, moderate restricted use of the existing stairway, and highly restrictive use of existing stair.[318]

A November 2001 report also by Pond & Company, entitled *Load Testing Analysis and Recommendations for the Cape Hatteras Lighthouse Stairs*, was released. The report supplied the following recommendations:

[316] Cape Hatteras National Seashore **Archives**, Manteo, NC, CAHA 5515: CAHA Compliance – Cape Hatteras Lighthouse Safety Fence Donation, 2001.
[317] NPS, "Cape Hatteras Light Station," *Website*.
[318] Pond & Company. "Structural Assessment of Cape Hatteras Lighthouse Stairs." July 24, 2001. Cape Hatteras National Seashore **Archives**, Manteo, NC, CAHA 5506 CAHA Compliance – Repair Stairs in the CAHA Lighthouse, 1998-2001, Folder 2.

1. Limit the safe service live load to 50psf which is equivalent to 20 people per flight and 160 people maximum capacity.
2. Post the safe lie load capacity near the lighthouse in public view.
3. . . .Replacing some of the more damaged members with new castings. . . .
4. If replacement of damaged members is rejected as an option, at a minimum. . .set up a weekly inspection program to inspect each tread to identify loose pieces of tread and tread support bracket.
5. . . .Cleaning and recoating the entire stair assembly to eliminate any rust and corrosion. . .
6. . . .Set up a monthly inspection program to remove delaminating cast iron from the backside of the wall stringer plate for all 8 flights.
7. . . .Yearly inspection of the stair structure by a registered Structural Engineer. . .
8. . . .Weather stripping and sealing around the roof, and window and door openings be repaired to minimize water penetration.
9. [Installation of a] large, commercial entrance mat. . .to remove dirt from visitors' shoes.

Additionally, the report pointed out those treads which should be replaced.[319]

On July 5, 2002 a final *Finding of No Significant Impact to the Complete Relocation of the Cape Hatteras Light Station* was completed to address any and all design changes that were made during the lighthouse move and since 1990 when the first EA was prepared.[320]

In 2002, significant work was completed on the lighthouse. Several stair treads were replaced. In September half of the original lighthouse gallery deck, railing, and the first-order lens were loaned to the Graveyard of the Atlantic Museum for display.[321] In December, the lighthouse was painted.[322] After all work was completed, the lighthouse was reopened on April 18, 2003.[323] It has since remained open to the public.

In 2005 the Graveyard of the Atlantic Museum, located in Hatteras, NC (south of the light station), funded a restoration project of the lighthouse lens. Jim Woodward, the lead lampist, was accompanied by lampist Jim Dunlap, and jeweler Kurt Fosburg.[324] In March, the men removed the remaining lens components from the National Seashore museum storage facility to the Graveyard of the Atlantic Museum.[325] A letter from December of that year requested the removal of the pedestal from the lighthouse and its loan to the Museum. The Museum also volunteered to pay for its removal and the necessary alterations which would be required to the USCG Beacon upon its removal.[326] In early 2006, the removal of the pedestal was deemed an adverse effect to the

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[319] Pond & Company. "Final Load Testing Analysis and Recommendations for the Cape Hatteras Lighthouse Stairs." November 19, 2001. Cape Hatteras National Seashore **Archives**, Manteo, NC, CAHA 5506 CAHA Compliance – Repair Stairs in the CAHA Lighthouse, 1998-2001, Folder 1.

[320] Regional Director, Southeast Region, National Park Service. "Finding of No Significant Impact for Package CAHA 227, Complete Relocation of Cape Hatteras Light Station and Package 326, Reconstruct Park Entrance Road and Future Projects." *Memo to Superintendent, Cape Hatteras National Seashore.* July 5, 2002. NPS DSC eTIC No. CAHA 603 D213.

[321] The deck and railing had been replaced prior to the move and were in storage. The lens, also having been in storage, was moved to the museum so that the public could see it. (Belli, Lawrence A., Superintendent, Outer Banks Group. *Letter to Joseph Karl Schwarzer II, Executive Director/CEO, Graveyard of the Atlantic Museum.* September 6, 2002. Cape Hatteras National Seashore Archives, No Box, Folder: CAHA-L.2002.01-Outgoing Loan-Graveyard Atlantic Museum-Copy.)

[322] NPS, "Cape Hatteras Light Station," *Website*.

[323] Ibid.

[324] Goodloe-Murphy, Helen Mary. "Experts restoring former Cape Hatteras Lighthouse lens." *The Coastland Times.* Manteo, NC. March 27, 2005. Pages 1A, 9A. Cape Hatteras National Seashore Archives, No Box, Folder: CAHA-L.2002.01-Outgoing Loan-Graveyard Atlantic Museum-Copy.

[325] Belli, Lawrence A., Superintendent, Outer Banks Group. *Letter to Joseph Schwarzer, Executive Director/CEO, Graveyard of the Atlantic Museum.* April 11, 2005. Cape Hatteras National Seashore Archives, No Box, Folder: CAHA-L.2002.01-Outgoing Loan-Graveyard Atlantic Museum-Copy.

[326] Duffus, Kevin P. Chairman, Board of Directors, Graveyard of the Atlantic Museum. *Letter to Lawrence Belli, Superintendent, Outer Banks Group.* December 15, 2005. Cape Hatteras National Seashore Archives, No Box, Folder: CAHA-L.2002.01-Outgoing Loan-Graveyard Atlantic Museum-Copy.

lighthouse by the NPS Southeast Regional Office's Cultural Resources Division and the North Carolina SHPO.[327] However, by October 24, 2006, the NPS agreed to loan the pedestal, additional lens panels, and railing pieces from the lighthouse in order to "restore the pedestal, the additional lens panels and the railing pieces. The project [includes] the removal and restoration of the pedestal from the upper levels of the lighthouse, the upper catadioptic lens panels from the Cape Hatteras Visitor Center, and removal of railing pieces from Fort Raleigh Museum Resource Center perimeter." After restoration the items were displayed in the Museum lobby. The NC SHPO concurred in an October 2, 2006 letter, with the following requirements:

- The pedestal and accessories would be treated as artifacts.
- Work was required to stop if any damage occurred to the artifacts.
- Restoration staff would be on site at the commencement of the work.
- The artifacts would be kept in a stable, secure, and protected environment.
- The agreement between the NPS and Musuem would be cancelled if threats occur.[328]

In 2006, the lens pedestal and clockwork were removed from the lighthouse and reunited with the lens at the Museum (fig. 170).[329]



Figure 170. The Cape Hatteras lighthouse First Order lens after restoration and display in the Graveyard of the Atlantic Museum. Photo: HPTC, 06/17/15.

In 2008, most of the remaining treads of the interior stair were replaced.

During the spring and summer 2014, the exterior of the lighthouse was repainted.[330]

In 2014, Joseph K. Opperman—Architect, P.A. and Bennett Preservation Engineering PC completed *Cape Hatteras Lighthouse Condition Assessment Report.*[331] This report will be further discussed in the following physical description, condition assessment, and recommended treatment sections.

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[327] Belli, Lawrence A., Superintendent, Outer Banks Group. *Letter to Kevin Duffus, Chairman, Board of Directors, Graveyard of the Atlantic Museum.* March 4, 2006. Cape Hatteras National Seashore Archives, No Box, Folder: CAHA-L.2002.01-Outgoing Loan-Graveyard Atlantic Museum-Copy.

[328] Murray, Michael B., Superintendent, Outer Banks Group. *Letter to Joseph Schwarzer, Executive Director/CEO, Graveyard of the Atlantic Museum.* October 24, 2006. Cape Hatteras National Seashore Archives, No Box, Folder: CAHA-L.2007.01-Outgoing Loan-Graveyard of the Atlantic Museum.

[329] NPS, "Cape Hatteras Light Station," *Website*.

[330] Ibid.

[331] Joseph K. Oppermann—Architect, P.A. with Bennett Preservation Engineering PC. "Cape Hatteras Lighthouse." *Condition Assessment Report.* September 2014.

Table 1. **Cape Hatteras Lighthouse Timeline**	
1799	Construction begins on first Cape Hatteras Lighthouse by Henry Dearborn
1802 (Dec)	Lighthouse completed; first keeper begins role
ca. 1815	18 Argand-style lamps and parabolic reflectors installed by Winslow Lewis
1853	First-Order Fresnel lens, intended for Cape Hatteras, displayed at the "Exhibition of the Industry of all Nations" in New York City's Crystal Palace.
1854	First-Order Fresnel lens installed in recently elevated lighthouse (focal plane now 150 feet above sea level)
1861 (Apr)	Civil War begins; lens removed from lighthouse by Confederacy
1862 (May)	Replacement Second-Order lens placed in lighthouse by Union
1863 (Jun)	Replacement First-Order lens placed in lighthouse by Union
1865 (Apr)	Civil War ends
1865 (Sep)	Original First-Order lens found by Union patrol near Henderson, NC; lens shipped to Staten Island, NY lighthouse depot
1867	Original First-Order lens sent to maker Henry-Lepaute Co. in Paris for repairs; In March, first appropriation approved for a new lighthouse at Cape Hatteras
1868	Original First-Order lens returned to Staten Island lighthouse depot; in October, first workers sent to Cape Hatteras, Dexter Stetson appointed as superintendent of construction
1870 (Dec)	Original First-Order lens re-lit in new lighthouse
1871 (Feb)	First lighthouse destroyed
1873	Lighthouse repainted with characteristic spiral daymark
ca. 1920	Original iron fence replaced with concrete posts and metal railings
1930	900 feet of steel groins installed on the beach to protect lighthouse from erosion
1934	Light is electrified, clockwork mechanism no longer used
1936 (May)	New skeletal lighthouse lit; 1870 lighthouse extinguished
1936 (Nov)	Cape Hatteras Light Station transferred to National Park Service
1939	CCC begins tours of the lighthouse for visitors
1940	CCC camp removed from Buxton; parking area and restroom added at lighthouse
1942 (Jan)	USCG begins lease of lighthouse as a World War II watch tower
1946	Inspection finds the lighthouse in poor condition and open to vandalism
1949	Repairs finally made; original lens removed
1950 (Jan)	Lighthouse reactivated with new modern lens
1953	Cape Hatteras National Seashore formed (1958 dedication); site altered to accommodate visitors
ca. 1964	Exterior window hoods removed from lighthouse
1966	312,000 cubic yards of sand added to beach in front of lighthouse
1967	Nylon sandbag revetment constructed to protect Naval Facility north of lighthouse
1970	Naval Facility begins construction of three sheetpile groins
1971-72	200,000 cubic yards of sand added to beach
1972	Rotary beacon added in lighthouse
1973	1.25 million cubic yards of sand added to beach
1974 (Apr)	Notion of moving the lighthouse first raised
1975	Lighthouse closed to public
1977	NC State completed three reports on the corrosion and recommendations for repair
1980	First comprehensive study completed on alternate options for protecting the lighthouse; In March, original lighthouse foundation washed away by a storm
1980-82	Two separate extensions made to southernmost groin, rip rap added to end
1981	500 units of SEASCAPE added to ocean
1982	Save the Cape Hatteras Lighthouse Committee formed; NPS begins discussions with public regarding options; 700 sandbags placed at base of lighthouse; 500 additional units of SEASCAPE added to ocean
1983	Scour mat apron installed at southernmost groin
1984	Lighthouse closed to the public
1985	ACOE completes final seawall/revetment plan to protect lighthouse
1986	Investigative reports completed on structure including preservation plan completed; Move the Lighthouse Committee formed
1988 (Apr)	Committee on Options for Preserving Cape Hatteras Lighthouse (NAS and NRC) submitted report that stated moving lighthouse is the preferred option

1989	In June, NPS released draft Protection Alternatives, Development Concept Plan, Environmental Assessment for public review; in October, FONSI for moving lighthouse signed
1990	Sandbag revetment rehabilitated
1991-94	International Chimney Corporation completed restoration work to lighthouse
1991 (Nov)	First plan completed to move lighthouse in two pieces
1994	Southernmost groin repaired; lighthouse reopened to public.
1998	International Chimney Corporation wins contract to move lighthouse; in December, site work and preparations begins
1999	Lighthouse (Jun-Jul) and other structures (Feb & Mar) moved 2,900'-0"
2000	New site redeveloped; lighthouse reopened to visitors
2001	Lighthouse closed for repairs to interior metal stair and other components
2003	Lighthouse opened
2005	Graveyard of the Atlantic Museum funded restoration of lens for display at the Museum
2006	Lens pedestal removed from lighthouse, remaining lens panels removed from storage, and railing pieces all restored for display at the Museum
2008	Additional repairs made to interior metal stair
End of Table 1.	

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Architectural Description

The Historic Preservation Training Center visited the Cape Hatteras Light Station once over the course of research for this Historic Structure Report. This trip occurred June 15-19, 2015. A large collection of field photographs, notes, and drawings were compiled during the visit. Through this work, detailed physical descriptions of features, condition assessments, and a compilation of character-defining and non-character-defining features have been made. Additional visits were coordinated with the Historic American Building Survey for documentation of the lighthouse (September 2015) and a contractor specializing in crack documentation and movement monitoring (October 2015). Park logistical assistance was provided by the Cape Hatteras National Seashore Resource Management Division and the Southeast Regional Office of the National Park Service.

Building Feature Master List

The Building Feature Master List (BFML) is an overall outline-format checklist used for creating a physical description of the lighthouse. The BFML describes features using a hierarchal structure based on industry standards adopted by the federal government—the UNIFORMAT II (ASTM E1557 Standard, 2008) used by many facility management industry leaders, including the National Park Service's Park Facility Management Division (PFMD). The BFML uses headings and sub-headings to divide architectural components, structural systems, mechanical systems, etc. into a simple organizational tool (Table 1).

A	Substructure
A10	Foundations
B	Shell
B10	Superstructure
B20	Exterior Enclosure
B30	Roof Closure
C	Interiors
C10	Interior Construction
C20	Stairs
C30	Interior Finishes
D	Services
D20	Plumbing
D30	HVAC
D40	Fire Protection Services
D50	Electrical
G	Building Sitework
G20	Site Improvements
G90	Other Site Work

Table 2. The basic UNIFORMAT II Building Feature Master List includes the above headings and subheadings.

Physical Description Summary

The Cape Hatteras Lighthouse has undergone periods of use and non-use since its completion in 1870. The original design and construction methodology is readily apparent and has resisted attempts at modernization by retaining most of its character-defining features. Despite the removal of some important character-defining features (window hoods, exterior perimeter fence, Fresnel lens and related machinery, etc.), the basic character-defining materials and architectural features of the lighthouse remain intact and can instruct the nature of its care. Future care of the structure should be based on the sustainable preservation maintenance of the traditional construction materials and methodologies, not on covering or replacing historic materials with inferior imitations. Significant character-defining features which have been removed should be installed as part of any future treatment of this structure.

Cape Hatteras Lighthouse Physical Description

Location within the Park

Cape Hatteras National Seashore (CAHA), the nation's first national seashore, is located along the Outer Banks of North Carolina, a series of barrier islands which separate the Atlantic Ocean from Pamlico Sound and the mainland. The park stretches from Nags Head in the north to Ocracoke in the south (fig. 171). The park currently oversees the care of three lighthouses, including the Cape Hatteras Lighthouse.

Hatteras Island, one of the barrier islands, is located about halfway between the northern and southern reaches of the park (fig. 170 inset). Just offshore of the cape (an elbow-like jut of the Outer Banks into the ocean), the Gulf Stream and the Virginia Drift, a branch of the Labrador Current, collide. The collision of currents directs southbound ships towards the Diamond Shoals, a dangerous twelve-mile-long sandbar. Hundreds, if not thousands, of shipwrecks are located within the vicinity of the Diamond Shoals, giving the area the name of *Graveyard of the Atlantic*. The Cape Hatteras Light Station was constructed on Hatteras Island to warn ships of the Diamond Shoals. The light station comprises the lighthouse, a small oil house just to the north, a principal keeper's quarters to the north-northwest, and a double keepers' quarters to the northwest.

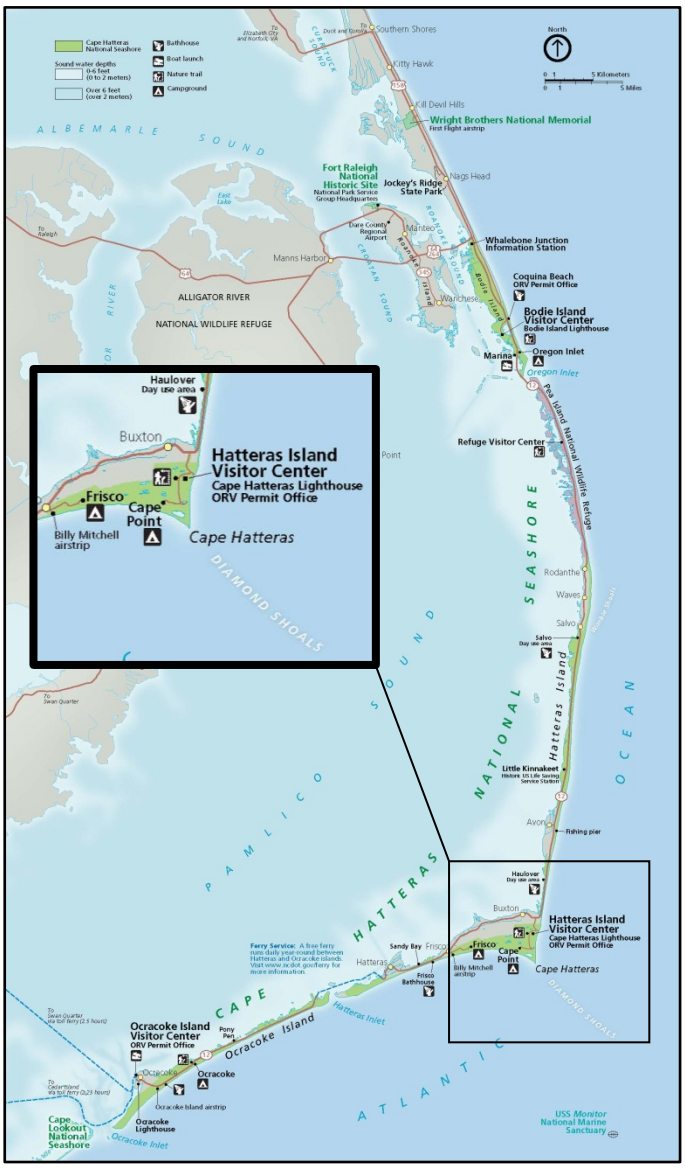


Figure 171. Cape Hatteras National Seashore is located on the Outer Banks of North Carolina. Inset: Cape Hatteras Lighthouse is located on Hatteras Island. Map: Harpers Ferry Center, 2008.

When completed in 1870, the lighthouse was located 1,600'-0" from the Atlantic Ocean. By 1980, 110 years later, the ocean was seventy feet away from the tower on the south. Due to the encroaching sea, all the lighthouse buildings were moved 2,900'-0" southwest in 1999 to remove them from the ocean's reach. Since the move, the buildings are once again 1,600'-0" from the

Atlantic Ocean and in their exact spatial relationship to one another as they were in their original locations (fig. 172).[1]

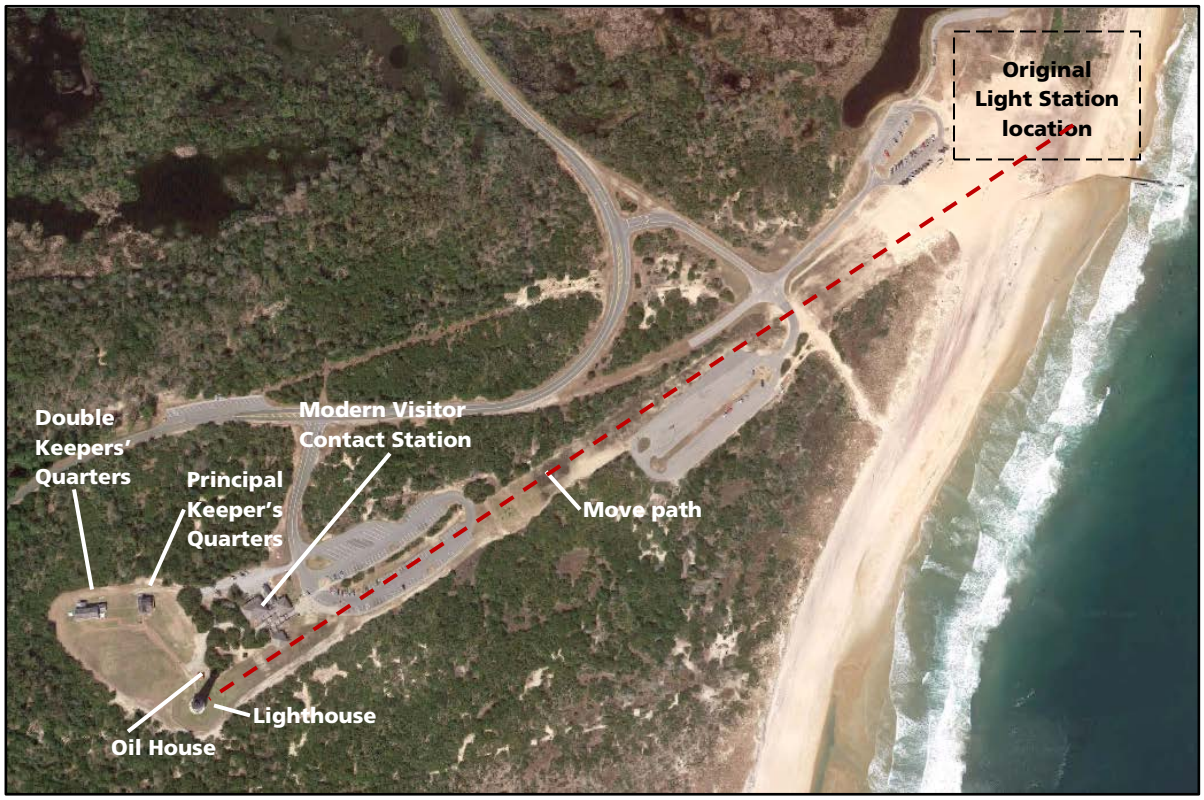


Figure 172. A Google Earth aerial view of the light station. The new location is at the bottom left, the original location is at the top right, and the move path joins the two sites. Photo: Google ©, 2015.

Exterior Overall

The lighthouse (fig. 173) is supported by an octagonal, stepped granite monolithic foundation (46'-0" diameter at grade and approximately 6'-3" high). Above the foundation is an octagonal painted brick base (39'-0" diameter just above foundation and approximately 22'-0" high) with granite quoins, cornice, and door surround. Above the base, the conical painted brick tower, with straight battered (sloped) sides, rises 131'-9" (seven floor levels) to just below the support brackets for the gallery (ninth floor level). The diameter of the brick tower just above the base is approximately 30'-0", and just below the metal brackets is approximately 18'-0". The lighthouse continues another 41'-2-½" to the top of the pinnacle. This includes the service level (bracket level), the watch room level (gallery level), and the glass lantern level.

Being conical, the tower changes little from elevation to elevation. The main differences between the elevations are in the form of window and door penetrations (fig. 174).

[1] The Request for Proposal required a tolerance of 0.1 foot for matching the relative positions (x, y, and z coordinates) of the light station buildings. After being positioned, one end of the Double Keepers' Quarters exceeded this tolerance due to a 0'-6" discrepancy in the x-y plane. The NPS concluded the risks of moving the building again outweighed the benefit to correct the position. For more information, see Paul Cloyd's comments on the Cape Hatteras Lighthouse HSR 100% draft, January 2016.

The north elevation includes the granite-surrounded main entrance bronze double doors at the first level. Stacked directly above the front entrance are three tower window openings at the third, fifth, and seventh floor levels.

The south elevation has four tower window openings which are stacked and directly opposite those on the north elevation. The south elevation openings are located at the second, fourth, sixth, and eighth floor levels. The door opening from the watch room (tenth floor level) onto the exterior gallery is stacked above the windows.

The east elevation contains no window or door openings.

The west elevation contains only a door opening at the lantern level (eleventh floor level) from the interior to the exterior gallery. The door is slightly off center to the north.

In addition, at the service room (ninth floor) level, three windows are located between the brackets at the northeast, southeast, and southwest corners. There is no window located at the northwest corner due to the configuration of the interior stair.

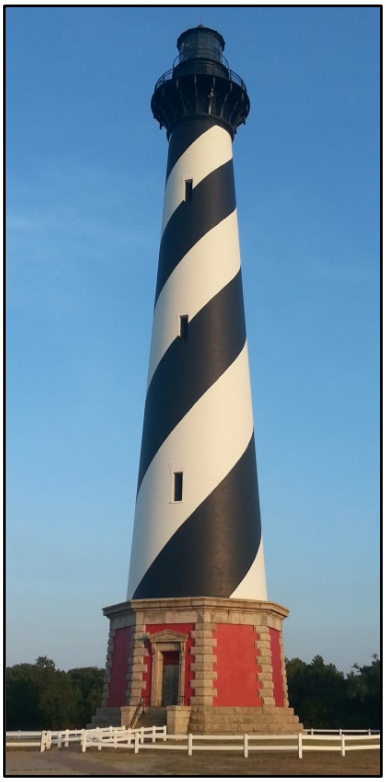


Figure 173. Cape Hatteras Lighthouse. Photo: HPTC, 06/18/15.

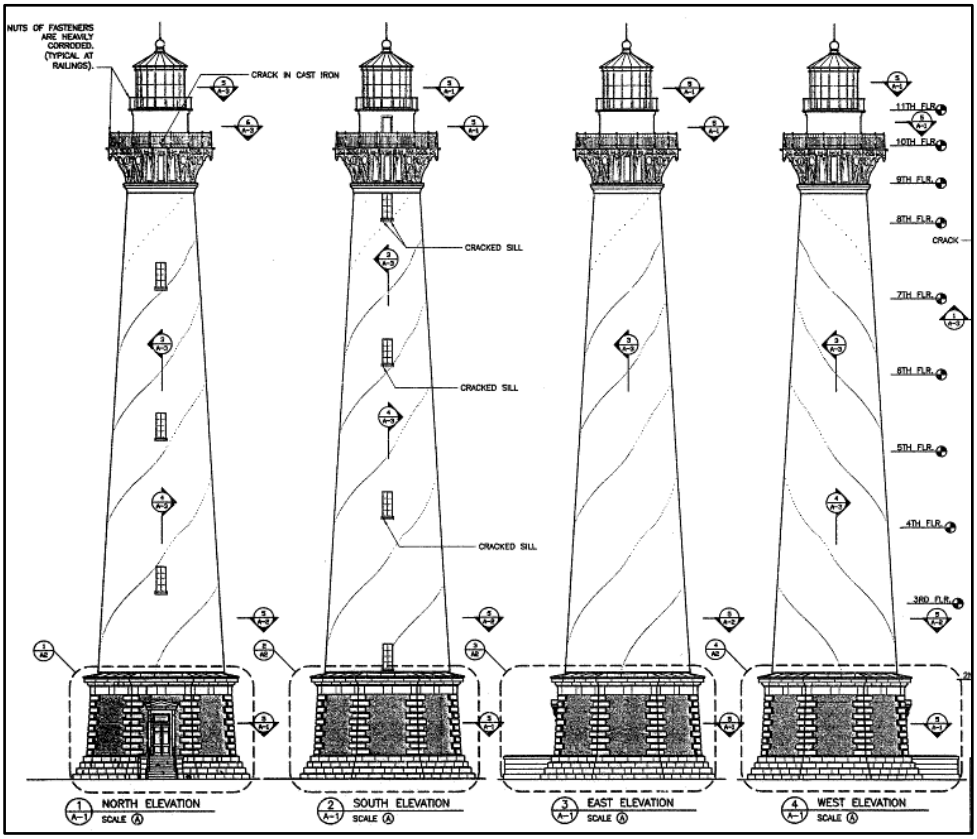


Figure 174. From left to right, the north elevation, south elevation, east elevation, and west elevation. Drawing: NPS DSC eTIC No. CAHA 603 25006A. Cropped by author.

Interior Organization

The interior is comprised of a single vertical, cylindrical shaft (no batter) from the first level to the ninth (service room) level. The shaft is 11'-6" in diameter. The interior of the space is slightly divided by balconies at each of the floor levels and a cylindrical metal stair which joins each of the balcony floor levels (fig. 175).

First Level

The first level is accessed from grade via a nine-tread exterior stair at the north elevation. The plan consists of the central circulation shaft with four radiating arched niches (4'-6" wide) at the four compass points (fig. 176). The north niche continues through to the exterior of the lighthouse and includes a series of two doorways. The exterior bronze-clad double doors are still extant; the interior double doors have been removed (location unknown), however the doorway is still extant. The 8'-0"-deep west niche is at the same level as the main floor. It contains two raised brick benches which once held an oil-storage tank. The 8'-0"-deep east niche located two treads (approximately 1'-3") above the main floor. It also contains two raised brick benches which once held an oil-storage tank. The 8'-0"-deep south niche is located nine treads (approximately 5'-9") above the main floor and contains raised brick benches which hold an extant metal oil-storage tank.

From the floor level, the spiral stair makes just over one full revolution (360°) to rise 20'-0-1/8" to the second level (31 treads, 32 risers).

Second Level

The second level plan contains a semi-circular balcony on the south side of the central circulation shaft (fig. 177). An arched niche (approximately 4'-6" wide and 7'-0" deep) at the south elevation contains a single window opening. From the floor level, the spiral stair makes 1½ revolutions (540°) to rise 20'-0-1/8" to the third level (30 treads, 31 risers).

Third Level

The third level plan contains a semi-circular balcony on the north side of the central circulation shaft (fig. 178). An arched niche (approximately 4'-6" wide and 6'-0" deep) at the north elevation contains a single window opening. From the floor

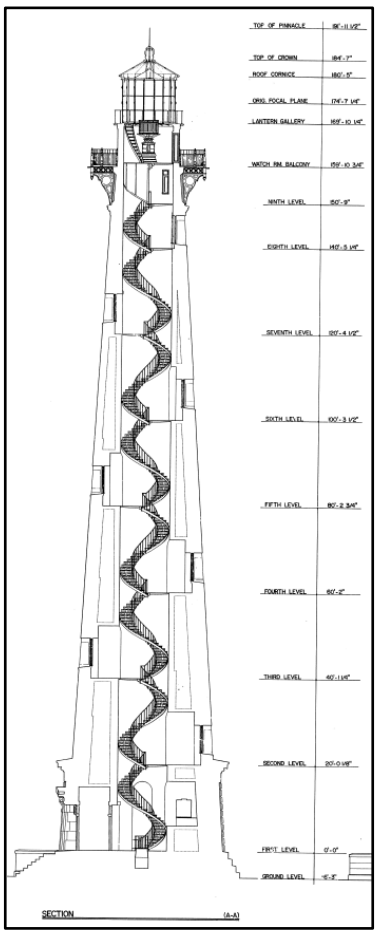


Figure 175. Section through the lighthouse showing the organization of the interior into separate balcony floor levels joined by a central vertical circulation shaft. See fig. 6 for cut line. Drawing: HABS, 1989. Cropped by author.

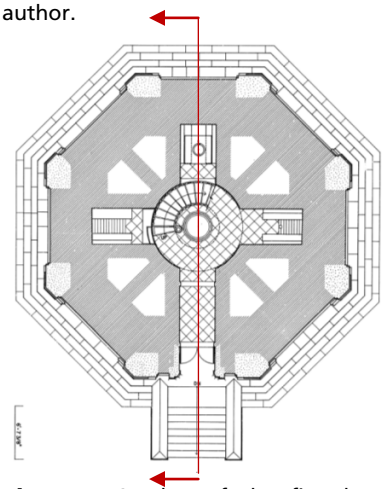


Figure 176. Plan of the first level. Drawing: HABS, 1989. Cropped by author.

level, the spiral stair makes 1½ revolutions (540°) to rise 20'-0-3/4" to the fourth level (30 treads, 31 risers).

Fourth Level

The fourth level plan contains a semi-circular balcony on the south side of the central circulation shaft (fig. 179). An arched niche (approximately 4'-6" wide and 5'-0" deep) at the south elevation contains a single window opening. From the floor level, the spiral stair makes 1½ revolutions (540°) to rise 20'-0-3/4" to the fifth level (30 treads, 31 risers).

Fifth Level

The fifth level plan contains a semi-circular balcony on the north side of the central circulation shaft (fig. 180). An arched niche (approximately 4'-6" wide and 4'-0" deep) at the north elevation contains a single window opening. From the floor level, the spiral stair makes 1½ revolutions (540°) to rise 20'-0-3/4" to the sixth level (30 treads, 31 risers).

Sixth Level

The sixth level plan contains a semi-circular balcony on the south side of the central circulation shaft (fig. 181). An arched niche (approximately 4'-6" wide and 2'-9" deep) at the south elevation contains a single window opening. From the floor level, the spiral stair makes 1½ revolutions (540°) to rise 20'-1" to the seventh level (30 treads, 31 risers).

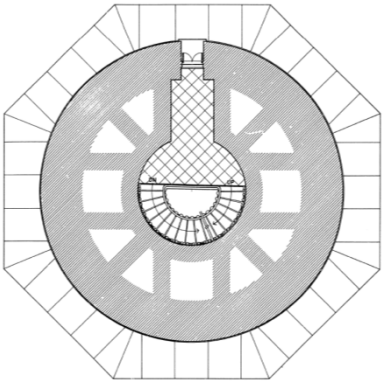


Figure 177. Plan of the second level. Drawing: HABS, 1989. Cropped by author.

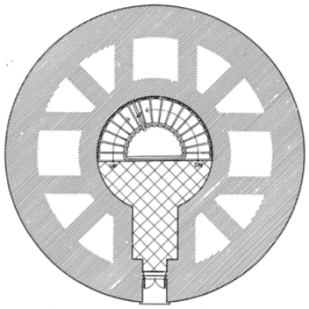


Figure 178. Plan of the third level. Drawing: HABS, 1989. Cropped by author.

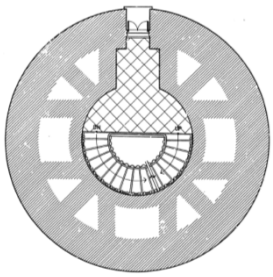


Figure 179. Plan of the fourth level. Drawing: HABS, 1989. Cropped by author.

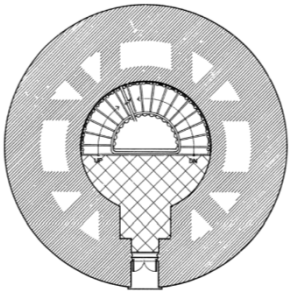


Figure 180. Plan of the fifth level. Drawing: HABS, 1989. Cropped by author.

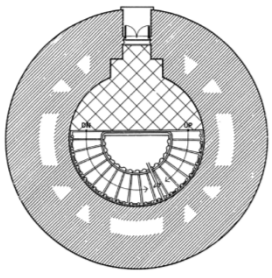


Figure 181. Plan of the sixth level. Drawing: HABS, 1989. Cropped by author.

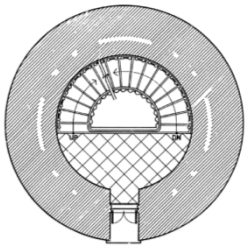


Figure 182. Plan of the seventh level. Drawing: HABS, 1989. Cropped by author.

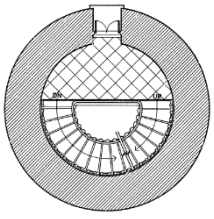


Figure 183. Plan of the eighth level. Drawing: HABS, 1989. Cropped by author.

Seventh Level

The seventh level plan contains a semi-circular balcony on the north side of the central circulation shaft (fig. 182). An arched niche (approximately 2'-6" wide and 1'-0" deep) at the north elevation contains a single window opening. From the floor level, the spiral stair makes 1½ revolutions (540°) to rise 20'-0-3/4" to the eighth level (30 treads, 31 risers).

Eighth Level

The eighth level plan contains a semi-circular balcony on the south side of the central circulation shaft (fig. 183). An arched niche (approximately 2'-6" wide and 0'-6" deep) at the south elevation contains a single window opening. From the floor level, the spiral stair makes half a revolution (180°) to rise 10'-3-3/4" to the ninth level (15 treads, 16 risers).

Ninth Level (Service Room)

The ninth level plan contains a semi-circular balcony on the south side of the central circulation shaft with an interior door accessing the interior stair (fig. 184). Window openings are located at the northeast, southeast and southwest; there is no window opening at the northwest due to the enclosed stair at this location. On the exterior, large decorative brackets rise from the floor level to the ceiling level and support the exterior gallery above. From the floor level, the enclosed stair makes less-than-half a revolution (135°) to rise 9'-1-3/4" to the tenth level.

Tenth Level (Watch Room and Exterior Gallery)

The tenth level plan contains a balcony which occupies nearly two-thirds of the plan (the other third is taken up by the stairs) (fig. 185). An exterior door opening is located on the south elevation. The interior door is missing, but the exterior door is extant. The door accesses the exterior gallery which wraps around the entire perimeter of the exterior. From the floor level, a spiral ladder, less than half a revolution (67.5°), rises 9'-11-1/2" to the lantern level (11 rungs, 12 risers).

Eleventh Level (Lantern)

The eleventh level plan contains an interior circular balcony along the exterior glass wall (fig. 186); it now supports a modern metal platform with the USCG beacon. The center space once held the Fresnel lens. The plan also includes a circular exterior balcony along the exterior glass wall. A glass doorway between the interior and exterior is located just north of west.

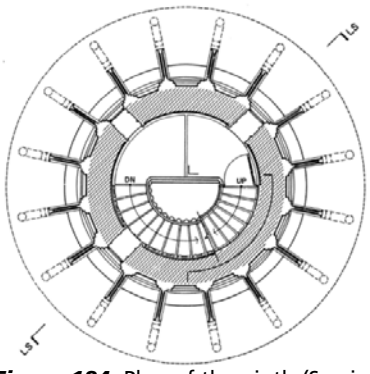


Figure 184. Plan of the ninth (Service Room) level. Drawing: HABS, 1989. Cropped by author.

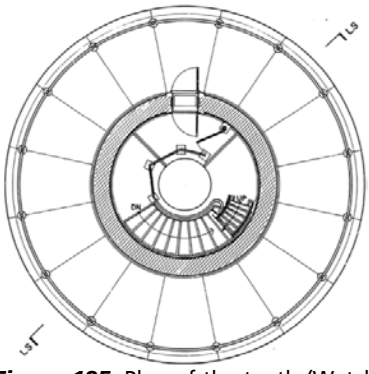


Figure 185. Plan of the tenth (Watch Room & Ext. Gallery) level. Drawing: HABS, 1989. Cropped by author.

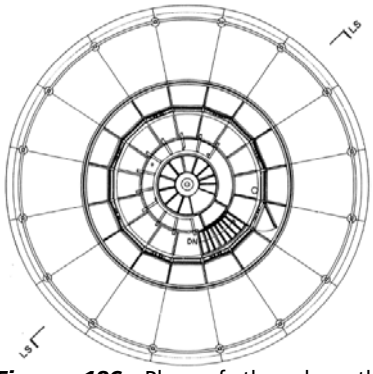


Figure 186. Plan of the eleventh (Lantern) level. Drawing: HABS, 1989. Cropped by author.

Building Feature Master List Descriptions

A	SUBSTRUCTURE
A10	FOUNDATIONS
A1010	Standard Foundations

Original Foundation

The original foundation consisted of two layers of timber mats approximately 48'-0" square. The mats were composed of 0'-6" x 0'-6" southern yellow pine timbers pinned together and located approximately 7'-0" below grade. These details match the written specifications.[2] During the lighthouse move, the grillage was found intact and in good condition due to its constant immersion in freshwater (figs. 187-88). The grillage was left in place at the original location of the lighthouse.



Figure 187. The original grillage as exposed after the lighthouse was moved. Photo: Cape Hatteras National Seashore Archives, 06/99.



Figure 188. Pieces of wood, part of the original grillage. Photo: Cape Hatteras National Seashore Archives, 06/99.

A granite foundation was constructed atop the timber grillage (fig. 189). The original specifications state:

> The foundation is to be of rubble masonry, in random courses, laid in the best manner with level beds. The lowest course will be 48 feet extreme diameter, and together with the outside of the work, composed of flat stones, as large as can be obtained.... The faces of the rubble will be gradually stepped back as it rises, until it measures 45 feet 6 inches diameter, at a point 4 feet 5 inches above the surface of the platform. From this point the face of the foundation will be completed perpendicularly to the surface of the ground, with blocks of cut granite, 1 foot 7 inches thick, upon which will be laid the cut-granite blocks forming the lower course of the plinth, which will also be 45 feet 6 inches diameter.[3]

Prior to the move, the foundation was sliced just above the lowest course of plinth. Everything below this, as well as the entry stair, was removed. Everything above was retained and moved with the lighthouse.

[2] Office of the Lighthouse Board, Treasury Department. "Specifications for a First Order Light-House to be erected at Cape Hatteras, North Carolina. Washington: Government Printing Office, 1869. Located in Cape Hatteras National Seashore Archives. pp. 12-13. Simpson, J.H., Lighthouse Engineer. *Letter to Admiral W.B. Shubrick, Chairman, U.S. Lighthouse Board.* March 27, 1869. Part of NARA's RG 26 Entry 24 (NC-31) "Letters Received from District Engineers and Inspectors, ca. 1853-1900;" available for view at Cape Hatteras National Seashore Archives.

[3] "Specifications," p. 12.

The original specifications for the plinth portion of the foundation state (fig. 190):

> The exterior of plinth is formed of four courses, each of which recedes from the face of the one next below it, forming steps of 11 inches tread. These courses are composed of blocks of granite, with rough-hammered vertical joints and beds, and each step will have a "wash" of 1¾-inch slope. The faces of the courses will be left rough, the edges being merely "pitched off" to a straight line.
>
> There will be no joint at the angles of the plinth, but there the single stones will be cut so as to bring their side joints in the adjoining faces. The top course will be 40 feet diameter; the wash cut upon its upper surface will be 15½ inches side, having a fall of 2 inches, the stone being first cut down perpendicularly 1 inch below the bed for the brick work, before commencing the slope. On the corner stones of the top course this perpendicular cutting projects horizontally 2½ inches, to form a bed for the quoins.
>
> The stones forming the plinth will all measure 3 feet 4 inches in length on the face, and break joints. ....
>
> The rubble will be carried up to within 6 inches of the top of the plinth.
>
> The whole of this stone work must be laid with full beds of cement mortar, and all interstices and vertical joints must be thouroughly grouted.
>
> All the courses of the plinth facing, except the 4th and 5th, will be continuous around its perimeter.

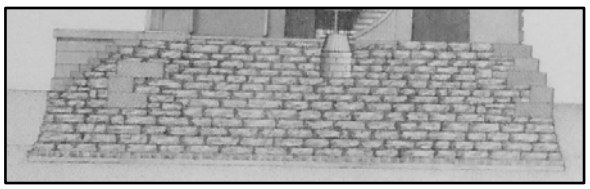


Figure 189. Atop the wood grillage (bottom layer as drawn) granite rubble masonry was laid. Above grade, the foundation was finished with five courses of a dressed granite plinth. Drawing: "Specifications," Plate No. 1. Cropped by author.

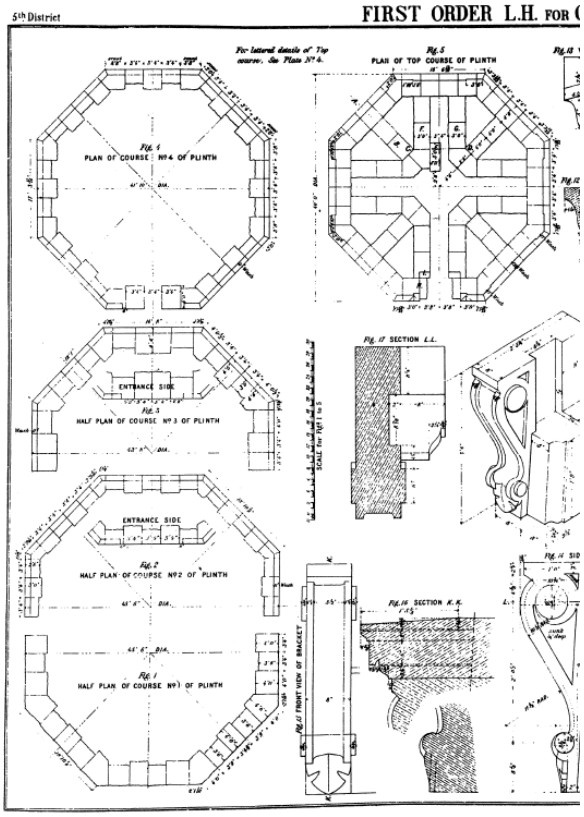


Figure 190. Plans of the granite plinth courses. Drawing: "Specifications," Plate No. 3. Cropped by author.

> These two courses will break at the tower entrance, leaving a gap under the sill to be filled in with the rubble-work, which passes through and connects the foundation of the stoop with the core of the plinth.
>
> On the top course are shown the stones forming the footings of the radial brick walls and window cheeks.[4]

New Foundation

After the lighthouse was moved in 1999, it was placed on a new foundation. The engineer's design drawings for the new foundation call for a 5,000-psi, steel-reinforced concrete mat foundation, measuring 60'-0" square by 4'-0" deep (540 yards of concrete), atop an aggregate stone base and additional reinforced-concrete infill (fig. 191). The bottom of the mat was to set 9'-0" below grade

[4] "Specifications," pp. 12-13.

on top of the stone aggregate (fig. 192). Between the concrete mat and the original granite plinth of the lighthouse above, 5'-0" of solid brick masonry was laid (fig. 193). The brick replaced the original monolithic granite foundation which was removed prior to the move.

On top of the new concrete and brick foundation rests a large portion of the original octagonal granite monolithic foundation. This encompasses the top four courses of the ashlar granite plinth, which have not been altered. The fifth (lowest) course is partially exposed at grade. This course is now a veneer. The faces of the stones were cut and reinstalled around the new brick foundation after the move (fig. 194). The quarry-faced granite plinth blocks measure 4'-0" wide x 1'-4" tall, and have a 0'-1" slope at the top edge to shed water. Each plinth course steps out from the course above by approximately 0'-11", however the fifth (lowest) course is flush with the fourth course above. All of the mortar joints are flush.



Figure 194. The top four courses of granite plinth were moved with the lighthouse. The bottom row was reinstalled as a veneer. Photo: Cape Hatteras National Seashore Archives, 09/99.



Figure 191. The formwork and rebar in place in preparation of pouring concrete. Photo: Cape Hatteras National Seashore Archives, 05/01/99.



Figure 192. The concrete mat is covered while it is curing. Photo: Cape Hatteras National Seashore Archives, 05/08/99.



Figure 193. Solid brick masonry is used to replace the removed portions of granite rubble foundation. Photo: Cape Hatteras National Seashore Archives, 09/99.

B	SHELL
B10	SUPERSTRUCTURE
B1010	Floor Construction
B101003	Floor Decks and Slabs

First Level Floor Slab

The first-floor slab is composed of several inches of concrete poured over the granite rubble foundation below (fig. 195). This was not altered during the move and is historic.



Figure 195. A section through the first-level floor concrete floor slab. "Specifications," Plate No. 7. Cropped by author.

Second Level through Eighth Level Floor Decks

Above the masonry first floor level, the vertical circulation core is divided into floor decks. The second-level floor deck occupies the southern half of the tower. Each successive landing above it alternates from the north to the south half of the tower (fig. 196).

Each of these floor decks (second level through eighth level) are supported by two original iron I-beams and shallow brick arches. At each landing, the two beams span east-west across the tower, are embedded into the masonry of the core wall, and rest on cast-iron shoe plates (fig. 197). One beam is located at the edge of the landing; this beam measures 1'-0" deep, 0'-4" wide, and 13'-0" long. The second beam, laid parallel to the first, is located at the halfway point of the landing; this beam measures 0'-9" deep, 0'-3-1/2" wide, and 11'-6" long. Shallow arches, composed on one-with-thick brick units laid on their side, span between the beams and the masonry of the core wall (figs. 198-99). Above the brick lies poured concrete (below decorative tile).[5]

All of the floor deck components are painted (the metal is red, the brick is white).

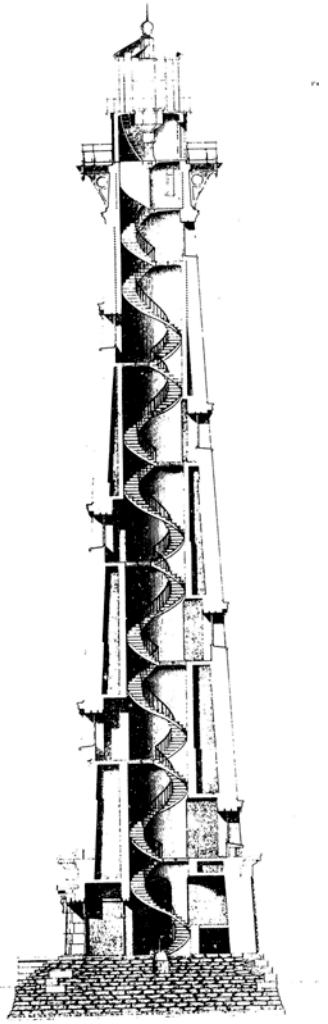


Figure 196. The vertical space of the lighthouse is divided by floor decks which alternate from occupying the north half and the south half of the core. Drawing: "Specifications," Plate No. 7. Cropped by author.

[5] "Specifications," Plate No. 7 and pp. 20-23.

Ninth Level (Service Room) Floor Deck

The ninth-level (Service Room) floor deck is composed of two cast iron plates bolted together (figs. 200-1). A single cast iron beam spans the deck along the outer edge (east-west). This beam measures 1'-0" deep, 0'-4" wide, and 13'-0" long. It extends through the exterior masonry wall and is bolted to the bottom of two opposing exterior brackets which support the exterior gallery above. Perpendicular to this beam is a secondary support rib (fig. 202). The perimeter of the iron plates are attached bolted to the exterior cast iron shelf below the brackets.[6] All of the metal components are painted red.

Tenth Level (Watch Room) Floor Deck

The tenth-level (Watch Room) floor deck is composed of three cast iron plates bolted together (fig. 203). Two parallel cast iron beams span the deck (east-west) through the center of the space approximately 2'-3" apart (figs. 204-5). The beams measure 1'-0" deep, 0'-4" wide, and at least 13'-0" long.[7] The following is a description of the floor deck by HHA/WJE in March 1986:

> A series of three smaller secondary supports fan out from the inside iron beam. The ends of both beams are supported on short stub columns on the back portion of the large cast-iron Gallery support brackets, which are embedded in the exterior masonry wall. The ends of the three secondary support ribs are supported directly in the masonry wall. The cast-iron deck plate is bolted to the stub column on the back of the Gallery support brackets, similar to those stub columns upon which the floor beams are supported.[8]

All of the metal components are painted.

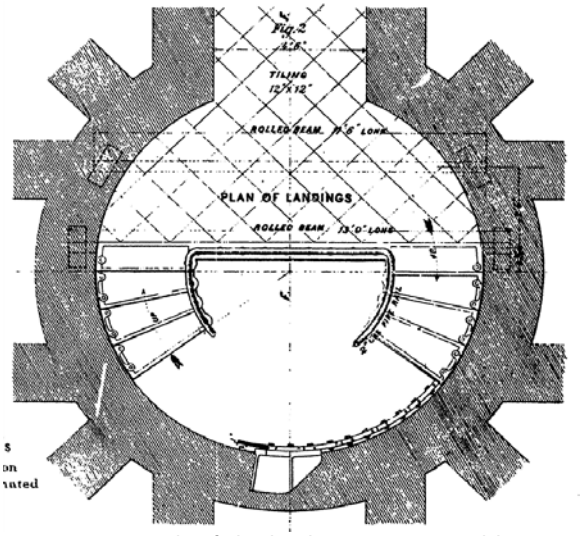


Figure 197. Each of the landings is supported by two I-beams. One is located along the edge of the landing; the other is located at the halfway point. Drawing: "Specifications," Plate No. 7. Cropped by author.

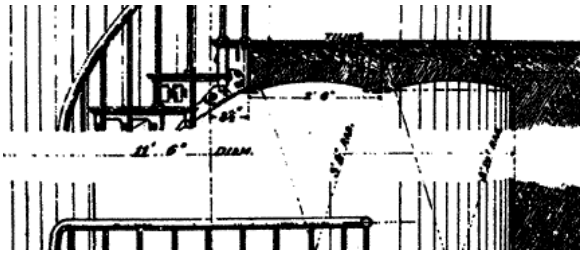


Figure 198. Brick arches are located between the iron I-beams. Concrete was poured atop the brick to make a flat surface for the finish tile. Drawing: "Specifications," Plate No. 7. Cropped by author.



Figure 199. One of the landings in the lighthouse from below shows the two iron I-beams with shallow brick arches between. Photo: HPTC, 06/17/15.

[6] "Specifications," Plate No. 10 and pp. 20-23.
[7] Ibid.
[8] HHA/WJE. "Comprehensive Structural Analysis Report." p. 88.

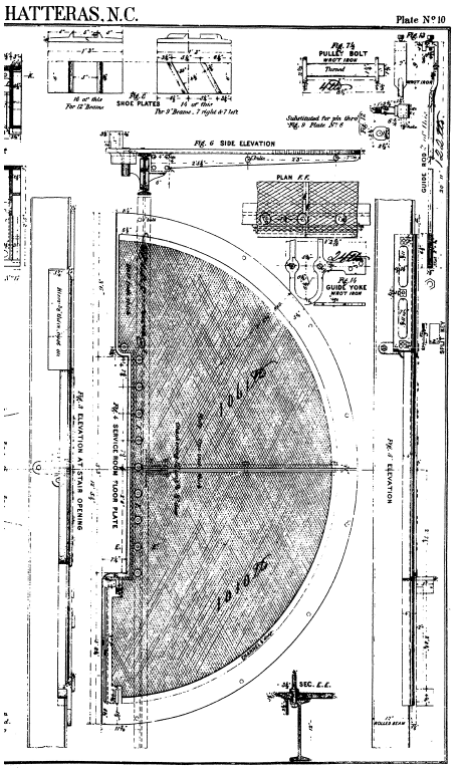


Figure 200. The original specification drawings for the ninth-level (Service Room) floor deck. Drawing: "Specifications," Plate No. 10. Cropped by author.



Figure 201. The ninth-level floor deck from above. Photo: HPTC, 06/17/15.



Figure 202. The ninth-level floor deck from below. Photo: HPTC, 06/17/15.

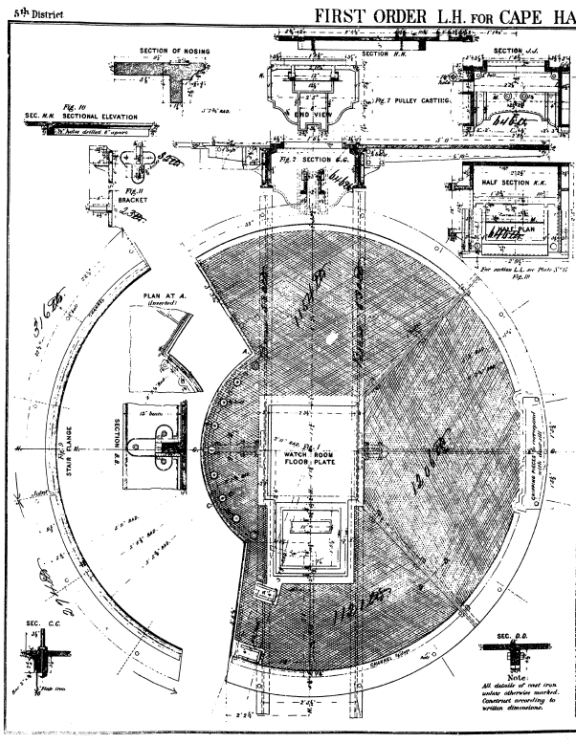


Figure 203, right. The original specification drawings for the tenth-level (Watch Room) floor deck. Drawing: "Specifications," Plate No. 10. Cropped by author.



Figure 204. The tenth-level floor deck from below. Photo: HPTC, 06/17/15.



Figure 205, right. The tenth-level floor deck from above. Photo: HPTC, 06/17/15.

B101004	Balcony Construction

Watch Room Level Gallery

The following is a description of the Watch Room level gallery by HHA/WJE in March 1986 (fig. 206):

> The deck of the [tenth-floor] Gallery is constructed with a series of sixteen truncated pie-shaped cast iron plates. These plates are supported directly on a series of sixteen cast-iron brackets [located at the ninth-floor level]. These brackets are basically triangular in shape, although somewhat ornamental [fig. 207]. The vertical leg of the triangle of each bracket is approximately [10'-0"] in height, while the horizontal dimension across the top of the bracket is approximately [6'-8"]. The deck which rests upon the bracket is [5'-10"] in width. The back portion of each bracket is embedded in the brick masonry wall of the Lighthouse. The top of each bracket is tied into the structure to prevent it from overturning due to its own weight and the applied live loads on the Gallery deck. The tie consists of a series of cast-iron bars which are bolted together at the back of each bracket. The completely encircle the tower and form a "tension ring." This ring is embedded in the masonry wall of the tower.
>
> The top of each triangular bracket includes an ornamental grid, approximately one foot in height. The outermost end of each triangular-shaped bracket features an ornamental cylinder, eight inches in diameter. Each cylinder houses a support system for a vertical post in the ornamental handrail system located around the perimeter of the Gallery deck above. That handrail system consists of a series of three horizontal, parallel iron bars, separated by a series of closely spaced small diameter iron rods that frame between each of the sixteen ornamental iron vertical posts [fig. 208].[9]

[9] HHA/WJE. "Comprehensive Structural Analysis Report." p. 102.

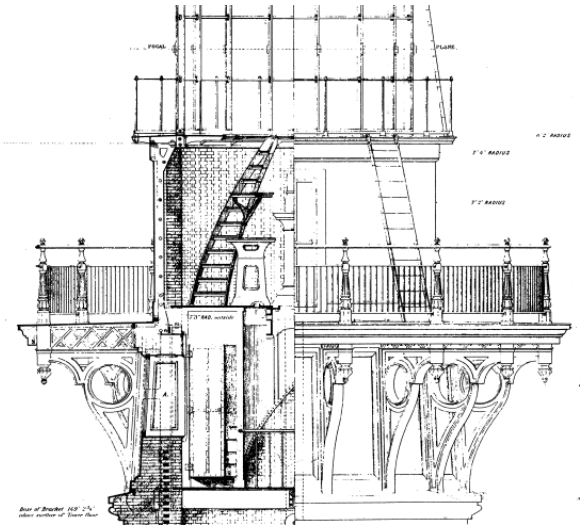


Figure 206, above. An elevation/section drawing at the Service Room and Watch Room and Gallery detailing how the components fit together. Drawing: "Specifications," Plate No. 12. Cropped by author.



Figure 207, top right. The underside of the gallery floor, with supporting brackets. Photo: HPTC, 06/17/15.

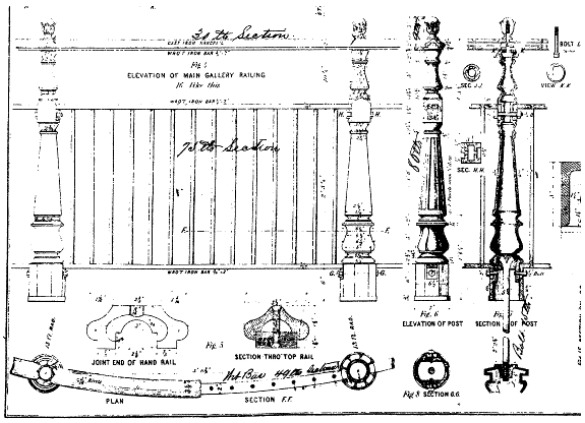


Figure 208, right. Original detail drawing of the cast iron posts and railings between for the gallery. Drawing: "Specifications," Plate No. 13. Cropped by author.

The following additional description is by JKO in 2014 (figs. 209-10):

> Sixteen cast iron posts that measure 4'-5" tall support the railing at the outer edge of the balcony; they appear to be original. The posts are decorative turned newels that sit on octagonal bases; the base of each newel measures 7" across. The top handrail sits 4'-0" above the deck. Partial-height balusters that measure ¾" in diameter are spaced 5" on center between the newel posts. Above, ¾" diameter balusters are spaced 10" on center. The balusters are secured by a middle and bottom rail. The balusters, middle, and bottom rail have been recently replaced. The metal wall panels, deck plates, and railing are coated in a black paint finish.[10]

Lantern Room Level: Interior and Exterior Balconies (figs. 211-16)

The deck of the interior and exterior balconies at the Lantern Room level are constructed of cast-iron plates which are supported in the center by the exterior wall of the Watch Room below and span approximately 2'-3" to the interior and 2'-1" to the exterior. The deck is composed of sixteen cast-iron plates (two are altered to accommodate the interior stair). The interior balcony components are painted grey.

The railing located at the perimeter of the exterior balcony consists of sixteen round posts and a horizontal rail. This railing was replaced during the 1991-93 work by ICC. All components are painted black.

[10] JKO/BPE, "Cape Hatteras Lighthouse," p. 13.





Figure 210, above. The gallery floor deck from above. Photo: HPTC, 06/17/15.

Figure 209, left. One of the posts at the gallery railing. Note the smaller finial on top and the altered rail from the original drawings. Photo: HPTC, 06/17/15.

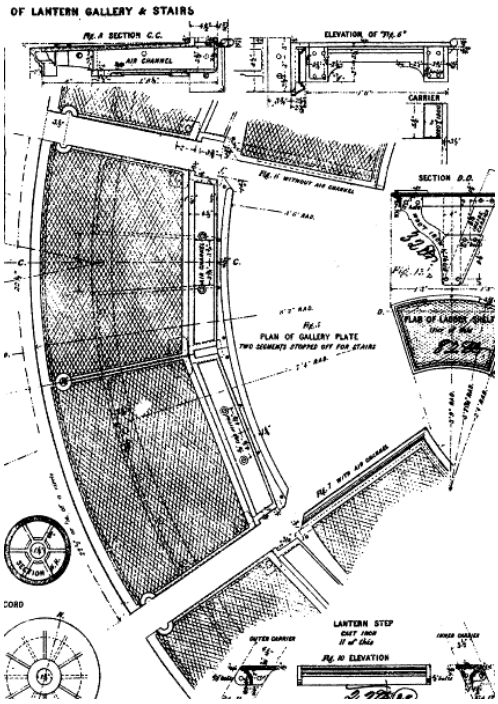


Figure 211. Plan of the lantern gallery plates at the interior ladder. Drawing: "Specifications," Plate No. 16. Cropped by author.

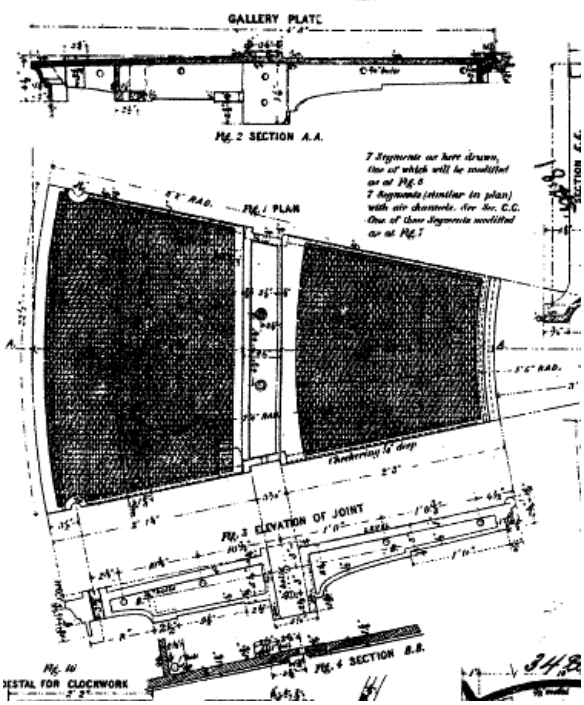


Figure 212. The original drawing of one of the sixteen lantern balcony plates. Drawing: "Specifications," Plate No. 16. Cropped by author.

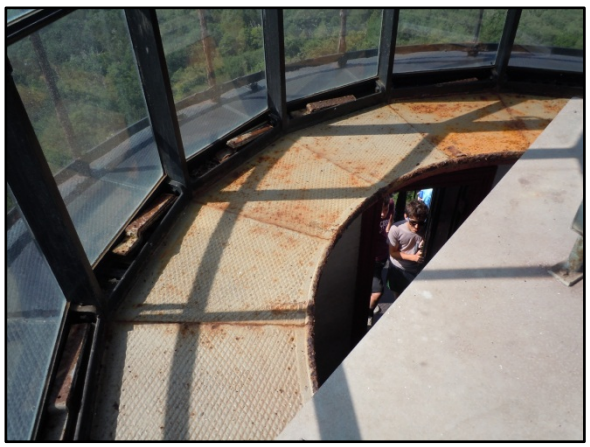


Figure 213. The glass lantern exterior wall separates the interior portion from the exterior. Photo: HPTC, 06/16/15.



Figure 214. The underside of the interior lantern balcony floor. Photo: HPTC, 06/17/15.



Figure 215. A view out to the exterior portion of the lantern balcony through the glass wall that separates it from the interior portion. Photo: HPTC, 06/16/15.



Figure 216. The replaced exterior handrail which surrounds the exterior portion of the lantern balcony. Photo: HPTC, 06/17/15.

B1020	Roof Construction

The roof framing structure consists of the "spider frame" common in many lighthouses (figs. 217-18). The frame is composed of "a series of sixteen slender wrought iron rafters, arranged like the spokes of a wheel, that frame from the eave to the peak of the [roof]. The top ends of these rafters are supported by a small wrought iron compression ring. The bottom end of each rafter is connected to a horizontal tie bar which frames across to a tension ring at the center of the room."[11] The tie rods also support the lens shelter. Above the lens shelter and through the center of the roof is a ventilator. The entire system is painted white.

[11] HHA/WJE. "Comprehensive Structural Analysis Report." p. 133.

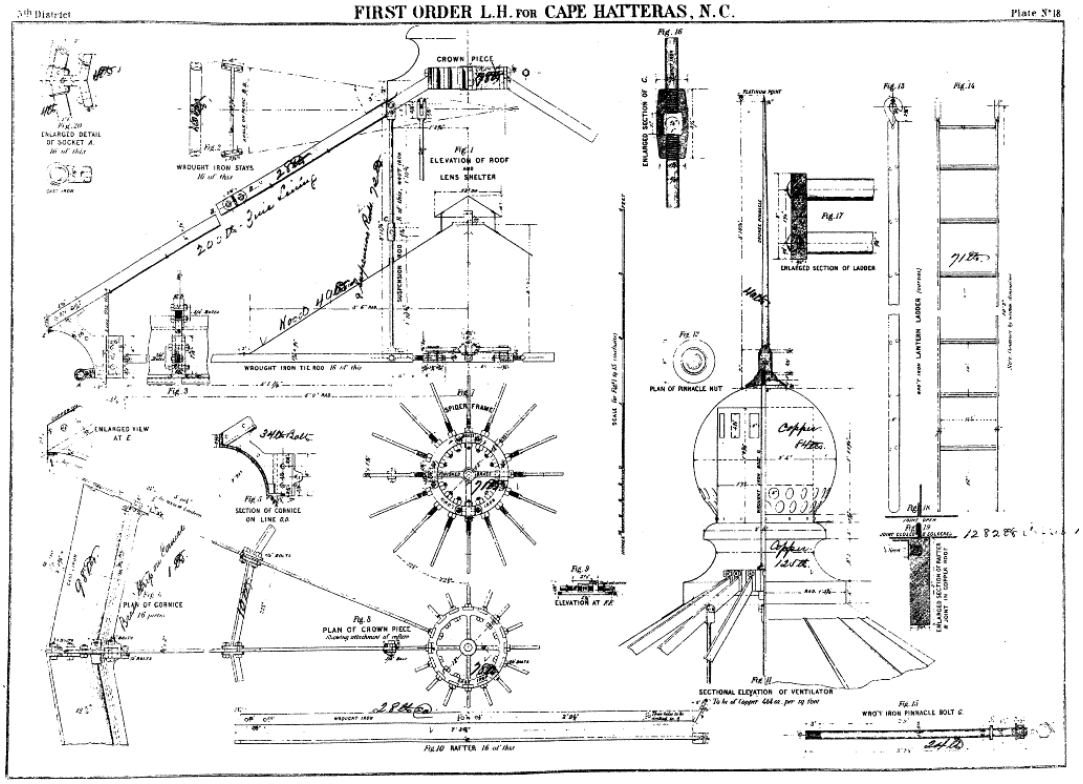


Figure 217. Original specification drawings showing how the roof framing structure works. Drawings: "Specifications," Plate No. 18..



Figure 218. A view from below the spider frame and the lens shelter. Photo: HPTC, 06/16/15.

B20	EXTERIOR ENCLOSURE
B2010	Exterior Walls

Base

The exterior walls of the base (which sits above the stepped plinth rows) are comprised of two separate 15'-10"-tall brick masonry walls (fig. 219). The approximately 5'-3"-thick (7½ bricks) outer walls are octagonal in plan (37'-5" exterior diameter); the approximately 1'-8"-thick inner wall is circular in plan (11'-6" interior diameter). Twelve brick masonry "ribs" join the exterior walls and the interior wall; the ribs are approximately 1'-8" thick. Between the walls and the ribs are cavities.

The exterior of the outer wall is composed mostly of brick masonry. Ten courses of granite quoins are located at all the corners and a granite cornice is located above (figs. 220-22). Regarding the quoins, the original specifications state:

> . . .the length of the faces are 3 feet and 2 feet, respectively, and the thickness uniformly 18¾ inches, which corresponds with the height of eight courses of brick, including ¼-inch joints. The faces of quoins will incline with and project 2½ inches from the surface of the brick work. These projecting faces will be cut with a draft 2½ inches wide all round the edge, beyond which the rough face of the stone will extend 2½ inches farther. The draft must be hammered, and the beds evenly dressed.[12]

The cornice wraps around the top of the entire base and corresponds with the level of the second level floor deck. The cornice is composed of four courses of granite: crown, fascia, bed-mould, and frieze. The cornice runs through the thickness of the outer wall to form a bed for the shaft above.[13]

The main entrance to the tower is located on the north side of the octagonal base (fig. 223). The entrance has grand granite details. The original specifications provide the following description:

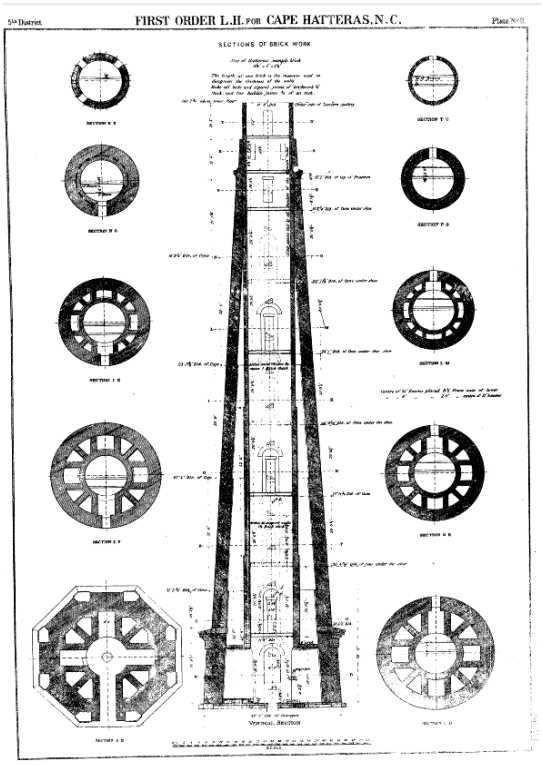


Figure 219. A section through the center of the tower and plans of each level (two through ten) show how the double exterior wall is constructed. Drawing: "Specifications," Plate No. 2.



Figure 220. Above the granite plinth, the octagonal, painted brick base has granite quoins and a granite cornice. Photo: HPTC, 06/17/15.

[12] "Specifications," pp. 14-15.
[13] Ibid.

> The door opening is about 10½ feet high, by 4 feet 4 inches wide in the clear. Its architraves, consoles, and pedimental head, are constructed of granite, fine hammered, but very plainly finished.
>
> The skew-backs,…key, and intermediate stones of the pediment, …penetrate well into the wall, …and their upper surfaces are dressed to give the brick work a level bed. …
>
> The cheeks of the entrance as far in as the iron door…are faced up with slabs of granite 8 inches thick.
>
> The outer corners of the entrance …will be formed of three pieces in height, cut out of blocks 16 inches square.
>
> The lintel,…each console,…and the horizontal fascia of the pediment, are cut out of single stones, and fitted together in the neatest manner with cement joints.[14]

The brick of the outer face of the outer wall is painted with red latex paint. Since the lighthouse was first painted in 1873, the base's brick walls were painted a brick color. All of the granite components are unpainted. Some rust staining appears at the decorative door surround, likely due to fasteners from removed conduit.

The inner face of the inner wall is painted with what appears to be latex paint. The cavity-side of the outer walls and inner wall are unpainted.



Figure 221. The granite quoins at the corner of the base. Photo: HPTC, 06/17/15.



Figure 222. The granite cornice at the top of the base. Photo: HPTC, 06/17/15.



Figure 223. The granite entrance surround on the north elevation. Photo: HPTC, 06/17/15.

[14] Ibid.

Tower (Second Level through Eighth Level)

The exterior wall assembly of the lighthouse is also comprised of two separate brick masonry walls (see fig. 219). Both are circular in plan. Twelve brick masonry "ribs" join the exterior wall and the interior wall; the ribs vary in thickness (to match the thickness of the inner wall) as the lighthouse increases in height. Between the walls and the ribs are cavities.

The outer wall has an exterior diameter of 32'-5-½" just above the base's granite entablature and an exterior diameter of 16'-10-½" just below the brick belt course which corresponds with the ninth level floor. The differing diameters create a batter in the tower (fig. 224). In addition, the thickness of the wall varies as the lighthouse increases in height, from approximately 3'-10-¾" (5½ bricks thick) just above the granite entablature of the base to approximately 2'-10" (four bricks thick) from approximately the sixth level floor up. The wall is constructed with a header course every three courses of brick.

The inner wall maintains an 11'-6" inner diameter the entire height of the tower (fig. 224). The thickness of the wall varies as the lighthouse increases in height, from approximately 1'-8" (five bricks thick) at the second level to 0'-8" (two bricks thick) at the ninth (Service Room) level. The wall is constructed with a header course every three courses of brick from the second through to about the middle of the seventh level.

The inner wall also has relieving arches built into the wall below the window niches on the north and south elevations. The arches are one brick thick.

From the middle of the seventh level up through the top of the eighth level, the inner wall and outer wall are only separated by a 0'-2" air space. At this section the inner wall is constructed with Flemish bond.



Figure 224. The exterior wall of the tower is constructed to have a batter (slopes in from bottom to top). Photo: HPTC, 06/17/15.



Figure 225. The inner wall of the tower is consistently 11'-6" in diameter. Photo: HPTC, 06/17/15.

The inner face of the inner wall and the outer face of the outer wall are both painted with an acrylic-based paint (white on interior, black and white spirals on exterior). The cavity-side faces of the inner and outer wall are unpainted.

Ninth Level (Service Room)

The exterior wall assembly of the ninth level is nearly identical to the floor levels below, except a few differences.

The ninth level is separated from the floors below by brick belt course (covered with metal) which supports the brackets for the gallery of the tenth level gallery above (fig. 226). Above this, the wall assembly is comprised of two separate brick masonry walls. Both are circular in plan. A 0'-2"-thick cavity is located between the walls. The outer wall retains the batter and brick coursing from the wall below. The interior retains the 11'-6" diameter, the Flemish bond, and the painted finish from below.

On the exterior, a decorative cast iron wall panel is located between each of the brackets. Three of these panels have fixed windows. The panels are painted black.

Tenth Level (Watch Room)

The exterior wall at the tenth level (Watch Room) is composed of single wall. The wall is approximately 1'-0-½" thick (or 1½ bricks). The outer surface is covered in iron panels (fig. 227), separated by an air space. According to JKO's 2014 report: "The panels are 7'-8" tall and 2'-10" wide. The cast iron baseboard on the paneled wall measures 12" tall with a 2" tall decorative cap. The cast iron cornice on the paneled wall is also 12" tall with a 2" tall cap below. Vents for the lantern are installed above the cornice at every-other panel [fig. 228]."[15] The interior of the wall is painted with an acrylic-based paint (white).

Lantern (Eleventh Level)

The following description was provided by JKO in their 2014 report:

> The lantern is constructed of sixteen vertical structural struts made of non-ferrous metal, likely bronze. Each member measures 1¼" by 3¾" and has two handles attached on the exterior side. Each of the sixteen sides of the lantern is infilled with three pieces of glass arranged vertically and separated by horizontal bars [figs. 229-30]. The panel facing northwest is infilled with an operable glazed door for access to the lantern balcony. The panels measure 2'-3½" wide and vary in height from 2'-6½" at the lowest panel, to 2'-3" at the middle panel, to 3'-10" at the upper panel. At the base of every-other panel there is a horizontal operable vent that draws in air from the vents above the cornice at the Watch Room balcony.[16]

A door is also integrated into the exterior wall of the lantern; this feature may not be original.

[15] JKO/BPE, "Cape Hatteras Lighthouse," p. 12.
[16] Ibid, p. 13.



Figure 226. The outer face of the outer wall of the ninth (service room) level is covered with decorative metal panels. Photo: HPTC, 06/17/15.



Figure 227, left. The exterior wall at the tenth level (Watch Room) is covered with metal panels. Photo: HPTC, 06/17/15.



Figure 228, above. The cornice above the wall panels surrounding the Watch Room. Two vents to the lantern above can be seen on the right and left (arrows). Photo: HPTC, 06/17/15.



Figure 229, left. The interior of the Lantern with glass wall system. Photo: HPTC, 06/17/15.



Figure 230, above. The exterior of the lantern exterior wall as seen from the Watch Room Gallery below. Photo: HPTC, 06/16/15.

Tower Windows

Each of the landings at levels two through eight is equipped with an iron window (seven window openings total). Three windows are vertically stacked on the north elevation; four are vertically stacked on the south elevation (figs. 231-32). According to JKO's 2014 report: "Each opening measures 1'-10" wide by 6'-0" tall and has a pair of four-light iron casement windows. The window frames, lintels, and sills are iron."[17] The original specification drawings and historic photographs show ornamental pedimented hoods and brackets over the lower six window openings (fig. 233). They were originally bolted to the lintel and embedded in the masonry above. These decorative features were removed in ca. 1965. On the interior side of the windows, a non-historic diamond-patterned plastic fence material has been installed (figs. 234-35).

According to the 1988 report by HHA/WJE, the "sash were originally equipped with internal catches to hold the window shut and hooks on the sill cheek walls to hold the windows open. There are two four-knuckle hinges on each sash." It was reported in the 1986 that all of the sash had been replaced.[18]

Service Room Windows

The three Service Room windows, facing northeast, southeast, and southwest, are a part of the exterior decorative bracket and panel system located beneath the gallery. The windows are 1'-8" wide and 4'-4" tall. According to the 1988 report by HHA/WJE, "The glazing, which is 1 inch to 1-1/8 inches thick, is fixed in place and mounted on a slight angle to match that of the iron panels between the gallery brackets." Originally, these windows "were equipped with an operable transom panel. If the door to the watchroom at this level was closed, these vents were used to draw air up through the tower and out at the top. The closing of these vents, consequently, has reduced the stack effect and eliminated effective ventilation for this level of the tower."[19] See figs. 236-237.



Figure 231. Three tower windows are vertically stacked on the north elevation. Photo: HPTC, 06/17/15.



Figure 232. Four tower windows are vertically stacked on the south elevation. Photo: HPTC, 06/17/15.

[17] JKO/BPE, "Cape Hatteras Lighthouse," pp. 10-11.
[18] HHA/WJE. "Comprehensive Structural Analysis Report." pp. 78-82.
[19] HHA/WJE. "Comprehensive Structural Analysis Report." pp. 78-82.

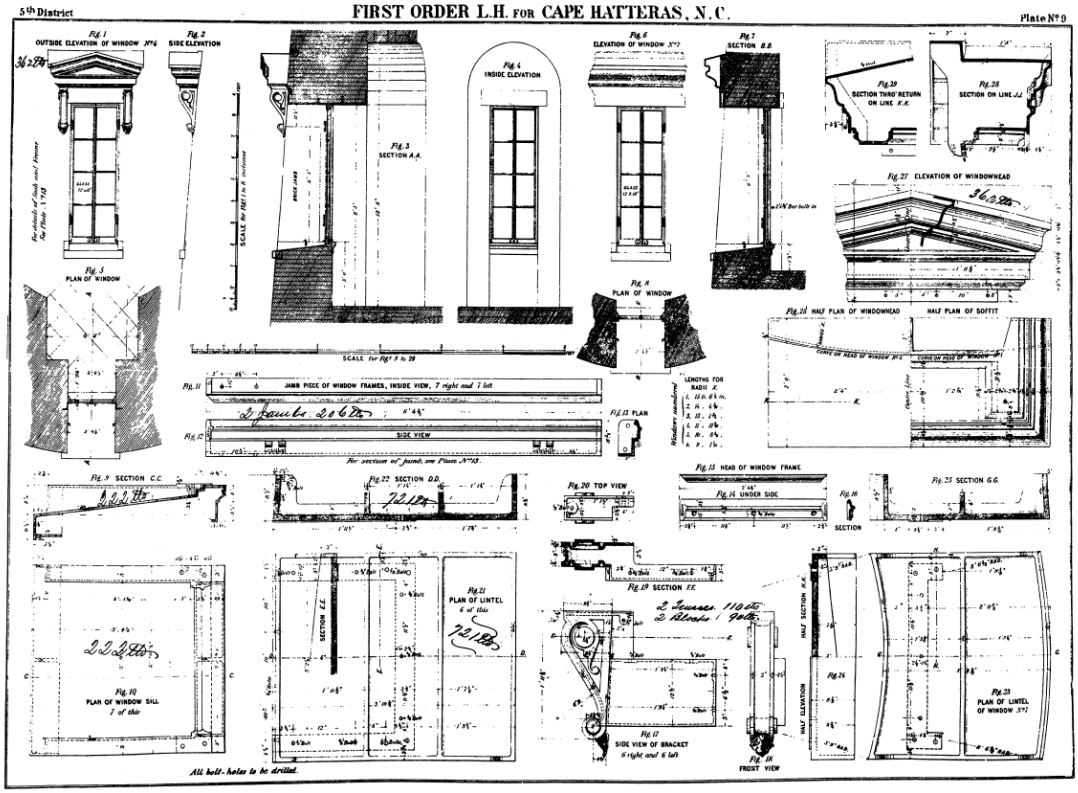


Figure 233. The original specifications drawings for the tower window (levels two through eight). Drawing: "Specifications," Plate No. 9.



Figure 234. Exterior of the second-level window. Note the scarring on the brickwork where the metal hood and brackets once were located. Photo: HPTC, 06/17/15.



Figure 235. The interior of one of the tower windows shows the metal lintel and sill and added (non-historic) screen on the interior. Photo: HPTC, 06/17/15.



Figure 236. One of the ninth-level windows. Photo: HPTC, 06/17/15.

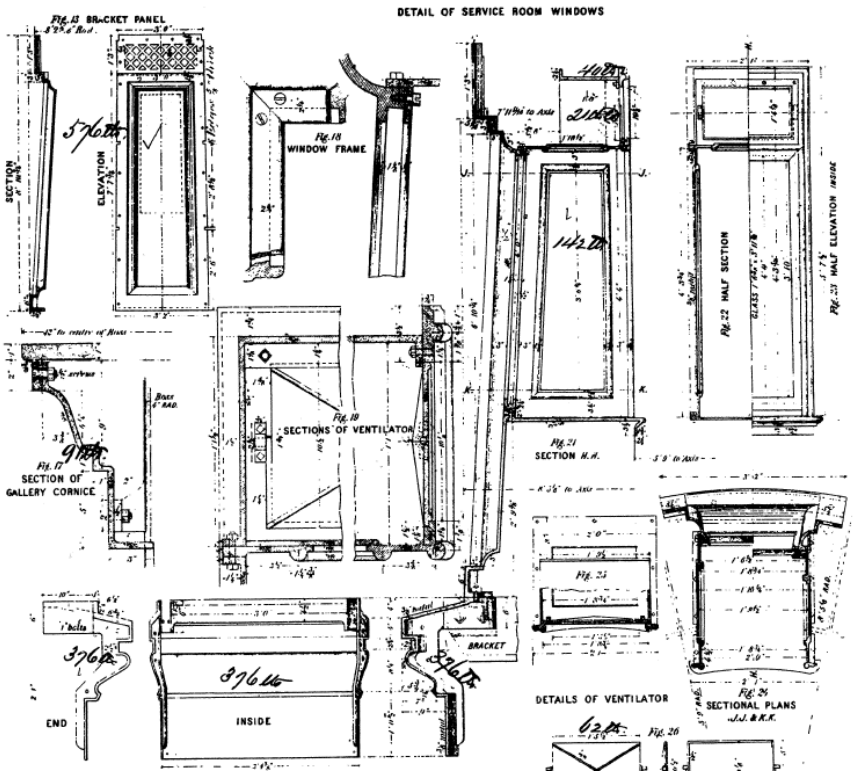


Figure 237. Original specification drawings for the Service Room windows. Drawing: "Specifications," Plate No. 15. Cropped by author.

B2030	Exterior Doors

Front Entrance (First Level)

The front entrance opening to the tower is located on the north elevation. The opening has two doorways: an outer opening and an inner opening, separated by a vestibule space (fig. 238).

The outer opening measures 4'-4" wide and 8'-0" tall (fig. 239). The three-paneled double doors are constructed of bronze plates and are 7/8" thick. The 0'-6" hinges are also of bronze. The door frame is made of iron; conduit runs through one portion of it. The original transom (opening is 4'-4" wide and 2'-0" tall) has been replaced with a wood louver.[20]

The inner vestibule doors have been removed from their opening (fig. 240). In 1986, the wood doors were in storage. At that time they were described by HHA/WJE as being glazed, wood paneled doors. They were painted white and had their glazing intact. The door handles had been painted over and the knobs were not extant. The hinges were missing and only a lock/bolt receiver remained. The cast iron doorframe is extant at the lighthouse, however "holes have been cut through the transom bar for the conduit that now runs through the empty transom space above." The glazed transom has been removed.[21] The current location of the doors and transom is unknown.

[20] HHA/WJE. "Comprehensive Structural Analysis Report." pp. 83-84.
JKO/BPE, "Cape Hatteras Lighthouse," p. 10.
[21] HHA/WJE. "Comprehensive Structural Analysis Report." pp. 83-84.

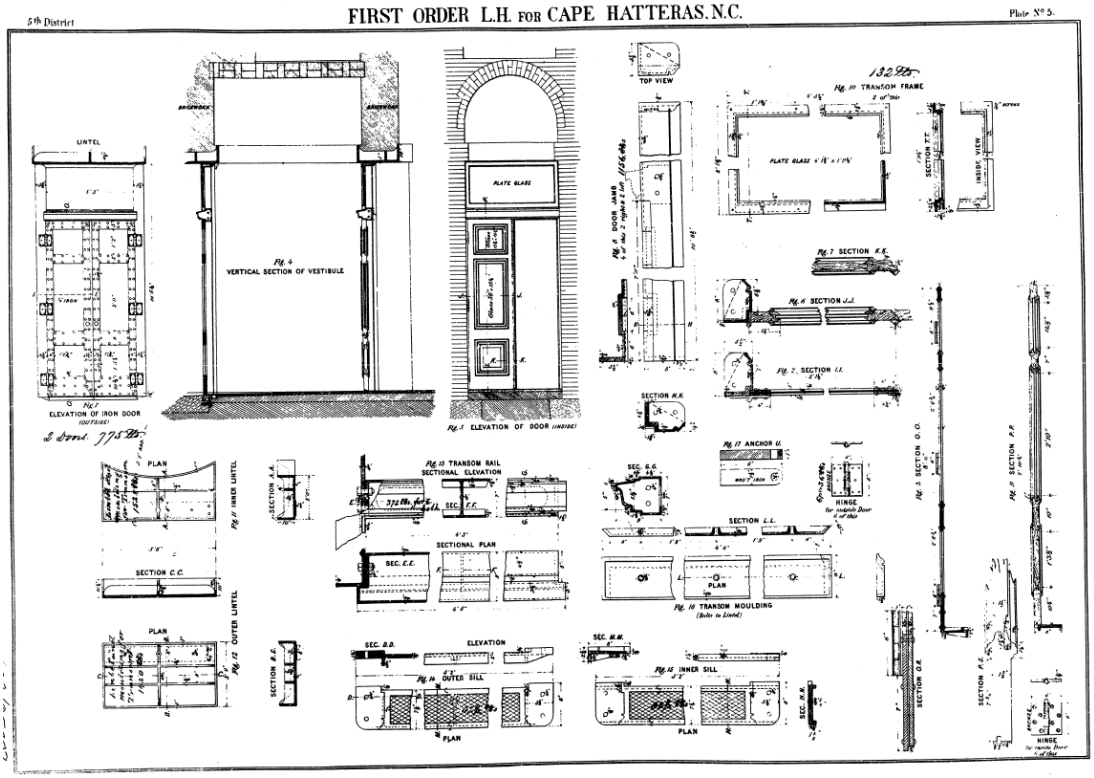


Figure 238. The original drawings for the front entrance. Both the outer door and the inner door are detailed. Drawing: "Specifications," Plate No. 5.



Figure 239. The exterior of the outer doors. The transom above the original bronze doors has been replaced. Photo: HPTC, 06/18/15.



Figure 240. The inner doors are missing from their opening, as is the original transom. Photo: HPTC, 06/17/15.

Gallery Level

The gallery level exterior door opening is located on the south elevation. The opening also has two doorways, though at this level the doorways use the same jamb (fig. 241).

The two-panel metal outer door is extant (fig. 242). It measures "1'-11" wide by 6'-11" tall by 1½" thick and is set in a cast iron paneled surround [fig. 243]. The door has three four-knuckle hinges that measure 4" by 3". The cast iron threshold is 1'-9" deep and 2'-0" wide"[22] (fig. 244).

Originally, an inner door was located at this opening. The original drawings show a 4-lite, 2-panel wood inner door. The current location of the door is unknown.

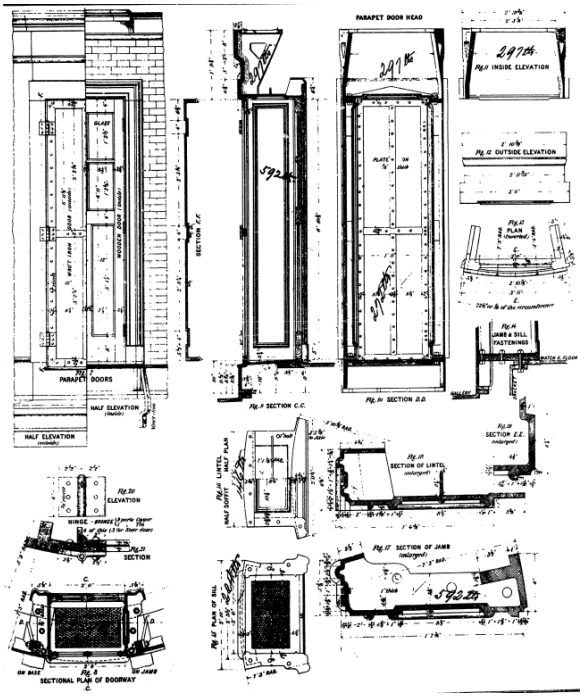


Figure 241. The original drawings for the inner and outer Watch Room doors. Drawing: "Specifications," Plate No. 14. Cropped by author.



Figure 242. The outer door of the Watch Room is extant. Photo: HPTC, 06/17/15.



Figure 243. The decorative jamb at the Watch Room door opening from the exterior. Photo: HPTC, 06/17/15.



Figure 244. The decorative sill at the Watch Room door opening from the exterior. Photo: HPTC, 06/17/15.

[22] JKO/BPE, "Cape Hatteras Lighthouse," p. 12.

B30	ROOFING
B3010	Roof Coverings

The roof was inaccessible for assessment. Therefore, a physical description of it is unknown.

Regarding the roof covering, the original specifications state:

> The roof must be covered with sheet copper, $^{1}/_{8}$ of an inch thick, weighing about five and a half (5½) pounds per square foot. It will be laid on in sixteen equal segments, with standing lock-joints. The roof-plates must have their lock-joints all prepared…, and tinned for soldering before they leave the workshop, so that they may be lowered into their places at the light-house; the joints will then only require bending down and soldering….

C	INTERIORS
C10	INTERIOR CONSTRUCTION
C1020	Interior Doors

A single interior door is located on the ninth level (Service Room). It allows access to the enclosed stairway up to the Watch Room level (figs. 245-46). The doorway "has a four-panel iron door formed by a horizontal and vertical bar. The door measures 2'-5" wide by 7'-0" tall and has three four-knuckle hinges that are 6" by 6"."[23]

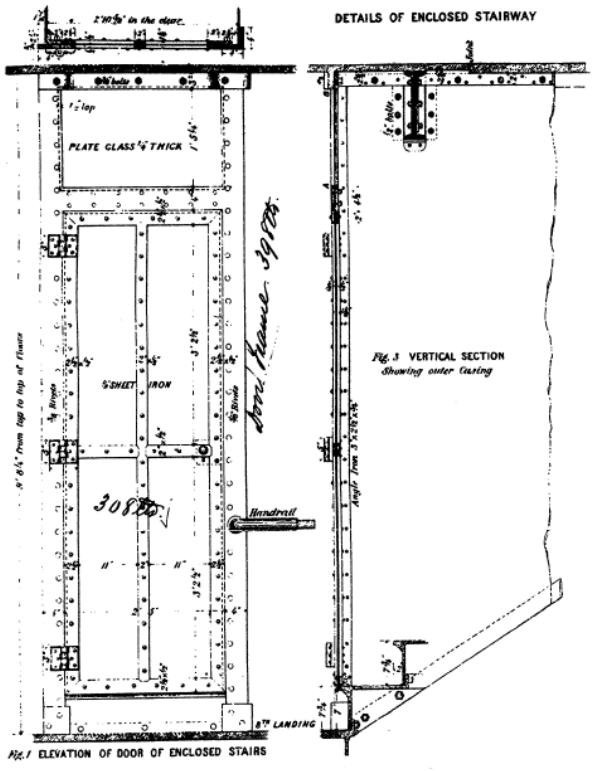


Figure 245. The original drawings for the Service Room interior door. Drawing: "Specifications," Plate No. 11. Cropped by author.



Figure 246. The historic service room interior door. Photo: HPTC, 06/17/15.

[23] JKO/BPE, "Cape Hatteras Lighthouse," p. 15.

Niche Benches & Oil-Storage Tank

Each of the three niches on the first level has two painted brick benches on either side (fig. 247). The low benches are capped with painted metal. The benches originally supported metal oil-storage tanks. Only one of these tanks is still extant; it is located in the south niche (fig. 248).



Figure 247. The west niche with historic brick oil-storage tank supports capped with metal. Photo: HPTC, 06/17/15.



Figure 248. The south niche replete with brick benches and an oil-storage tank. Photo: HPTC, 06/17/15.

Weight Well

A weight well is located in the center of the floor on the first level. The well, measuring 3'-0" in diameter 4'-0" deep from the surface of the floor, was originally used as part of the weight system for the original lens (fig. 249). The well is surrounded by a painted iron railing system. Attached to the historic railing system, via zip ties, is modern flexible fence. A painted metal screen covers the top of the well (fig. 250).

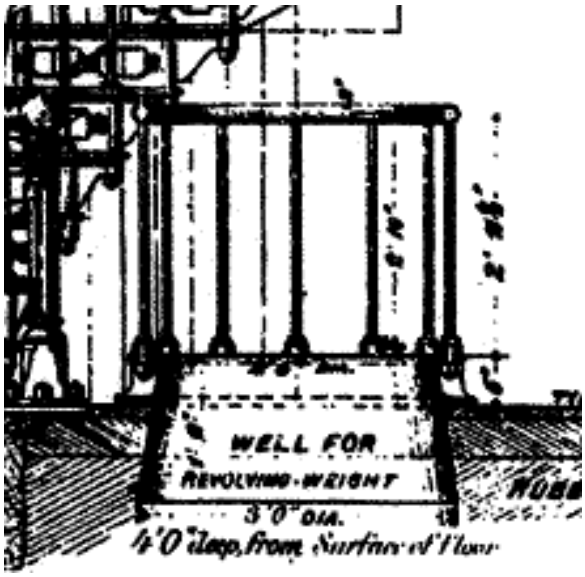


Figure 249. An original drawing showing the weight well. Drawing: "Specifications," Plate No. 7. Cropped by author.



Figure 250. The weight well has been covered with modern fencing. Photo: HPTC, 06/17/15.

Lens

The original lens was removed most recently in ca. 1949. The pedestal and clockwork for the lens were removed in 2006. It is assumed that at that time the wood railing was installed at the Watch Room level over the whole in the floor (fig. 251). The extant lens was installed in the 1970s (fig. 252).



Figure 251, left. A wood railing is located where the lens once stood. Photo: HPTC, 06/17/15.



Figure 252, above. The current lighthouse lens was installed in the 1970s. Photo: HPTC, 06/17/15.

C20	STAIRS
C2010	Stair Construction
C201001	Interior Stair Construction

Main Stair (First Level to Ninth Level)

Access through the interior of the lighthouse tower is accomplished via a circular painted iron staircase (figs. 253-54). "The iron staircase is constructed of a limited number of elements including a riser/tread, outside bracket and stringer, baluster and rail."

The outside stringer is held approximately 0'-1" away from the masonry wall (fig. 255). It is supported at the landings, at the top and bottom, and along the wall at the third points via brackets imbedded into the masonry wall (fig. 256). The pieces which comprise the outside stringer are bolted together at the imbedded brackets.

The tread/risers (3/4" thick and 2'-9-½" wide) are bolted (two bolts to the tread, one bolt to the riser) to the outside stringer via brackets and flanges on the stringer (fig. 257).

There is no identified inside stringer. A bracketed end is located on the inside of the tread/riser (fig. 258). The inner spiral portion is connected together "by the baluster that runs through the [bracketed end of the]…tread/riser to a nut at the bottom. Additional support for the tread is provided by a cast [L-bracket at]…the back side of the tread that is bolted to the next riser."

The top tread plate and bottom tread plate for the next portion are bolted to the top flange of the I-beam supporting the landing (figs. 259-60). "An iron nosing for each landing is attached to the top flange of the I-beam supporting the landing. The balusters along the edge of the landing run through the nosing and I-beam, and are fastened below"[24]

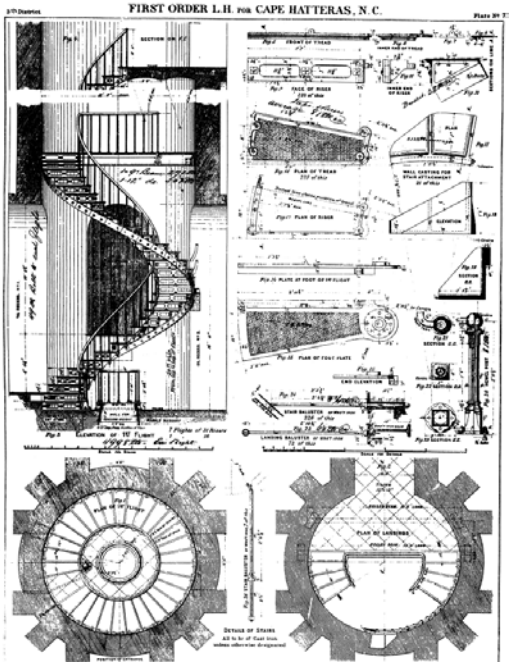


Figure 253. Original drawings detailing the stairs. Drawing: "Specifications," Plate No. 7.



Figure 254. The spiral stair runs from the first level to the eighth level. Photo: HPTC, 06/17/15.

[24] HHA/WJE. "Comprehensive Structural Analysis Report." p. 66.

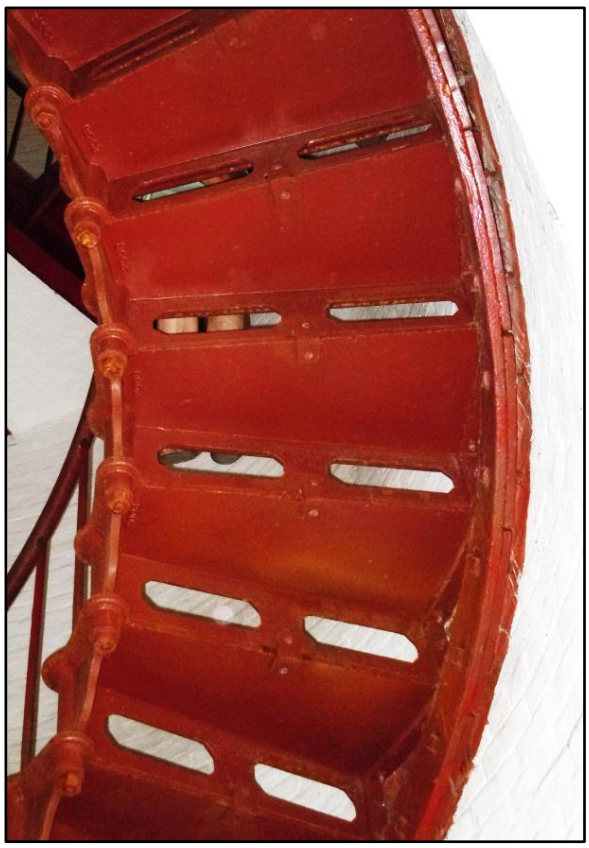




Figure 256. The outside stringer is supported at the wall by metal brackets embedded into the wall at the third point of each flight. The tread/risers are bolted to the stringer. Photo: HPTC, 06/17/15.

Figure 255, left. The outside stringer is held approximately 1" from the wall. Photo: HPTC, 06/17/15.

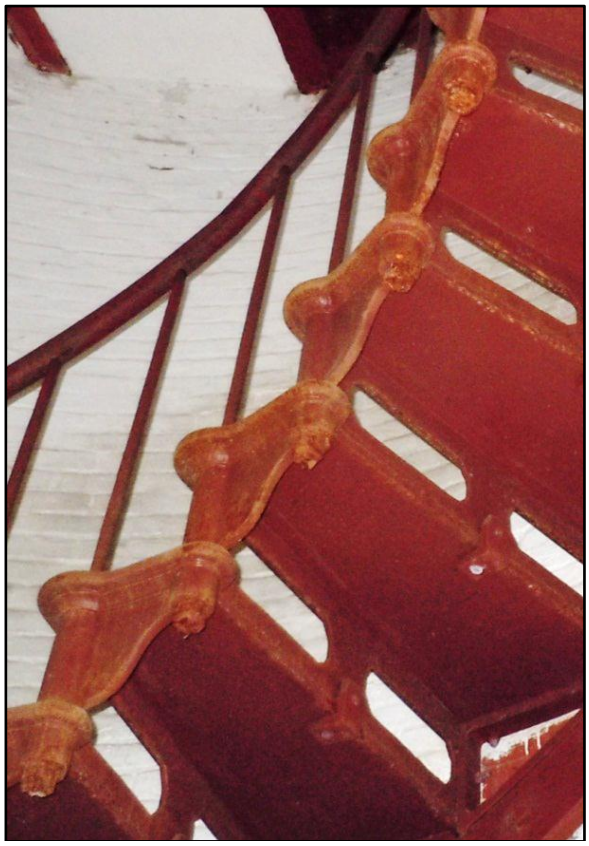




Figure 258. The top tread of the stair below the landing is bolted to the end I-beam as is a nosing through which the balusters run. Photo: HPTC, 06/17/15.

Figure 257, left. Brackets are located on the ends of the tread/risers. Balusters run from the handrail down through the brackets, and are secured with a nut at the bottom. Note the L-bracket used to tie the tread to the riser above. Photo: HPTC, 06/17/15.



Figure 259. The bottom tread of the stair above the landing is bolted to the end I-beam as is a nosing through which the balusters run. Photo: HPTC, 06/17/15.



Figure 260, left. The tread and nosing are bolted to the end I-beam supporting the floor deck. Photo: HPTC, 06/17/15.

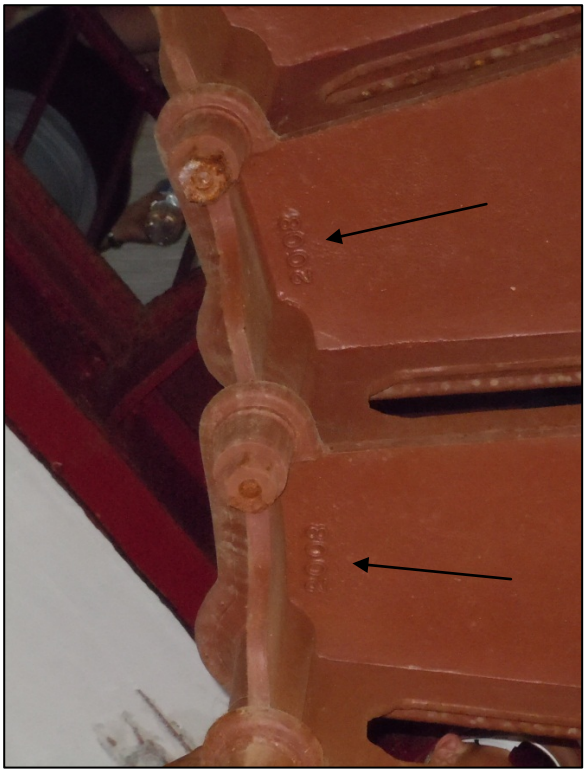


Figure 261, above. Both of these treads are marked 2008 on their underside. Some are also marked 2002. Photo: HPTC, 06/17/15.

It should be noted that most of the tread/risers have been replaced in either 2002 or 2008. Those that have been replaced are marked with the year on the underside of the tread (fig. 261). The following charts show which treads have been replaced and when they were replaced.

First to Second Level					
1	Historic	11	2002	21	2002?
2	Historic	12	Historic	22	2002?
3	2002	13	2002	23	2002?
4	2002	14	Historic	24	2002?
5	2002	15	Historic	25	2002?
6	2002	16	Historic	26	2002?
7	2002	17	Historic	27	2002?
8	2002	18	Historic	28	2002?
9	2002	19	Historic	29	2002?
10	2002	20	2002?	30	2002?
				31	2002?

Second to Third Level					
1	2008	11	2008	21	2008
2	2008	12	2008	22	2008
3	2008	13	2008	23	2008
4	2008	14	2008	24	2008
5	2008	15	2008	25	2008
6	2008	16	2008	26	2008
7	2008	17	2008	27	2008
8	2008	18	2008	28	2008
9	2008	19	2008	29	2008
10	2008	20	2008	30	2008

Third to Fourth Level					
1	2008	11	2008	21	2008
2	2008	12	2008	22	2008
3	2008	13	2008	23	2008
4	2008	14	2008	24	2008
5	2008	15	2008	25	2008
6	2008	16	2008	26	2008
7	2008	17	2008	27	2008
8	2008	18	2008	28	2008
9	2008	19	2008	29	2008
10	2008	20	2008	30	2008

Fourth to Fifth Level					
1	2008	11	2008	21	2008
2	2008	12	2008	22	2008
3	2008	13	2008	23	2008
4	2008	14	2008	24	2008
5	2008	15	2008	25	2008
6	2008	16	2008	26	2008
7	2008	17	2008	27	2008
8	2008	18	2008	28	2008
9	2008	19	2008	29	2008
10	2008	20	2008	30	2008

Fifth Level to Sixth Level					
1	2008	11	2008	21	2008
2	Historic	12	2008	22	2008
3	2008	13	2008	23	Historic
4	2008	14	2008	24	2008
5	2008	15	2008	25	2008
6	Historic	16	2008	26	2008
7	2008	17	Historic	27	2008
8	2008	18	2008	28	2008
9	Historic	19	2008	29	2008
10	2008	20	2008	30	Historic

Sixth to Seventh Level					
1	2008	11	2008	21	2008
2	2008	12	2008	22	2008
3	2008	13	2008	23	2008
4	2008	14	2008	24	2008
5	2008	15	2008	25	2008
6	2008	16	2008	26	2008
7	2008	17	2008	27	2008
8	2008	18	2008	28	2008
9	2008	19	2008	29	2008
10	2008	20	2008	30	2008

Seventh to Eighth Level					
1	2008	11	2008	21	2008
2	2008	12	2008	22	2008
3	2008	13	2008	23	2008
4	2008	14	2008	24	2008
5	2008	15	2008	25	2008
6	2008	16	2008	26	2008
7	2008	17	2008	27	2008
8	2008	18	2008	28	2008
9	2008	19	2008	29	2008
10	2008	20	2008	30	2008

Eighth to Ninth Level					
1	2008	6	2008	11	2008
2	2008	7	2008	12	2008
3	2008	8	2008	13	Historic
4	2008	9	2008	14	2008
5	2008	10	2008	15	2008

Enclosed stair (Ninth Level to Tenth Level)

The stair located between the ninth and tenth level is enclosed with curved metal wall panels which follow the curved stair. The panels measure 3'-6" wide by 9'-0" tall. These stairs are framed in much the same way as those below (fig. 262); however on the inside, instead of being connected via the balusters, the enclosed stair treads/risers are bolted through a metal strip at the bottom of the inner wall (figs. 263-64). The wall enclosure is also fastened to the bottom of the floor above.

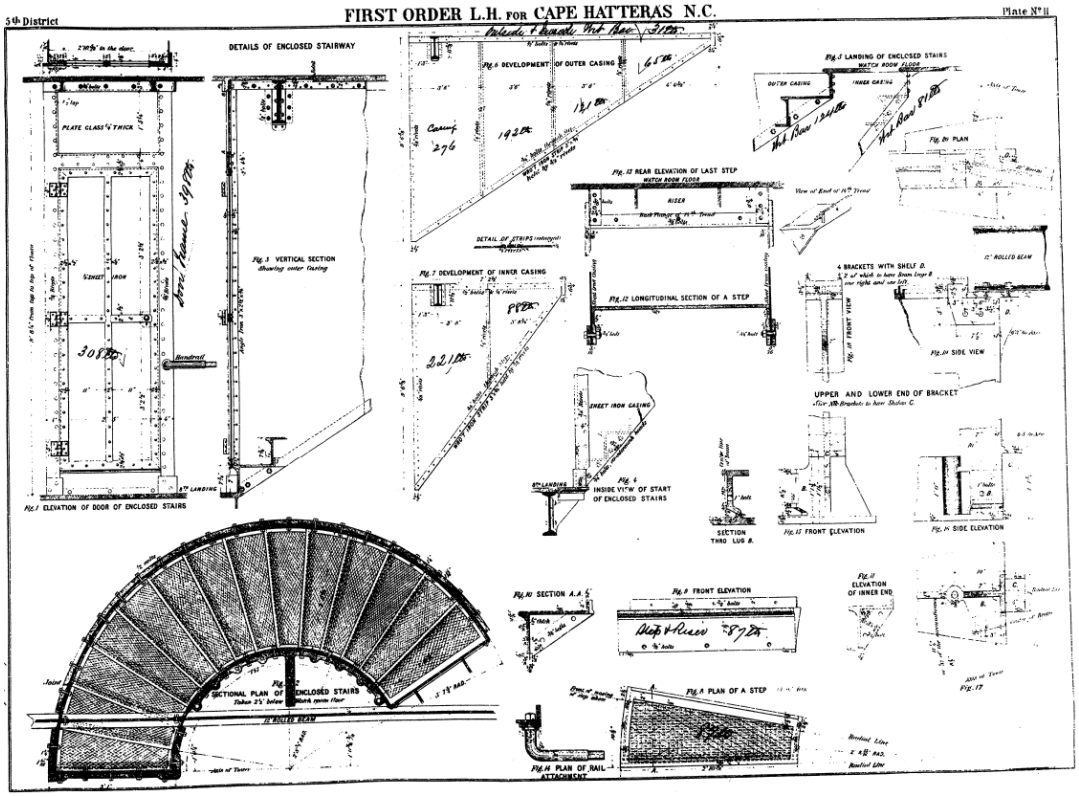


Figure 262. Original drawings detailing the enclosed stairs from the eighth floor to the ninth floor. Drawing: "Specifications," Plate No. 11.



Figure 263. The underside of the enclosed stairs shows that the outside of the run is supported by a stringer at the wall. Photo: HPTC, 06/17/15.



Figure 264. The inside of the run is bolted through a strap at the bottom of the wall enclosure. Photo: HPTC, 06/17/15.

Ladder (Tenth Level to Lantern)

The following description of the ladder was provided in the 2014 JKO report:

> The staircase to the lantern above is a curving ladder made of iron that measures 1'-11½" wide. The ladder is attached to the Watch Room landing and the lantern gallery above; it is not attached to the wall. The ladder has eleven ½"-thick treads that measure 4½" on the inside and 6¼" on the outside of the curve. The treads are bolted with two ½" bolts per side to the vertical flange. The ladder risers measure 9 ¼" tall. There is a square platform bolted to the side of the flange at the eighth tread used for carrying lamp oil to the lantern above. The ladder and platform have a grey paint finish" (figs. 265-66).[25]

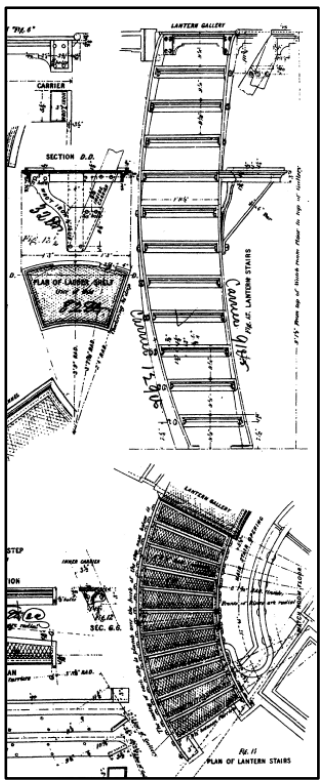


Figure 265. Original drawings detailing the stairs from the Watch Room to the Lantern above. Drawing: "Specifications," Plate No. 16. Cropped by author.



Figure 266. A view down the ladder stair from the lantern. Photo: HPTC, 06/17/15.

[25] JKO/BPE, "Cape Hatteras Lighthouse," pp. 16-17

The original specifications for the entrance stair and stoop state (fig. 267):

> The stoop at the tower entrance is constructed of granite, and consists of seven steps, a platform, and a sill, all of 8 inches rise; the steps are 11 inches tread, the platform 2 feet 9 inches wide, and the sill 5 feet entrance all the stone forming the stoop lap upon each other 3 inches, …and are confined between two cheeks or buttresses, which are cut with rests for the ends of the steps and platform…. Each cheek is built of blocks, in four courses, 16 inches high, and capped with a coping 10 inches thick at the middle, and sloping to 8 inches at the sides. The coping is 2 feet wide, the cheeks 20 inches thick, and the base 26 inches thick.
>
> All the steps, as well as the platform, are cut with ¼ of an inch droop to the front edge. The sill will have about 1¼ inches fall outward, but its sides will be worked with a level bearing to take the granite jamb of doorway.
>
> A foundation of rubble masonry, resting upon a continuation of the timber platform, …will support the stoop, and be built up to form a bed under each step.
>
> The under side of the sill must not touch the foundation, but be supported solely at the sides of the doorway, resting upon the plinth stones prepared for its reception.

Contrary to the original specifications, the exterior is actually composed of nine treads.

The sill was removed prior to the lighthouse move. After the move, the exterior stair was reconstructed in nearly the same manner as originally built (fig. 268). The only alteration occurred in the new foundation. The new foundation was constructed of load-bearing brick masonry (figs. 269-70).

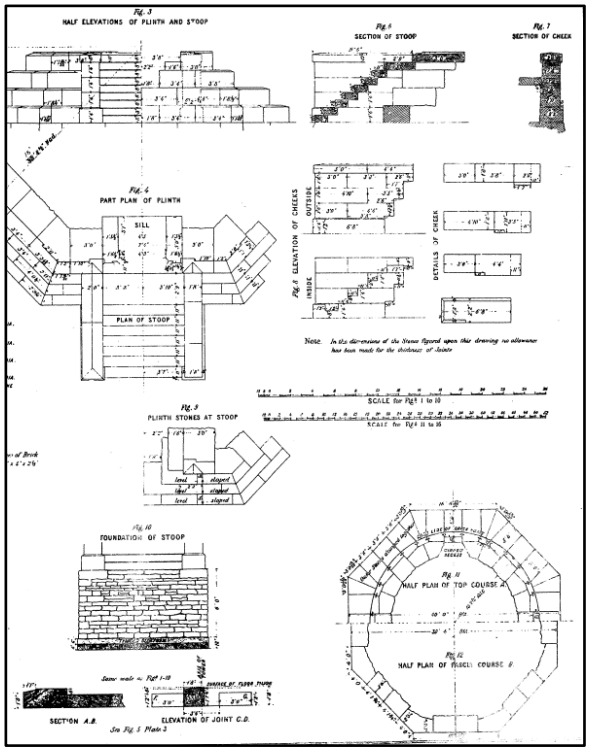


Figure 267, left. Original drawings for the exterior stair. Drawing: "Specifications," Plate No. 4. Cropped by author.



Figure 268, above. The exterior stair as it is today, after reconstruction. Photo: HPTC, 06/17/15.





Figure 270, above. The granite of the front stair is reinstalled on the new brick foundation after the lighthouse's move. Cape Hatteras National Seashore Archives, 10/12/99

Figure 269, left. The brick foundation for the front stair is in place after the lighthouse's move. Photo: Cape Hatteras National Seashore Archives, 09/27/99.

C30	INTERIOR FINISHES
C3020	Floor Finishes

First Level through Eighth Level

The first-level floor slab and the floor decks of levels two through eight are covered with square marble and what probably is soapstone tiles. The original specifications state the following about the tiling:

> The floors of the vestibule and stair well, and the arched landings, will be covered with black and white tiles, 12 inches square and 1 inch thick, thoroughly bedded in cement, spread upon a thin layer of concrete, which fills up to within about 1½ inch of the top of plinth in the spaces where the tiling is to be laid; joints between tiles to be of cement. . . .
>
> The floors of the recesses will be paved with brick, laid in cement, except for a few inches under the front of the tank in recess No. 3, to which point the tiling of the tower floor will extend. [26]

The floor tiling has been retained on every level (figs. 271-72).

[26] "Specifications," pp. 12-13.

Ninth Level through Eleventh Level

The floor decks, galleries, and balconies of the ninth through eleventh level are composed of metal plates. For more information on these systems, refer to B101003 Floor Decks and Slabs and B101004 Balcony Construction.



Figure 271. Original floor tiling at the first level. Photo: HPTC, 06/17/15.



Figure 272. Original floor tiling in the window niche of the second level. Photo: HPTC, 06/17/15.

D	SERVICES
D20	PLUMBING

No plumbing system is extant within the lighthouse.

D	SERVICES
D30	HVAC

No HVAC system is extant within the lighthouse.

D40	FIRE PROTECTION SYSTEMS

No Fire Protection Systems (sprinklers, fire extinguishing devices, smoke/heat detection devices, etc.) are extant within the lighthouse.

D50	ELECTRICAL

According to HABS documentation, electricity was first installed and used in the lighthouse in 1934 when the original lens was equipped with an automatic light powered by electricity.

According the JKO's 2014 report, the…

> …electrical service to the lighthouse runs underground, up the granite entrance door trim, and through the transom above the door. The electrical wiring runs in modern ¾"rigid non-metallic schedule 40 conduit manufactured by Cantex. This conduit runs along the ceiling inside the entryway and at the west niche over to the center of the staircase. Double steel rails run vertically through the center of the lighthouse between landings and support the two conduits running to the top of the tower [fig. 273]. A 220 amp electrical box is mounted on the wall at the tenth level, or Watch Room [fig. 274]. A modern metal lamp base with jelly jar and metal cage is mounted above the electrical box along with a switch and duplex outlet."[27]



Figure 273. Conduit travels up the rail to power the lighthouse lens. One conduit likely houses the lightning protection system. Photo: HPTC, 06/17/15.



Figure 274. An electrical panel is located at the top of the lighthouse. Photo: HPTC, 06/17/15.

D5030	COMMUNICATIONS & SECURITY

No Communications & Security Systems (fire alarm system, security system, etc.) are extant within the lighthouse.

[27] JKO/BPE, "Cape Hatteras Lighthouse," pp. 8-9.

D5090	OTHER ELECTRICAL SYSTEMS
D509004	Lightning Protection System

A lightning protection system was first added to the lighthouse in 1879, after it was struck by lightning. At that time a metal rod was added to connect the iron work of the tower to an iron disk sunk into the ground. Portions of this system, including a lead-encased grounding rod" were found during the removal of the original foundation.

A new lightning protection system was added to the lighthouse after its move in 1999. The complete details of the new system are not known. It is assumed that the lightning rod at the center of the lighthouse's roof is connected all of the other exterior metal components and grounds on the interior of the lighthouse (through conduit attached to the center track) through to the foundation (figs. 275-76).



Figure 275. Conduit travels the length of the rail. One conduit likely houses the lightning protection system. Photo: HPTC, 06/17/15.



Figure 276, right. The conduit that runs down through the west niche and through the floor likely houses the ground for the lightning protection system. Photo: HPTC, 06/17/15.

G	BUILDING SITEWORK
G20	SITE IMPROVEMENTS
G2040	Site Development

Walkways

The original brick walkway leading to the front entrance of the lighthouse was removed in large pieces prior to the lighthouse's move. During Phase II of the light station relocation, the brick walk was reconstructed with new brick.

Fences

The original decorative cast iron fence was removed in ca. 1920. The replacement fence was then installed over the original granite base stones. This replacement fence was removed in ca. 1949, though the original granite base stones remained. Prior to the lighthouse's move the base stones were documented and removed. They were not re-installed after the move. In 2001, the current vinyl fence was installed around the perimeter of the lighthouse (fig. 277).



Figure 277. A brick walkway leads to the front entrance of the lighthouse. A modern vinyl fence is located around the lighthouse site. Photo: HPTC, 06/18/15.

G90	OTHER SITE WORK
G9087	Overall Building Site Drainage

The site was re-graded after the lighthouse's move. The lighthouse now sits atop a slight mound, creating a swale (see fig. 277).

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Character-Defining Features

Each historic building is unique, with its own identity and its own distinctive character. Character refers to the visual aspects and physical features that comprise the appearance of historic buildings. Character-defining features include the overall shape of the building, its materials, craftsmanship, decorative details, interior spaces and features, as well as the various aspects of its site and environment. Identifying and preserving a building's character-defining features is essential.

A character-defining feature (CDF) is defined in Director's Order 28, *Cultural Resources Management Guidelines*, (Appendix A: Glossary) as:

> A prominent or distinctive aspect, quality, or characteristic of a historic property that contributes significantly to its physical character. Structures, objects, vegetation, spatial relationships, view, furnishings, decorative details, and materials may be such features.

In order to ascertain the important aspects of a building for future reference and analysis, character-defining features must be recorded. These are prominent or distinctive aspects, qualities, and characteristics of a historic property that contribute significantly to its physical character as represented at the time of intervention or treatment.

The process used in this assessment for determining the character-defining features was adapted from the NPS Preservation Brief #17: "Architectural Character: Identifying the Visual Aspects of Historic Buildings as an Aid to Preserving Their Character," and are in accordance with *The Secretary of the Interior's Standards for the Treatment of Historic Properties* and NPS Management Policies and Guidelines, specifically Director's Order 28, *Cultural Resource Management Guidelines*.

Preservation Brief #17 divides the assessment of character-defining features into three steps:

1. Identify the Overall Visual Aspects,
2. Identify the Visual Character at Close Range,
3. Identify the Visual Character of Interior Spaces, Features, and Finishes.

The purpose of Preservation Brief #17 is to help the owner or the architect identify those features or elements that give the building its visual character and that should be taken into account in order to preserve them to the maximum extent possible. The Brief states:

> There are different ways of understanding old buildings. They can be seen as examples of specific building types, which are usually related to a building's function…. Buildings can be studied as examples of using specific materials….They can also be considered as examples of an historical period, which is often related to a specific architectural style….
>
> There are many other facets of an historic building besides its functional type, its materials, or construction or style that contribute to its historic qualities or significance. Some of these qualities are feelings conveyed by the sense of time and place or in buildings associated with events or people. A complete understanding of any property may require documentary research about its style, construction, function, its furnishings or contents; knowledge about the original builder, owners, and later occupants; and knowledge about the evolutionary history of the building. Even though buildings may be of historic, rather than architectural significance, it is their tangible elements that embody its significance for association with specific events or

persons and it is those *tangible elements* both on the exterior and interior that should be preserved.

Therefore, the approach taken in this Brief is limited to identifying those visual and tangible aspects of the historic building. While this may aid in the planning process for carrying out any ongoing or new use or restoration of the building, this approach is not a substitute for developing an understanding about the significance of an historic building and the district in which it is located.

If the various materials, features, and spaces that give a building its visual character are not recognized and preserved, then essential aspects of its character may be damaged in the process of change.

A building's character can be irreversibly damaged or changed in many ways, for example, by inappropriate repointing of the brickwork, by removal of a distinctive side porch, by changes to the window sash, by changes to the setting around the building, by changes to the major room arrangements, by the introduction of an atrium, by painting previously unpainted woodwork, etc.

In summary, the Secretary of the Interior's Standards for the Treatment of Historic Properties embody two important goals:

1. Preservation of historic materials.
2. Preservation of a building's distinguishing character.

By succeeding at these two goals, it is likely that a building's historic integrity will be preserved.

Extant Character-Defining Features (to be retained)

Overall Visual Aspects

Shape and Mass

- Shape and mass of a tall, conical lighthouse tower with heavy raised plinth and base, battered tower, and gallery and lantern at the top (fig. 278).

Roof and Related Features

- Shallow conical roof, clad with painted metal, with ventilator and lightning rod.

Openings

- Original pronounced front entrance surround with stair (transom is not original and not a character-defining feature) (fig. 279).
- Seven original window openings in the tower: three on the north elevation, four on the south elevation (see fig. 278).
- Three original window openings at the ninth level (Watch Room) at southwest, southeast, and northeast.
- Original door opening at gallery level (tenth floor).

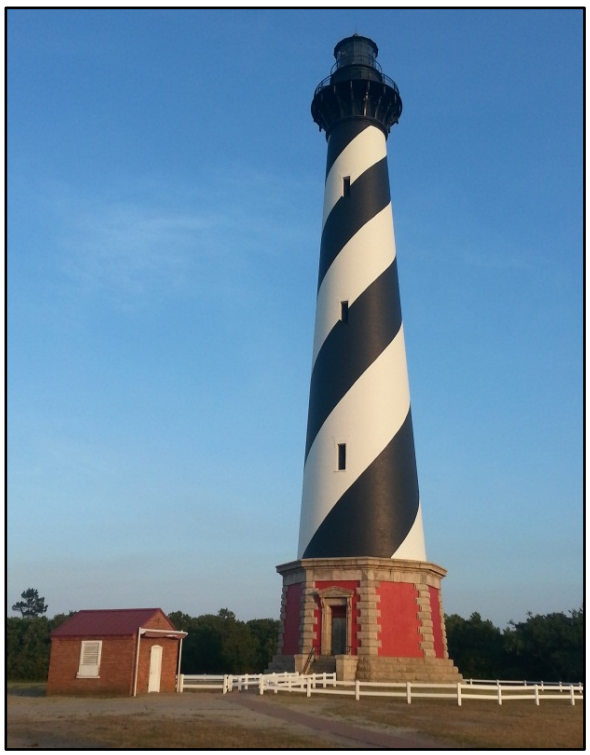


Figure 278. North elevation of the Cape Hatteras Lighthouse. Note four of the original tower windows on this elevation; they lack their original window hoods. Photo: HPTC, 06/18/15.



Figure 279. The original front door opening with original bronze door. Photo: HPTC, 06/18/15.

Trim and Secondary Features

- Skilled use of granite masonry at plinth, base quoins, cornice, and front entrance (fig. 280).
- Skilled use of cast iron elements at gallery level, including brackets, decorative panels, plate deck, metal railing, etc. (figs. 281-82).
- Use of glass and cast iron at the lantern level and roof level, including plate deck, and roof structure, etc. (handrail has been replaced and is not character defining). (fig. 283)

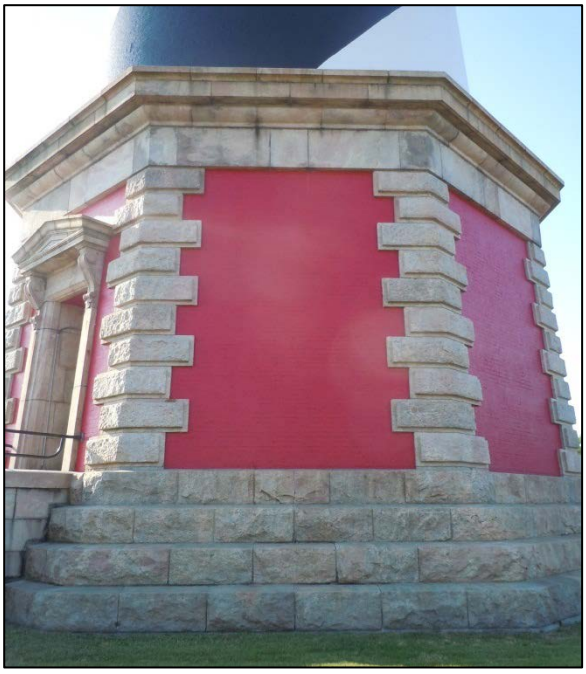


Figure 280. The base is adorned with a granite plinth, quoins, and cornice. Photo: HPTC, 06/17/15.



Figure 281. The gallery is adorned with decorative cast iron elements, including brackets. Photo: HPTC, 06/17/15.

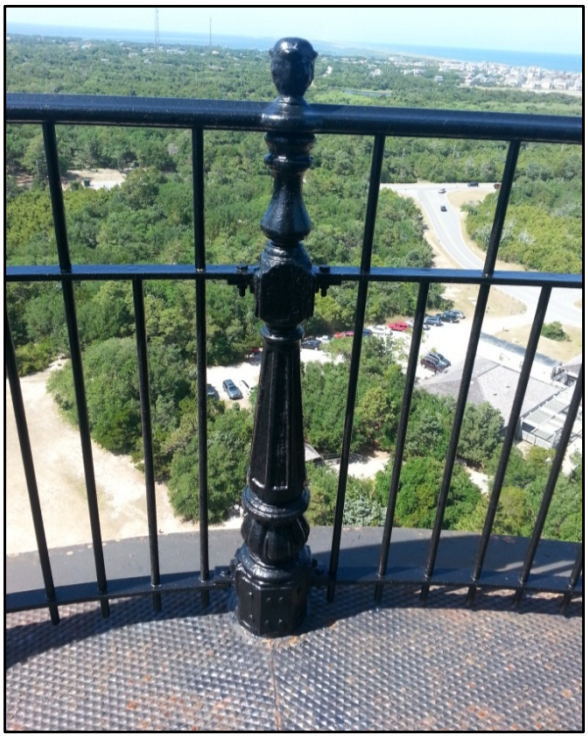


Figure 282, left. A cast iron post on the gallery deck with rail on either side. Photo: HPTC, 06/17/15.



Figure 283, above. The glass and cast iron lantern is surrounded by a cast iron balcony and handrail. The handrail has been replaced and is no longer a character-defining feature. Photo: HPTC, 06/16/15.



Figure 284. The lighthouse was moved 2,900 feet in 1999. The move corridor is extant. The lighthouse retains its coastal setting. Photo: HPTC, 06/16/15.



Figure 285. Following the move, the lighthouse maintained its spatial relationship to the three other buildings at the light station. Photo: HPTC, 06/16/15.

Setting

- Coastal location (fig. 284).
- Moved 2,900'-0" in 1999; move corridor is still present (see fig. 284).
- Relationship to oil house, double keepers' quarters, and principal keeper's quarters (fig. 285).

Character, Materials & Craft Details at Close Range

- Granite features of the base (figs. 286-88).
- Brick exterior walls: painted red at base; painted with white and black spiral on the tower (fig. 289).
- Ironwork at the exterior gallery (see fig. 281).



Figure 286. The granite plinth. Photo: HPTC, 06/17/15.



Figure 287, right. The granite cornice. Photo: HPTC, 06/17/15.



Figure 288. Granite quoins and brick wall of the base. Photo: HPTC, 06/17/15.



Figure 289. The painted brick exterior wall of the lighthouse tower. Photo: HPTC, 06/17/15.

Interior Visual Character

Individual Spaces, Related Spaces & Sequence of Spaces

- Retention of major landing configurations, joined by central spiral stair (fig. 290).
- First Level entrance with oil room niches and entrance vestibule (fig. 291).
- Second Level through Eighth Level with semi-circular landing occupying half of area, opposing sides of tower for each landing (fig. 292).
- Ninth Level (Service Room) with enclosed stair to Tenth Level (Watch Room) (fig. 293).
- Tenth Level (Watch Room) with ladder to Eleventh Level (Lantern) (figs. 294-95).



Figure 290. The character-defining central spiral stair connects all of the levels from the ground to the Watch Room (Tenth) Level. Photo: HPTC, 06/17/15.



Figure 291. From the entrance vestibule looking into first level. One of the oil niches can be seen behind the central spiral stair. Photo: HPTC, 06/17/15.



Figure 292. One of the character-defining semi-circular landings in the lighthouse accessed by the central spiral stair. Photo: HPTC, 06/17/15.



Figure 293, right. The original enclosed stair between the Ninth and Tenth Levels. Photo: HPTC, 06/17/15.



Figure 294. The original ladder from the Tenth Level to the Lantern. Photo: HPTC, 06/17/15.



Figure 295. The Lantern as seen from the Tenth Level below. Photo: HPTC, 06/17/15.

Interior Features

- Brick walls (fig. 296)
- Individual Landings (see fig. 296)
- Central spiral stair (fig. 297)
- Weight Well (plastic fence is not character defining) (fig. 298)
- Three arched oil tank niches, with one extant oil tank (fig. 299)
- Arched window niches, one at each level (2-8) (fig. 300)
- Service Room with enclosed stair and three windows (see fig. 293, fig. 301)
- Watch Room with ladder to Lantern (see fig. 294)
- Lantern (see fig. 295)

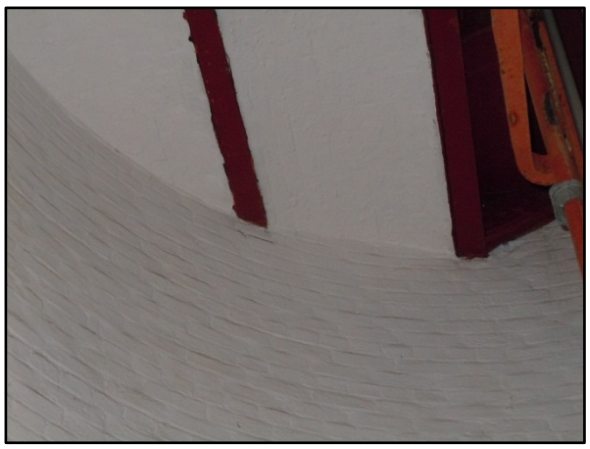


Figure 296. The interior walls are constructed of brick. The individual floor level landings are integrated into the walls. Photo: HPTC, 06/17/15.



Figure 297, right. The central spiral stair, as seen from the First Level. Photo: HPTC, 06/17/15.



Figure 298. The weight well is original to the lighthouse. The plastic fence is not a CDF. Photo: HPTC, 06/17/15.



Figure 299. One of the three oil tank niches on the First Level. This one retains its oil tank. Photo: HPTC, 06/17/15.



Figure 300. One of the arched window niches. This one is on the Third Level. Photo: HPTC, 06/17/15.



Figure 301. One of the three fixed window openings in the Service Room (Ninth Level). Photo: HPTC, 06/17/15.

Surface Materials and Finishes

- Painted brick walls (fig. 302)
- Painted metal stair (fig. 303)
- Black and white tile floors (First through Eighth Levels) (fig. 304)
- Painted metal floors (Ninth through Eleventh Levels) (fig. 305)
- Painted metal stair enclosure at Service Room (see fig. 293)
- Painted metal ladder at Watch Room (see fig. 294)
- Painted metal interior of lantern, including roof framing (figs. 306-7)





Figure 303, above. The central spiral stair is painted, and likely was originally. Photo: HPTC, 06/17/15.

Figure 302, left. The interior surfaces of the exterior brick walls are painted throughout the entire lighthouse, and likely were originally. Photo: HPTC, 06/17/15.



Figure 304. Each floor level (1-8) is covered with original black-and-white floor tiles. Photo: HPTC, 06/17/15.



Figure 305. The Ninth Level floor is composed of original painted metal plates. Photo: HPTC, 06/17/15.

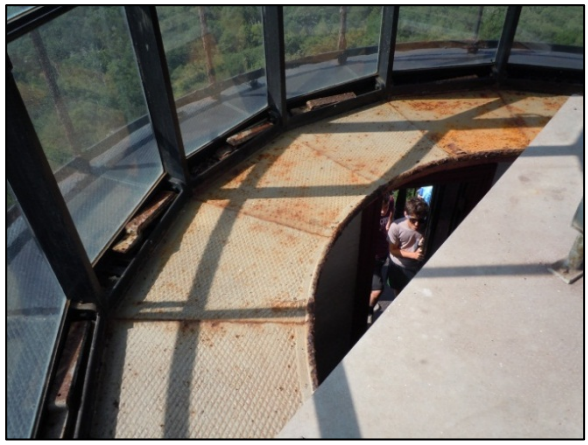


Figure 306. The Lantern has a painted metal plate balcony (interior and exterior). Photo: HPTC, 06/17/15.



Figure 307. The original painted roof framing as seen in the Lantern. Photo: HPTC, 06/17/15.

Missing Character-Defining Features
(to be reconstructed in future phases of treatment)

- Decorative cast-iron and granite fence surrounding the base of the lighthouse (fig. 308)
- First-order Fresnel lens with pedestal and clockwork (fig. 309)
- Interior wood main entrance double doors; storage location unknown (fig. 310)
- Interior metal gallery-level door; storage location unknown
- Lantern roller shades (fig. 311)
- Exterior window hoods and brackets (fig. 312)



Figure 308. The original decorative cast-iron and granite fence as seen on June 1, 1893. The cast iron portion was removed in ca. 1920. The granite portion was removed prior to the move in 1999. Neither was reconstructed at the current site. Photo: Cape Hatteras National Seashore Archives. Cropped by author.



Figure 309. The original Fresnel lens as seen with its last keeper, Unaka Jennette, in the lighthouse in April 1933. Photo: Cape Hatteras National Seashore Archives.



Figure 310. The original interior wood main entrance double doors are extant in this 1955 photograph. They were removed by 1986. Their current location is unknown. Photo: Cape Hatteras National Seashore Archives. Cropped by author.



Figure 311. Roller blinds were once used in the lantern during the day to protect the lens. Photo: Cape Hatteras National Seashore Archives. Cropped by author.



Figure 312. Each of the seven casement window openings in the tower once included cast iron hood and brackets. This photo shows one in place on November 8, 1934. The hoods were removed between July 1963 and August 1965. Photo: Harpers Ferry Center photographic archives (CAHA_WASO-H-790).

Non-Character Defining Features
(to be removed in future phases of treatment)

- Plastic fencing around Weight Well; this could be replaced with a more sympathetic material (fig. 313)
- Plastic fencing at each exterior window; this could be replaced with a more sympathetic material (fig. 314)
- Better integration of electrical conduit (figs. 315-16)
- Better integration of electrical panel (fig. 317)
- Exterior vinyl fence at base of lighthouse (fig. 318)



Figure 313. The plastic fence should be removed from around the historic and character-defining Weight Well. A more sympathetic approach/product should be used. Photo: HPTC, 06/17/15.



Figure 314. The plastic fence should be removed from each of the historic and character-defining window openings. A more sympathetic approach/product should be used. Photo: HPTC, 06/17/15.

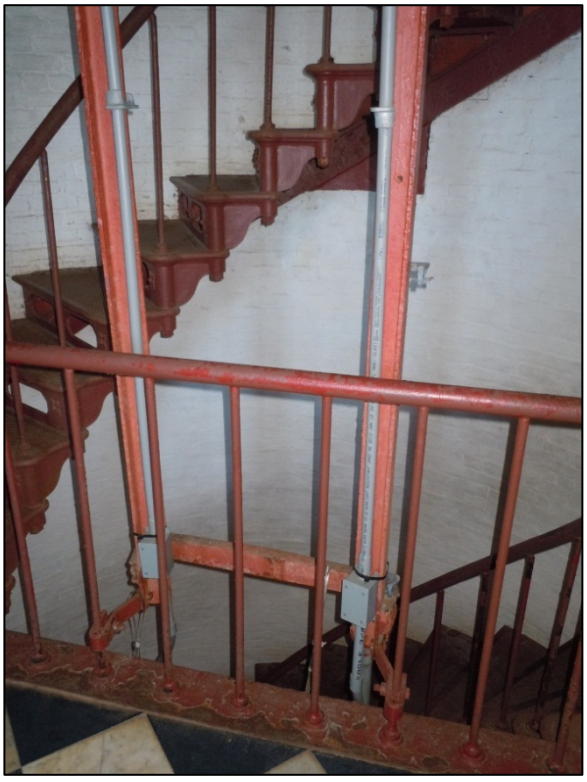


Figure 315. The modern electrical conduit blatantly stands out against the historic structure. Photo: HPTC, 06/17/15.



Figure 316. The modern electrical conduit blatantly stands out against the historic structure. Photo: HPTC, 06/18/15.





Figure 318, above. The modern vinyl fence was installed in 2001. It is not a character-defining feature. Photo: HPTC, 06/18/15.

Figure 317, left. The electrical panel at the top of the lighthouse could be made smaller and more inconspicuous. Photo: HPTC, 06/18/15.

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Condition Assessment

The conditions assessment definitions used for this HSR are based on those outlined in the NPS PFMD's Asset Management Process (AMP), the Facilities Management Software System (FMSS), and the Facility Condition Assessment Survey (FCAS) and adapted for use by HPTC. For the purpose of this report, these definitions were strictly adhered to as a way to qualitatively assess the current condition of the Cape Hatteras Lighthouse.

Qualitative Condition Ratings

Good

- Routine maintenance should be sufficient to maintain the current condition; and/or
- A cyclic maintenance or repair/rehabilitation project is not specifically required to maintain the current condition or correct deficiencies.

Fair

- The feature generally provides an adequate level of service to operations, but
- The feature requires more than routine maintenance, and
- Cyclic maintenance or repair/rehabilitation work may be required in the future.

Poor

- Feature requires immediate attention;
- Routine maintenance is need at a much higher level of effort to meet significant safety and legal requirements;
- Cyclic maintenance should be scheduled for the current year; and/or
- A special repair/rehabilitation project should be requested consistent with park requirements, priorities, and long-term management objectives.

Maintenance Deficiency Priority Ratings (10-Year Rating Period)

Minor – Short-Term/Long-Term Priority

- This rating indicates standard preventative maintenance priorities and preservation methods have not been follow; or
- There is reduced life expectancy of affected adjacent or related materials and/or systems within 5 to 10 years and beyond; or
- There is condition with a long-term impact within 5 to 10 years and beyond.

Serious – Immediate/Short-Term Priority

- This rating defines a deteriorated condition that if not corrected within 1 to 5 years will result in the failure of the feature; or
- A threat to the health and/or safety of the user may occur within 1 to 5 years if the ongoing deterioration is not corrected; or
- There is ongoing deterioration of adjacent or related materials and/or features as a result of the feature's deficiency.

Critical – Immediate Priority

- This rating defines an advanced state of deterioration which has resulted in the failure of a feature or will result in the failure of a feature if not corrected within 1 year; or
- There is accelerated deterioration of adjacent or related materials or systems as a result of the feature's deficiencies if not corrected within 1 year; or
- There is immediate threat to the health and/or safety of the user; or
- There is failure to meet a legislated requirement.

Not Rated

- The feature was not rated as it was not extant at the time of the report or is non-contributing, removed, and not planned to be replaced.

Code Compliance

Both NPS policies and federal regulations stipulate that when an historic structure is preserved and/or rehabilitated, attempts should be made to meet applicable nationally-accepted model building codes to the maximum extent feasible. Compliance with nationally-accepted codes does not automatically trigger a complete code-based upgrade. Alternative criteria exist for alterations to historic structures; these typically encourage flexibility in the literal application of the code intent.

The *Public Buildings Amendment of 1988* instructs Federal agencies to follow "to the maximum extent feasible," as determined by the administrator or head of the agency, the "…nationally recognized model building codes and other applicable nationally recognized codes such as electrical codes, and fire and life safety codes." The National Park Service intends to consult pertinent national, state, and local codes, and typically applies to most strident code requirements. The Southeast Regional Office (NPS) Structural Fire Safety leader will be the Authority Having Jurisdiction (AHJ) for final determination of code applications for these structures.

The National Park Service has prepared Design Standards for all construction projects, including those affecting historic structures.[1] The design standard presents all codes that should be reviewed and includes the most recent copies of the following major codes and applicable laws, policies, codes, directives, standards, and NPS guidelines. The design standards present requirements for accessibility, civil, and environmental engineering, landscape architecture, architecture, including

[1] Denver Service Center. "Design Standards." *Denver Service Center Workflows.* National Park Service, Department of the Interior. 2009. Accessed at http://www.nps.gov/dscw/dstandards.htm on March 6, 2012.

roofing and waterproofing, structural, mechanical, safety and fire protection, electrical, lighting, and sustainability disciplines.

Major codes, laws, standards, and guidelines that are part of the NPS Design Standards include:

- *Architectural Barriers Act Accessibility Standard* (ABAAS) for Federal Facilities, 2004
- *International Building Code* (IBC), 2009
- *International Existing Building Code* (IEBC), 2009
- *National Fire Protection Association 101* (NFPA 101), Life Safety Code
- *National Historic Preservation Act of 1966* (NHPA), amended
- *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring, and Reconstructing Historic Buildings* (36 CFR 68), 1995
- *The Secretary of the Interior's Standards for the Treatment of Historic Properties and the Guidelines for the Treatment of Cultural Landscapes*
- *The Secretary of the Interior's Standards and Guidelines for Archeological Documentation*
- *Uniform Code for Building Conservation*
- *Building Construction and Safety Code* (NFPA 5000)
- *National Fire Protection Association 70* (NFPA 70), National Electrical Code
- *Installation of Lightning Protection Systems* (NFPA 780)
- *Code for the Protection of Cultural Resource Properties* (NFPA 909)
- *Code for the Fire Protection of Historic Structures* (NFPA 914)
- *Safeguarding Construction, Alteration, and Demolition Operations* (NFPA 241)
- *Director's Order (DO) 5oB, Risk Management* (Manual 50B)
- *Director's Order (DO) 58, Structural Fire Management* (Manual 58)
- *5 U.S.C § 7902* (Safety Program)
- *15 U.S.C § 2225* (Fire Prevention and Control)
- *29 U.S.C § 668* (Occupational Safety and Health)
- *40 U.S.C § 619* (Construction, Alteration, and Acquisition of Public Buildings)

Summary of Conditions

Table 3. **Cape Hatteras Lighthouse Summary of Conditions Table**

UNIFORMAT II Outline Data			Condition Rating	Deficiency Rating
A	SUBSTRUCTURE			
A10	FOUNDATIONS			
A1010	Standard Foundations		FAIR	SERIOUS
B	SHELL			
B10	SUPERSTRUCTURE			
B1010	Floor Construction			
B101003	Floor Decks and Slabs			
	B101003-1	First Level Floor Slab	GOOD	MINOR
	B101003-2	Second thru Eighth Level Floor Decks	POOR	SERIOUS
	B101003-3	Ninth (Service Room) Level Floor Deck	POOR	CRITICAL

(Table 3 continued)

			B101003-4	Tenth (Watch Room) Level Floor Deck	POOR	CRITICAL
			B101004	Balcony Construction		
			B101004-1	Ninth (Watch Room) Level Exterior Gallery	FAIR	SERIOUS
			B101004-2	Lantern Room Interior & Exterior Balconies	FAIR	SERIOUS
		B1020	Roof Construction		FAIR	SERIOUS
	B20	EXTERIOR ENCLOSURE				
		B2010	Exterior Walls			
			B2010-1	Base	FAIR	SERIOUS
			B2010-2	Tower (2nd thru 8th Level)	FAIR	SERIOUS
			B2010-3	Ninth (Service Room) Level	FAIR	SERIOUS
			B2010-4	Tenth (Watch Room) Level	FAIR	MINOR
			B2010-5	Lantern Level	FAIR	MINOR
		B2020	Exterior Windows			
			B2020-1	Tower (2nd thru 8th Level)	POOR	CRITICAL
			B2020-2	Ninth (Service Room) Level	POOR	CRITICAL
		B2030	Exterior Doors			
			B2030-1	First Level	FAIR	MINOR
			B2030-2	Tenth (Watch Room) Level	POOR	SERIOUS
	B30	ROOFING				
		B3010	Roof Coverings		FAIR	MINOR
C	INTERIORS					
	C10	INTERIOR CONSTRUCTION				
		C1020	Interior Doors			
			C1020-1	First Level	GOOD	MINOR
			C1020-2	Ninth (Service Room) Level	FAIR	MINOR
			C1020-3	Tenth (Watch Room) Level	N/A	N/A
	C20	STAIRS				
		C2010	Stair Construction			
			C201001	Interior Stair Construction		
				C201001-1 Main Stair (2nd to 9th Levels)	FAIR	SERIOUS
				C201001-2 Ninth Level Enclosed Stair	POOR	SERIOUS
				C201001-3 Lantern Ladder	FAIR	MINOR
			C201002	Exterior Stair Construction	FAIR	MINOR
	C30	INTERIOR FINISHES				
		C3020	Floor Finishes		FAIR	MINOR
D	SERVICES					
	D20	PLUMBING			N/A	N/A
	D40	FIRE PROTECTION SYSTEMS			N/A	N/A
	D50	ELECTRICAL			GOOD	MINOR
		D5030	Communications & Security Systems		N/A	N/A
		D5090	Other Electrical Systems			
			D509004	Lightning Protection	GOOD	MINOR
G	BUILDING SITEWORK					
	G20	SITE IMPROVEMENTS				
		G2040	Site Development		GOOD	MINOR
	G90	OTHER SITE WORK				
		G9087	Overall Building Site Drainage		GOOD	MINOR

End of Table.

Cape Hatteras Condition Assessment

Note: Additional photographs of all building features are found in the physical description section.

A	SUBSTRUCTURE
A10	FOUNDATIONS
A1010	**Standard Foundations**

The condition of the sub-surface foundations is unknown; it was inaccessible for assessment by the HPTC team in June 2015. The sub-surface foundation was not accessible during the 2014 visit by Joseph K. Opperman—Architect, P.A. and Bennett Preservation Engineering PC (JKO/BPE).

The following assessment description is provided regarding the above-grade foundation, also known as the plinth.

Drawings for the preservation of the lighthouse were completed in October 1989 (work completed in 1991-93 by International Chimney Company (ICC). The drawings noted that all caulk was to be removed from the plinth, and it was to be repointed.[1]

Prior to the move in 1999, existing cracks throughout the lighthouse structure were documented in the design drawings for the move. The documentation drawings note numerous cracks, areas of spalling, and previous repairs to the plinth (fig. 319).

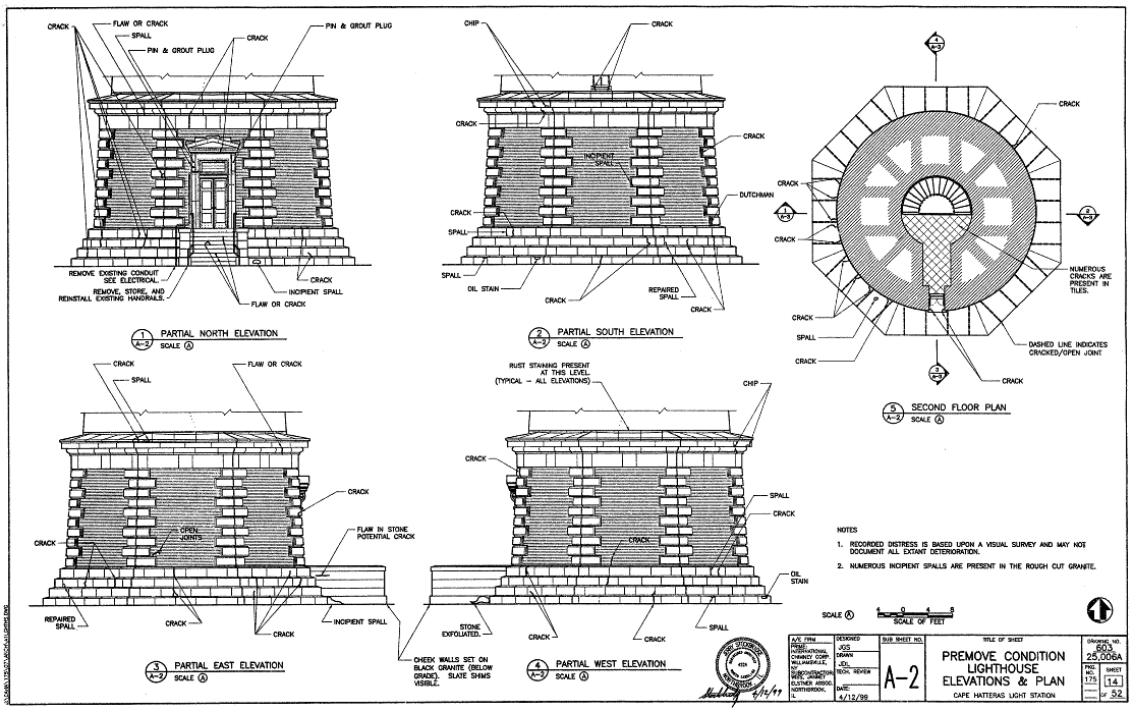


Figure 319. The pre-move condition of the lighthouse plinth was included in the design drawings for the lighthouse move in 1999. Drawing: NPS DSC eTIC No. CAHA 603 25006A.

[1] Hasbrouck Peterson Associates with Wiss, Janney, Elstner Associates. "Preservation of Cape Hatteras Lighthouse." *18 sheet drawing set.* October 13, 1989. NPS DSC eTIC No. CAHA 603 80020A.

As early as March 1986, in a report by Hasbrouck Hunderman Architects and Wiss, Janney, Elstner Associates, Inc. (HHA/WJE), cracks were noted in the plinth. HHA/WJE included the following assessment regarding the cracks in the plinth:

> Many of the plinth blocks are cracked vertically through the center of the block in line with the joint of the courses above and below. Some of these joints have been caulked. Any load on these blocks [can] lead to this type of cracking pattern. This does not appear to be a serious structural problem although the cracks should be sealed against water penetration. [2]

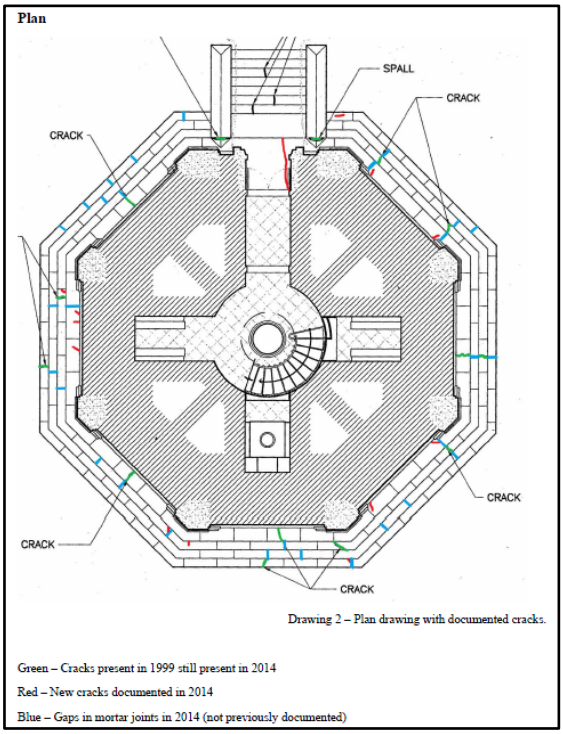


Figure 320. Plan showing the condition assessment of the plinth in 2014 by JKO/BPE. Cropped by author.

During the 2014 visit by Joseph K. Opperman—Architect, P.A. and Bennett Preservation Engineering PC (JKO/BPE), the assessment team thoroughly documented the existing cracks in the granite plinth, particularly as they related to those documented in 1999 (figs. 320-24). Their report notes:

> Many of the cracks were already documented in 1999 after the lighthouse was moved, but there are additional new cracks and some existing cracks have lengthened. Many of the cracks in the foundation are located where the mortar joints in the course below meet the stone above. These cracks are found on every face of the foundation. The cracks that completely split the stones typically continue into mortar joints above or below. [3]

The new cracks are small in width and length. All of them are caused by telescoping from existing cracks below or above, or mortar joints directly below (fig 325). Refer to B2010-1 Base Exterior Walls for more information on cracks in the brick walls of the base.

Also in 2014, it was noted that several joints, particularly those at grade had degraded mortar (fig. 326).

During HPTC's 2015 visit, it was noted that additional joints at the base and elsewhere have degraded or missing mortar. In addition, traces of white mastic compound were seen at several of the mortar joints and some of the old cracks (fig. 327). This compound was also noted in the 1986 report by HHA/WJE. [4]

Similarly, Vertical Access visited the site in October 2015. In their Site Visit Report, they mention that the use of brick between the new concrete mat and the original granite plinth could cause

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[2] Hasbrouck Hunderman Architects with Wiss, Janney, Elstner Associates, Inc. "Cape Hatteras Lighthouse." *Comprehensive Structural Analysis Report.* March 1986. NPS DSC eTIC No. CAHA 603 D39. p. 42.
[3] Joseph K. Opperman—Architect, P.A. with Bennett Preservation Engineering PC. "Cape Hatteras Lighthouse Cape Hatteras National Seashore North Carolina." *Condition Assessment Report.* September 2014. p. 22.
Note: Many pictures are included in the appendix of the JKO/BPE report. Please refer to the report for more in-depth photographs of the condition of the plinth.
[4] HHA/WJE, *Comprehensive Structural Analyses Report*, p. 40.

settling and cracking of the stone units in the plinth. "If this is the case, then that settlement should have ceased by now, as the load was re-distributed. . . . Problems with the new reinforced concrete slab foundation seems [sic] unlikely 15 years after construction."[5]

Condition Rating: FAIR
Deficiency Rating: SERIOUS

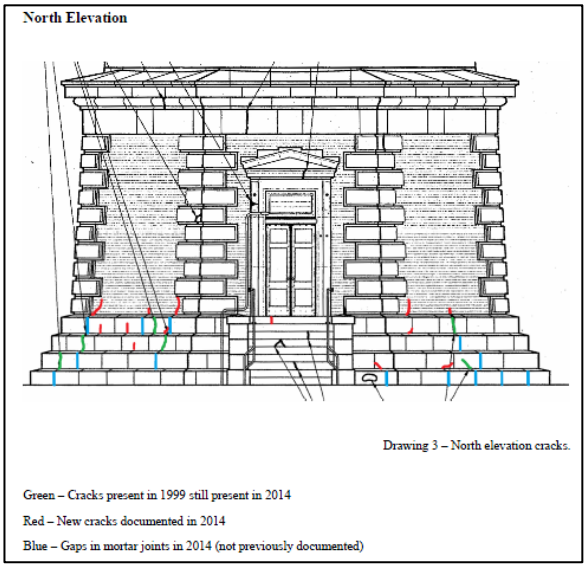


Figure 321. North Elevation drawing showing the condition assessment of the plinth in 2014 by JKO/BPE. Cropped by author.

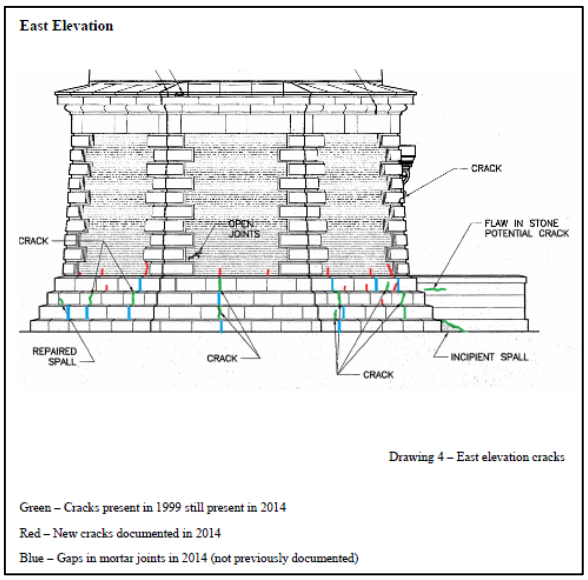


Figure 322. East Elevation drawing showing the condition assessment of the plinth in 2014 by JKO/BPE. Cropped by author.

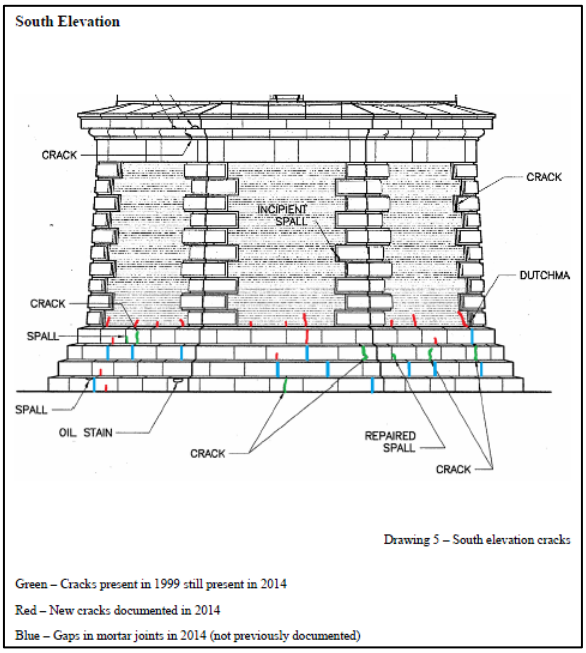


Figure 323. South Elevation drawing showing the condition assessment of the plinth in 2014 by JKO/BPE. Cropped by author.

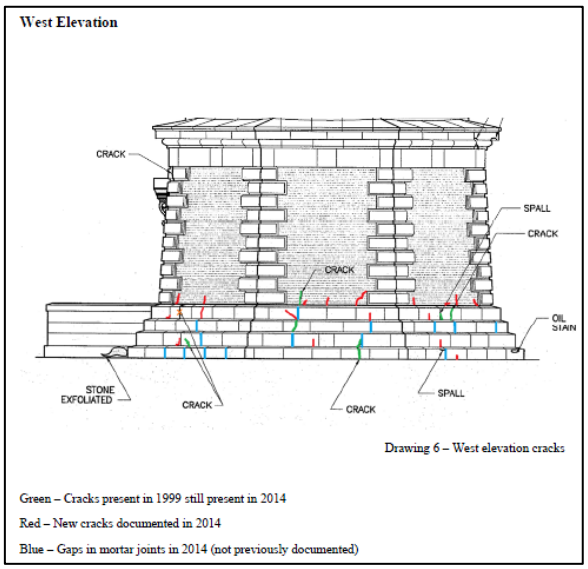


Figure 324. West Elevation drawing showing the condition assessment of the plinth in 2014 by JKO/BPE. Cropped by author.

[5] Diebolt, Kent (Vertical Access) "Cape Hatteras Lighthouse." *Site Visit Report.* Completed for NPS HPTC. November 11, 2015.



Figure 325. The crack in the plinth, located right of the dotted line, was documented in 1999 prior to the move, and telescopes through the stones from the mortar joint below. Due to the painting of the exterior walls above, the new crack in the brick is now covered. Photo: HPTC, 06/17/15.



Figure 326. Deteriorated mortar joints can be seen throughout the entire plinth, as can vegetative growth, where mortar is missing. Photo: HPTC, 06/17/15.



Figure 327, right. Traces of a white mastic compound pre-dating 1986 can be seen on the granite plinth in several locations. Photo: HPTC, 06/17/15.

B	SHELL
B10	SUPERSTRUCTURE
B1010	Floor Construction
B101003	Floor Decks and Slabs
B101003-1	**First Level Floor Slab**

No notes on the first-level floor slab were included in the March 1986 HHA/WJE report or the 2014 JKO/BPE report.

The first-level floor slab was inaccessible for direct assessment by the HPTC team. However, based on conditions of surrounding systems, the slab is in good structural condition.

Condition Rating: GOOD
Deficiency Rating: MINOR

B101003-2	Second – Eighth Level Floor Decks

The Second through Eighth Level floor decks were comprehensively assessed by HHA/WJE in 1986. The report states that many of the deterioration issues stemmed from exposure to repeated cycles of wetting and drying. The moisture was directly related to the open/broken windows within the tower, deteriorated window wall condition at the Lantern Room level, and heavy condensation on the interior. The report described several locations, i.e. landing nosing, iron beams embedded in brick wall, etc., where corrosion could be seen. It was also noted that the brickwork of the landings might be compromised. However, the report did state that the deterioration was not severe enough to warrant repair at that time.[6]

The 1989 preservation drawings for the lighthouse note the following repair work to the Second through Eighth Level floor decks:

> Existing marble floor tiles – Remove tiles in areas shown on plan; remove deteriorated concrete below. Reset tiles as shown in new bed of setting mortar.
>
> Existing Iron Beam – Abrasively clean all rust from top flange and upper portion of web where exposed after removal of marble tiles. Rebuild profile of top flange as required for proper bearing of nosing elements with plastic metal filler. Prime and paint exposed surfaces prior to reinstalling marble and iron nosing. Remove deteriorated mortar, clean rust from exposed portions of beam flange, paint exposed metal and repoint.
>
> Remove all rust from exposed length of iron beam & brackets, prime & paint.
>
> New cast iron tread element – Attach to existing iron beam with new flat head screws….[7]

It is assumed that all of this work was completed by ICC in 1991-93.

JKO/BPE noted the following conditions of the floor decks in their 2014 report:

> Throughout the structure, corrosion of the [original] iron [components] and [replacement] steel [components] is pervasive. Pieces of iron that are easy to maintain have been maintained but those that are difficult to maintain have not been. The common problems throughout the ferrous metals in the lighthouse include:
>
> - Corrosion of the nuts on the bottom of the stair balustrade.
> - Corrosion of the iron up against the masonry, where it is not repainted regularly.
> - Corrosion of the stair treads on the face and nosing.
> - Corrosion and delamination of the joists, especially where they are pocketed into the brick masonry cylinder wall.[8]

More specifically, JKO/BPE noted the following concerns: on the Second Level, significant corrosion of the top flange of the deck edge beam; on the Fifth Level, corrosion of the deck edge beam where it is embedded in the wall (see p. 27 of the 2014 JKO/BPE report for photographs); on the Sixth Level, delamination and corrosion of the intermediate deck beam; on the Seventh Level, complete corrosion of the deck edge beam and delamination and corrosion of the intermediate deck beam.[9]

[6] HHA/WJE, *Comprehensive Structural Analysis Report*, pp. 73-77.
[7] HPA/WJE. "Preservation of Cape Hatteras Lighthouse."
[8] JKO/BPE, *Condition Assessment Report,* pp. 23-24.
[9] JKO/BPE, *Condition Assessment Report,* pp. 26-28.

During HPTC's assessment, the above-noted deterioration was visually seen. In addition to the above, the following floor deck-by-floor deck assessment is provided:

Second Level (fig. 328)

Deck Edge Beam:	Corrosion on top flange.
Deck Intermediate Beam:	No noted issues.
Brick Vaulting:	Some peeling paint and spalling on underside – evidence of water infiltration, likely from open window.

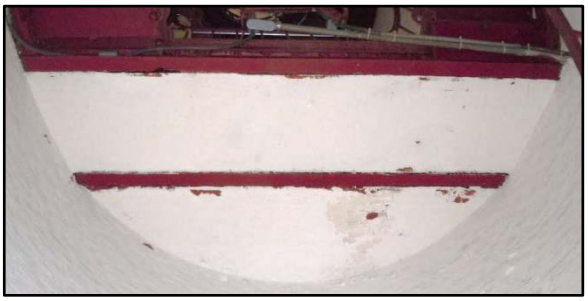


Figure 328. The underside of the Second Level floor deck. Note peeling paint and brick spalling due to water infiltration from above. Photo: HPTC, 06/17/15.

Third Level (fig. 329)

Deck Edge Beam:	No noted issues.
Deck Intermediate Beam:	Small crack in brick wall below end of beam on east side.
Brick Vaulting:	Some peeling paint and spalling on underside – evidence of water infiltration, likely from open window.



Figure 329.The underside of the Third Level floor deck. A small crack in the brick wall is noted by the arrow. Note peeling paint and brick spalling due to water infiltration from above. Photo: HPTC, 06/17/15.

Fourth Level (fig. 330)

Deck Edge Beam:	No noted issues.
Deck Intermediate Beam:	No noted issues.
Brick Vaulting:	Some peeling paint and spalling on underside – evidence of water infiltration, likely from open window.



Figure 330. The underside of the Fourth Level floor deck. Note peeling paint and brick spalling due to water infiltration from above. Photo: HPTC, 06/17/15.

Fifth Level

Deck Edge Beam:	Corrosion where embedded into the wall (fig. 331).
Deck Intermediate Beam:	Corrosion where embedded into the wall (fig. 332).
Brick Vaulting:	Some peeling paint and spalling on underside -evidence of water infiltration, likely from open window (see fig. 332).



Figure 331. Corrosion of the fifth-level floor deck edge I-beam where it is embedded into the wall. Photo: HPTC, 06/17/15.



Figure 332. Corrosion of the fifth-level floor deck intermediate I-beam where it is embedded into the wall. Note peeling paint and brick spalling due to water infiltration from above. Photo: HPTC, 06/17/15.

Sixth Level

Deck Edge Beam: No noted issues.

Deck Intermediate Beam: Delamination and corrosion entire length of beam, including where it is embedded into the wall (figs. 333-34).

Brick Vaulting: Some peeling paint and spalling on underside – evidence of water infiltration, likely from open window (see fig. 333).



Figure 333. The intermediate I-beam is corroded along its entire length. Note peeling paint and brick spalling due to water infiltration from above. Photo: HPTC, 06/17/15.



Figure 334. The intermediate I-beam is corroded where it is embedded into the wall. Photo: HPTC, 06/17/15.

Seventh Level (fig. 335)

Deck Edge Beam: Corrosion.

Deck Intermediate Beam: Delamination and corrosion.

Brick Vaulting: Some peeling paint and spalling on underside – evidence of water infiltration, likely from open window.



Figure 335. The underside of the Seventh Level floor deck. Both beams exhibit corrosion and delamination. Note peeling paint and brick spalling due to water infiltration from above. Photo: HPTC, 06/17/15.

Eighth Level (fig. 336)

Deck Edge Beam:	Corrosion.
Deck Intermediate Beam:	Delamination and corrosion.
Brick Vaulting:	Some peeling paint and spalling on underside – evidence of water infiltration, likely from open window.



Figure 336. The underside of the Eighth-Level floor deck. Both beams exhibit corrosion and some delamination. Note the peeling paint and brick spalling due to water infiltration from above. Photo: HPTC, 06/17/15.

Regarding the color of the floor decks: The 1902 *Instructions to Light-Keepers and Masters of Light-House Vessels*, published by the U.S. Lighthouse Board, notes the required color for interior iron work to be black (primed with red lead), the brickwork was to be whitewashed, and the underside of tower stairways was to be black or white.[10]

Condition Rating: POOR
Deficiency Rating: SERIOUS

B101003-3	Ninth (Service Room) Level Floor Deck

The Ninth (Service Room) Level floor deck was assessed by HHA/WJE in 1986. The report blames the following deterioration on the water issues discussed above:

> The cast iron support beam for the free edge of the Service Room cast iron floor plate has corroded at either end where the beam penetrates the inner masonry wall of the Lighthouse. . . . It is estimated that 10 to 15 percent of the web of the beam has been lost to corrosion in the areas. Approximately 5 to 10 percent of the area of the bottom flange has also been lost to corrosion. This is not serious enough to warrant repair at this time. However, this will become a serious problem if the source of the water leaks is not eliminated.
>
> The cast iron floor plate and the cast iron supplemental floor supports for the Service Room floor were found to be in good condition.[11]

The 1989 preservation drawings for the lighthouse note the following regarding the Ninth Level floor deck:

> Existing iron beam under deck – Clean all rust from beam ends. Clean out rust from joints between beam and masonry. Prime and paint, then regrout joints. Typical for both ends of beam.
>
> Clean rust from exposed metal at these locations. Prime and paint metal surfaces. Replace all missing brick. Allow for expansion joint between metal and masonry. Paint masonry to match adjacent. . . .
>
> Existing iron floor plates – remove all rust, dirt, and loose paint from top and bottom surfaces. Prime and paint all metal surfaces exposed during cleaning.[12]

[10] Great Lakes Lighthouse Keepers Association. "Instructions to Light-Keepers." *A photoreproduction of the 1902 Edition of Instructions to Light-Keepers and masters of Light-House Vessels.* Allen Park, Michigan: Great Lakes Lighthouse Keepers Association, 1989. p. 53.
[11] HHA/WJE, *Comprehensive Structural Analysis Report*, pp. 86-87.

It is assumed that all of this work was completed by ICC in 1991-93.

JKO/BPE noted in their 2014 assessment report that the iron floor plates of the Ninth Level were corroding. They also state that the deck edge beam "is corroded enough to raise concern about its safety. Because of limited access, we were not able to fully evaluate the joist."[13]

HPTC agrees with the JKO/BPE's assessment. Figures 337-40 show the condition as HPTC found the floor deck components. It should be noted that most of the floor deck corrosion is likely caused by water infiltration from the open window and its direct contact to the brick masonry adjacent (see fig. 339).

Regarding the color of the floor deck: The 1902 *Instructions to Light-Keepers and Masters of Light-House Vessels,* published by the U.S. Lighthouse Board, notes the required color for interior iron work to be black (primed with red lead). The underside of tower stairways was to be black or white.[14]

Condition Rating: POOR
Deficiency Rating: CRITICAL



Figure 337. The east end of the floor deck edge beam is corroded where it is embedded into the wall. Photo: HPTC, 06/17/15.



Figure 338, right. The west end of the floor deck edge beam is corroded where it is embedded into the wall. Photo: HPTC, 06/17/15.

[12] HPA/WJE, "Preservation of Cape Hatteras Lighthouse."
[13] JKO/BPE, *Condition Assessment Report,* pp. 30.-32.
[14] Great Lakes Lighthouse Keepers Association. "Instructions to Light-Keepers," p. 53.



Figure 339. The underside of the metal floor deck of the Ninth (Service Room) Level shows corrosion at the bolts and around the perimeter where the metal is in direct contact with the brick masonry, particularly the areas directly under the windows. Photo: HPTC, 06/17/15.



Figure 340, right. The Ninth Level metal floor deck from above shows worn paint and metal surfaces due to wear and water infiltration from the open window. Photo: HPTC, 06/17/15.

B101003-4	Tenth (Watch Room) Level Floor Deck

The Tenth (Watch Room) Level floor deck was assessed by HHA/WJE in 1986. The report blames the following deterioration on the water issues discussed above, as well as the support beams being directly tied to the corroding exterior gallery-support brackets. In addition, the following was noted:

> The watch room floor plate is generally in good condition. Some deterioration of the top surface of the plate in evident due to corrosion…. This corrosion is due to repeated wetting and drying cycles from water draining onto the floor from the Lantern Room above. The corrosion will continue until this situation is corrected.[15]

The 1989 preservation drawings of the lighthouse note the following regarding the Tenth Level floor deck:

> Existing iron floor support beams (typ.) – clean all rust and loose paint from beam ends and from exposed stub columns within the masonry wall. Prime and paint all metal, including exposed surfaces of stub columns. Replace missing masonry at beam ends, leaving expansion joint around metal elements. Seal joint between metal and masonry with caulk.
>
> Existing iron floor plates (typ.) – remove all rust, dirt, and loose paint from top surface. Prime and paint all surfaces.[16]

It is assumed that all of this work was completed by ICC in 1991-93.

[15] HHA/WJE, *Comprehensive Structural Analysis Report*, pp. 88-89.
[16] HPA/WJE. "Preservation of Cape Hatteras Lighthouse."

JKO/BPE did not note any specific concerns on the Tenth Level floor deck in their 2014 report.

HPTC found the floor deck components of the Tenth Level to be in a similar state as those on the Ninth Level, which raises concern about the safety of the floor deck. The beams are heavily corroded where they are embedded into the masonry, especially on their east end (figs. 341-42).

The floor plates are generally in good condition. It should be noted that most of the floor deck corrosion is likely caused by the floor deck's direct contact to the brick masonry adjacent (figs. 343-44).

Regarding the color of the floor deck: The 1902 *Instructions to Light-Keepers and Masters of Light-House Vessels*, published by the U.S. Lighthouse Board, notes the required color for interior iron work to be black (primed with red lead). The underside of tower stairways was to be black or white.[17]

Condition Rating: POOR
Deficiency Rating: CRITICAL



Figure 341. West end of the beams embedded into the wall. Note rust staining which shows water infiltration in this area. Photo: HPTC, 06/17/15.



Figure 342, right. East end of one of the beams embedded into the wall. This end is in worse condition than the west end. Photo: HPTC, 06/17/15.

[17] Great Lakes Lighthouse Keepers Association. "Instructions to Light-Keepers," p. 53.



Figure 343. The underside of the Tenth Level floor deck. Rust and corrosion can be seen around the perimeter where the metal is in direct contact with the brick masonry adjacent. Photo: HPTC, 06/17/15.



Figure 344, right. The Tenth Level metal floor deck from above shows worn paint and metal surfaces due to wear. Photo: HPTC, 06/17/15.

B101004	Balcony Construction
B101004-1	**Ninth (Watch Room) Level Exterior Gallery**

The HHA/WJE March 1986 report notes the condition of the exterior gallery support brackets. Two brackets were significantly cracked at the time. Eleven of the sixteen brackets required replacement of the top gridwork and all ornamental cylinders required replacement. A structural analysis of the Gallery found that the support brackets were significantly overdesigned and therefore the corrosion of some elements was not detrimental. The horizontal rails of the handrails needed to be replaced. Three vertical posts required replacement. The deck plates were in good condition on the top and poor condition on the bottom. Because of other stresses and corrosion to related components, replacement of the deck plates was recommended. The cast iron belt course segments were cracked and likely corroded on the backside, but only four of the sixteen required replacement.[18]

The 1989 preservation drawings of the lighthouse note the following regarding the Tenth Level floor deck:

> Existing Cast Iron Brackets – Clean to bright metal, fill all pits and rebuild corrosion-damaged areas to their original profile with plastic metal filler, prime and paint. (Typical)
>
> Replace lintel grids and cylinders.
>
> Existing Cast Iron Belt Course Below – Clean to brick metal. Clean out corrosion pits and fill with plastic metal filler. Prime and repaint. Shaded elements are to be repaired. . . .

[18] HHA/WJE, *Comprehensive Structural Analysis Report*, pp. 92-93, 104-116, 121-132.

New iron handrail, cap rail, and balustrade all around. . . .

Replace handrail posts at lines 10, 11, & 12 only. All others are to be refurbished. . . .[19]

It is assumed that all of this work was completed by ICC in 1991-93. It should be noted that it appears that only two of the handrail posts were actually replaced.

The JKO/BPE 2014 assessment report on the lighthouse noted that all of the exterior metal components of the exterior gallery exhibit corrosion. In addition, the railing at the perimeter of the gallery was determined to meet required code loadings.[20] See Figures 345-49 for photographs taken during HPTC's assessment of the structure.

Regarding the color of the exterior gallery: The gallery appears to have always been painted black. The 1902 *Instructions to Light-Keepers and Masters of Light-House Vessels*, published by the U.S. Lighthouse Board, notes that exterior gallery railings were to be black (primed with red lead).[21]

Condition Rating: FAIR
Deficiency Rating: SERIOUS



Figure 345. Areas of rust and corrosion can be seen on the underside of the Tenth Floor Exterior Gallery and its related structural components (brackets, belt course, etc.). Photo: HPTC, 06/17/15.

[19] HPA/WJE. "Preservation of Cape Hatteras Lighthouse."
[20] JKO/BPE, *Condition Assessment Report,* pp. 26, 38.
[21] Great Lakes Lighthouse Keepers Association. "Instructions to Light-Keeper," p. 53





Figure 347, above. The floor deck of the exterior gallery from above. Photo: HPTC, 06/17/15.

Figure 346, left. One of the exterior gallery support brackets as seen through a Ninth Level window. Note the areas of corrosion. Photo: HPTC, 06/17/15.

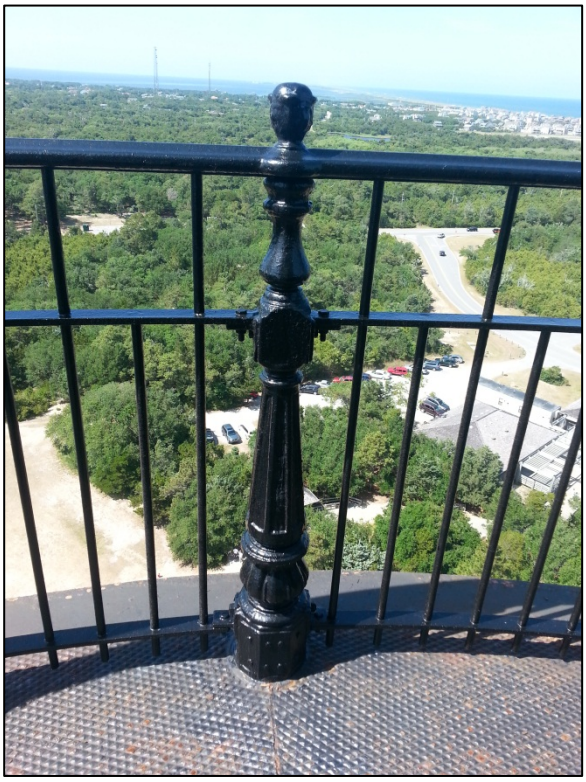


Figure 348. One of the original gallery handrail posts. The railing has been replaced. Photo: HPTC, 06/17/15.



Figure 349. One of the two replacement handrail posts. The railing has also been replaced. Photo: HPTC, 06/17/15.

B101004-2	Lantern Room Interior & Exterior Balconies

HHA/WJE included an extensive assessment of the Lantern Room Interior and Exterior Balconies in their 1986 report. The underside of the interior balcony was found in good condition with only minor pitting; the top was lightly corroded and did collect rainwater due to defects in the Lantern wall. The inner edge of the balcony was moderately corroded.[22]

An assessment of the exterior balcony portions determined that the top exhibited moderate pitting and a few holes. The underside of the balcony, including hardware, had extensive pitting and corrosion. The ornamental ironwork was in good condition along the perimeter, but some pieces were missing. The exterior vents to the interior of the Lantern did not have screens and moderate corrosion could be seen. The handrail was in good condition but had moderate corrosion on the vertical posts and missing components.[23]

The 1989 preservation drawings of the lighthouse note the following regarding the Lantern Room Interior and Exterior Balconies:

> Existing Lantern Gallery Deck Plates (Typ.) – Upper Surface clean interior… and exterior… removing all rust. Clean out and fill miscellaneous deep pits and perforations with plastic metal (pits to be filled occur in the plates [near three brackets]). Prime and paint.
>
> Lower Surface – Clean interior…and exterior… removing all rust. Prime and paint.
>
> After cleaning, rebuild eroded bead at inner edge of plate with plastic metal filler. Prime and paint.
>
> Existing Floor Vent (Typ.) – Refurbish sliding register so that it operates feely. Clean out air channel below.
>
> Attach new metal screen at each existing air channel at underside of exterior deck.[24]

It is assumed that all of this work was completed by ICC in 1991-93.

The JKO/BPE 2014 report stated that the floor plates and railing of the Tenth Level Interior and Exterior Galleries are severely corroded, the exterior railing likely beyond repair.[25]

HPTC agrees with the general statement by JKO/BPE. Most of the interior corrosion is due to degraded paint from excessive UV exposure. See Figures 32-35 for photographs taken during HPTC's assessment.

Regarding the color of the Lantern gallery: The 1902 *Instructions to Light-Keepers and Masters of Light-House Vessels,* published by the U.S. Lighthouse Board, notes that exterior gallery railings were to be black (primed with red lead). The interior components of the lanterns were to be painted white, however interior ironwork was to be painted black (primed with red lead).[26]

Condition Rating: FAIR
Deficiency Rating: SERIOUS

[22] HHA/WJE, *Comprehensive Structural Analysis Report*, p. 135.
[23] HHA/WJE, *Comprehensive Structural Analysis Report*, pp. 136-139.
[24] HPA/WJE. "Preservation of Cape Hatteras Lighthouse."
[25] JKO/BPE, *Condition Assessment Report,* p. 26.
[26] Great Lakes Lighthouse Keepers Association. "Instructions to Light-Keepers," p. 53.

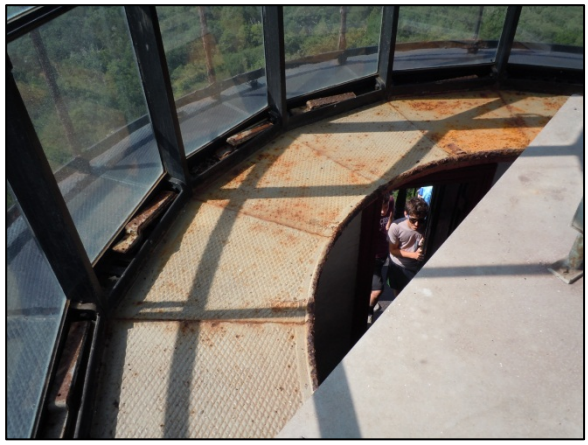


Figure 350. The interior portion of the balcony shows rust due to degraded paint from UV exposure. Photo: HPTC, 06/16/15.



Figure 351. A vent located in the space between the interior balcony and the exterior balcony. Note the paint on the exterior balcony is in good condition. Photo: HPTC, 06/16/15.



Figure 352. The exterior railing of the Lantern balcony is severely corroded and delamintaing. Photo: HPTC, 06/16/15.



Figure 353, right. The exterior railing of the Lantern balcony, seen here from inside the Lantern, likely cannot be feasibly repaired. Photo: HPTC, 06/16/15.

B1020	Roof Construction

The HHA/WJE 1986 report provided the following assessment regarding the roof framing:

> One of the sixteen horizontal, wrought iron tie rods is completely missing. This deficiency is not critical; however, the missing rod should be replaced.
>
> Corrosion is evident on the connections between the outer end of the horizontal wrought iron tie rods and the sloping iron roof support rafters. Only a small portion of these connections is

> visible inside the Lantern Room, so a full inspection of these connections is not possible and the full extent of the corrosion problem cannot be determined.
>
> Light to moderate pitting caused by corrosion exists on the curved underside of the roof overhang (i.e., cornice) around the perimeter of the lantern. . . . This corrosion is concentrated near the outside edge of the surface.
>
> The top surface of the roof of the Lantern was not accessible for inspection. However, it is probably in good condition, judging from the absence of any substantial distress in the regions below which are visible from inside the Lantern.[27]

The 1989 preservation drawings of the lighthouse note the following regarding the Lantern Room Interior and Exterior Balconies:

> Clean and paint all exposed interior surfaces of cornice, tie rods, and ceiling. Remove rust as necessary. Prime and repaint.
>
> Replace missing horizontal tie rod.[28]

It is assumed that all of this work was completed by ICC in 1991-93.

The JKO/BPE 2014 report stated that the iron supports of the roof structure were corroded.[29]

HPTC noticed minor corrosion and rusting to the interior structure for the roof due to degraded paint from excessive UV protection (fig 354). Overall, the system is in good structural condition.

Regarding the color of the interior roof structure: The 1902 *Instructions to Light-Keepers and Masters of Light-House Vessels*, published by the U.S. Lighthouse Board, notes the required color for the interior of the lantern was to be white.[30]

Condition Rating: FAIR
Deficiency Rating: SERIOUS



Figure 354. The exposed roof framing is in good structural condition, but requires maintenance for its minor rust, corrosion, and paint issues. Photo: HPTC, 06/16/15.

[27] HHA/WJE. *Comprehensive Structural Analysis Report*, pp. 143-144.
[28] HPA/WJE. "Preservation of Cape Hatteras Lighthouse."
[29] JKO/BPE, *Condition Assessment Report,* pp. 33-34.
[30] Great Lakes Lighthouse Keepers Association. "Instructions to Light-Keepers," p. 53.

B20	EXTERIOR ENCLOSURE
B2010	Exterior Walls
B2010-1	**Base Exterior Walls**

The Base exterior walls were not specifically addressed in the 1986 HHA/WJE report. The report did discuss the decorative granite elements surrounding the door.

> Both of the ornamental granite brackets that flank the entrance have been damaged by stresses in the masonry. The face of the east bracket has been pinned to the body of the block and epoxy grouted. The west bracket, however, has not been stabilized and the face of the bracket is cracked.
>
> The original plans indicate that [the granite cornice elements] are anchored one to another by a U-shaped, horizontal metal anchor in the joint between the granite and the brick. These anchors have rusted and rust stains run out of this joint. In many instances fine 45-deree cracks have developed on the face of this granite lip to relive the pressure from the corroding anchors. Examination of the type and configuration of these anchors indicates that the corrosion of the anchors is not a significant problem at this time.
>
> The octagonal brick masonry below [the granite cornice] is in fair condition. That masonry is painted a dull red color.[31]

The 1989 preservation drawings of the lighthouse note the following regarding the Base walls:

> Completely remove metal anchors embedded in masonry. Cut out damaged bricks as required and replace with salvaged brick stored on site.
>
> Existing granite quoins – Clean out loose mortar and tuckpoint.[32]

It is assumed that all of this work was completed by ICC in 1991-93.

The following assessment of the Base exterior walls was included in the 2014 JKO/BPE report:

> The brick base of the structure has cracks on every face. All of these cracks continue from cracks or gaps in the stone foundation below. These cracks extend 2 to 18 inches up from the stone foundation. … In addition to the cracking, the flush mortar joints have significant erosion, particularly on the south and east exposures.
>
> As was previously documented in 1999 after the lighthouse was moved, the stone entablature atop the base shows vertical cracking. There are no new cracks, though there is additional spalling along the cornice at the south-facing side. The frieze of the northwest-facing side exhibits water saturation, suggesting water intrusion above the cornice.
>
> The red paint on the exterior brick work of the base is faded, peeling, cracking, and in generally poor condition.[33]

HPTC deduces that the cracks found in the brick portion of the base (radiating up from the plinth below) are all new since the 1999 documentation. It should be noted that the base was freshly painted prior to HPTC's 2015 visit and the cracks in the first level walls were not noticeable. This could mean that the cracks are only visible when the structure needs to be repainted and they have

[31] HHA/WJE, *Comprehensive Structural Analysis Report*, pp. 40-44.
[32] HPA/WJE. "Preservation of Cape Hatteras Lighthouse."
[33] JKO/BPE, *Condition Assessment Report,* pp. 22-23.

existed for a long time, or that they are new cracks which were covered up by the most recent painting.

Otherwise, HPTC agrees with the assessment presented by JKO/BPE. See Figures 355-56 for photographs from the assessment by HPTC.

Regarding the color of the painted brick: when the lighthouse was originally painted (1873), it was proposed to "be colored white between the quoins."[34] No pictures of this color scheme exist and no further documentation has been found to concur that the brick was originally whitewashed. A request in 1887 asked for 100 barrels of Indian red paint. This could have been used to paint the base. The earliest-known photographs of the lighthouse in 1893 show that the brick of the base was certainly not whitewashed, but appears to be unpainted or painted a mid-tone color, maybe red (see fig. 331). Further, the 1902 *Instructions to Light-Keepers and Masters of Light-House Vessels,* published by the U.S. Lighthouse Board, notes the required color for exterior "stone and brick work where a change in the natural color is authorized and on rough-board work" was to be whitewash. The color red was only approved on the exterior for "trimmings of structures" and "outside shutters."[35]

Condition Rating: FAIR
Deficiency Rating: SERIOUS



Figure 355. A crack telescopes up from the plinth below into the brick wall of the base. It was recently painted and covered the cracks. Photo: HPTC, 06/17/15.

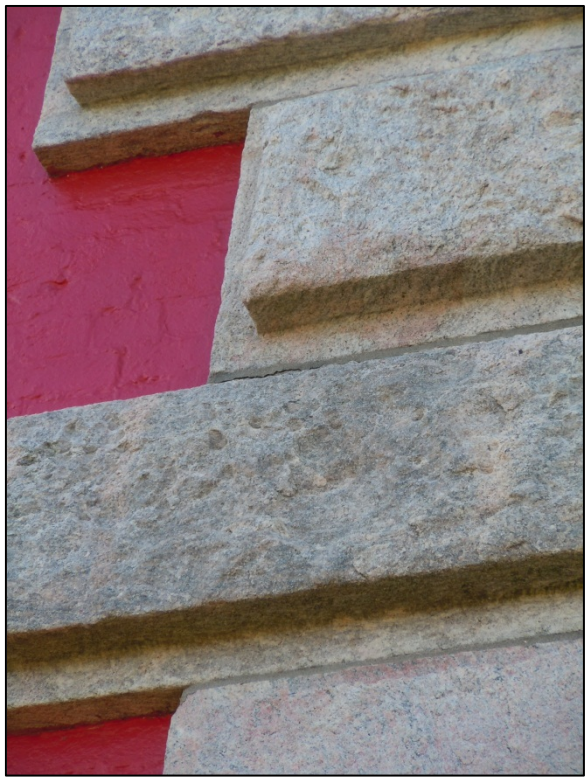


Figure 356. Some of the mortar between the quoins is failing or missing. Photo: HPTC, 06/17/15.

[34] Hains, Peter C., Captain of Engineers. *Letter to Major George H. Elliot, Engineering Secretary, Chairman, U.S. Light-House Board.* March 22, 1873. NARA.
[35] Great Lakes Lighthouse Keepers Association. "Instructions to Light-Keepers," p. 53.

B2010-2	Tower (Second – Eighth) Level Exterior Walls

HHA/WJE extensively assessed the exterior walls of the tower (second through eighth levels) in their 1986 report. They found the painted brick masonry to be in generally good condition. At that time, no large cracks were found on the exterior and no previous patches could be discerned. A summary of other findings included:

- Some repointing was required where paint had deteriorated from exterior of tower. Scope of repointing work could not be determined until all paint was removed.
- No brick deterioration was noted on exterior of tower. Scope of repair work could not be determined until all paint was removed.
- Exterior had been painted with inappropriate paint which did not allow the masonry to breath. This caused failing paint, biological growth, and presence of insects behind paint.
- Historic mortar used on tower exterior consisted of one (1) part hydrated dolomitic lime and four and one-half (4½) parts sand.
- Interior had recently been cleaned, likely by walnut-shell blasting.
- Interior had been painted with acrylic-based whitewash, which does allow masonry to breathe and pass moisture; however areas of deteriorated paint were noted in Service Room and on first-level arches due to buildup of moisture inside wall cavities.
- Long vertical cracks located on interior walls on north and south elevations from Second Level to Seventh Level. The cracks, still extant in 2015, run through points where stair stringers are anchored into masonry walls, as well as vertically between window openings. The cracks have been documented since 1879. In 1986, the cracks were determined to be caused by thermal expansion:

  > Expansion of the cylindrical outer masonry wall induces high tensile stresses in the cylindrical inner masonry wall of the Lighthouse. This occurs because the two walls are tied together with a series of large brick masonry ribs. The interior wall would be expected to crack under the tensile forces at and along its weakest vertical sections. Those weakest sections are along the north and south sides of the Lighthouse where the window openings interrupt the masonry wall construction. This hypothesis of the cause of the vertical cracks has been initially confirmed by the installation of a strain gauge across one of the vertical cracks. The strain gauge measures movement of the crack perpendicular to its length. The data from the gauge is being continuously recorded. The initial reading was taken on a cold, sunny day in January. Initial data from the gauge revealed that the width of this crack grows by nearly one-third when the sun comes up in the morning and heats up the exterior wall of the Lighthouse. The vertical cracks are active cracks, but do not adversely affect the structural integrity of the walls of the Lighthouse.

- Deteriorated mortar and brickwork in Service Room (Ninth Level) and Eighth Level due to water infiltration from Lantern above.
- Some vertical cracks at floor deck I-beams due to thermal stress. Cracks determined to be minor and did not affect structural capacity of floor decks.
- Inspection of brick masonry within internal cavity (between exterior wall and interior wall) determined the brick and mortar to be in good condition with light surface efflorescence visible. Humidity levels were high. A debris pile is located at bottom of cavity.[36]

The 1989 preservation drawings of the lighthouse noted the following regarding the exterior tower walls:

[36] HHA/WJE, *Comprehensive Structural Analysis Report*, pp. 44-65.

> Scrape away any loose paint at mortar joints. Clean out loose mortar. Tuckpoint open mortar joints. Touch-up paint to match existing pattern where removed to repair masonry.
>
> Existing [interior] vertical cracks in masonry to be caulked.[37]

It is assumed that all of this work was completed by ICC in 1991-93.

Prior to the move in 1999, existing interior cracks and other deterioration throughout the lighthouse structure were documented in the design drawings for the move (fig. 357).

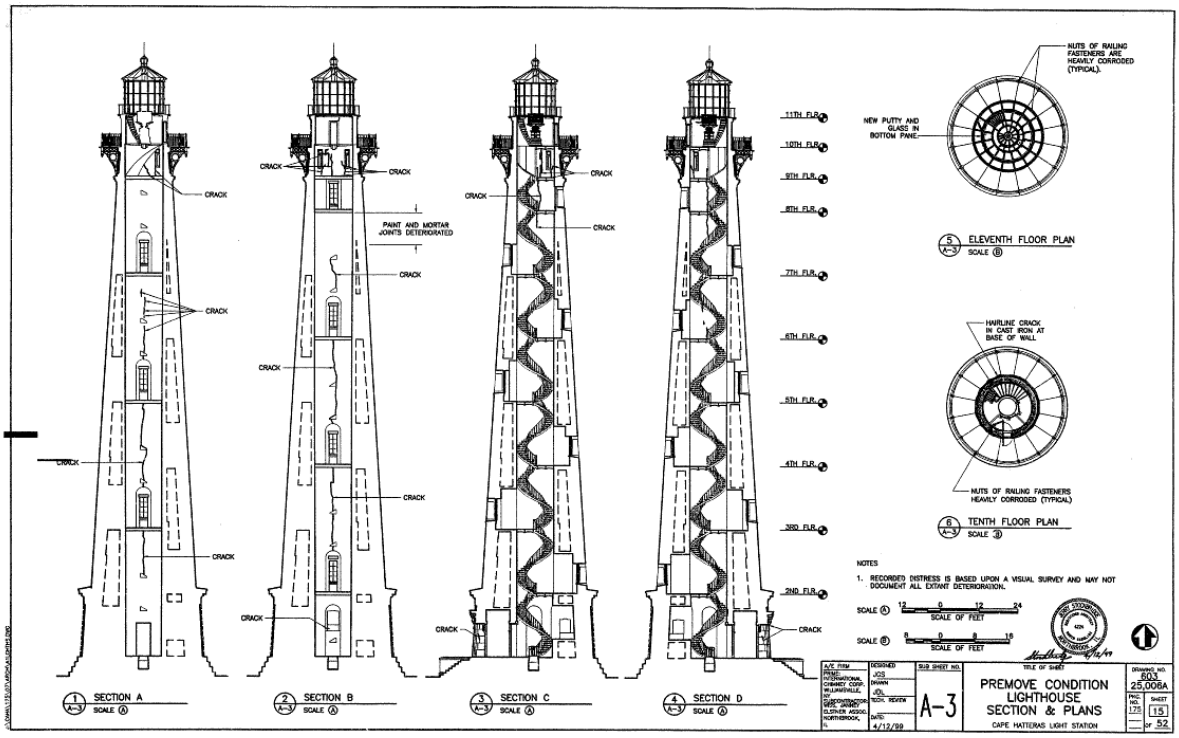


Figure 357. The pre-move condition of the lighthouse interior was included in the design drawings for the lighthouse move in 1999. Drawing: NPS DSC eTIC No. CAHA 603 25006A.

The JKO/BPE 2014 report on the lighthouse provided a reassessment of the tower exterior walls, including an update to the drawings completed in 1999. The updated drawings show a few new exterior cracks (fig. 358). These cracks may be new between 1999 and 2014 or may have been covered with paint during the 1999 assessment. The interior section drawings show a few new cracks especially associated with the floor decks and the Ninth Level windows (fig. 359). The following written description was also provided:

> The masonry walls of the lighthouse have cracks on the interior cylinder and the exterior cone. These cracks were documented during the site visits on March 19th through 31st, 2014. . . .
>
> - There are very few cracks in the exterior brick masonry cone. Those that exist are typically found at the corners of windows.
> - The majority of the interior and exterior cracks that were documented in 2014 had also been documented in the 1999 drawings from the National Park Service.

[37] HPA/WJE. "Preservation of Cape Hatteras Lighthouse."

- Typically, cracks and damaged bricks were found where iron is pocketed into the walls.
- Additionally, long vertical cracks on the interior cylinder of the structure are found on the north and south sides, running from window to window, up through the seventh level.
- At the eighth level, vertical cracks appear on the east and west sides of the interior cylinder.

In addition to the cracking, the mortar joints exhibit extensive erosion, both on the exterior and interior of the tower.

The exterior black and white paint of the tower is in poor condition. It is flaking, cracking, and powdering in many locations.

On the interior of the tower, the white paint finish is failing in numerous locations. It is in particularly poor condition on the underside of the vaulted ceilings and on the walls at the seventh, eighth, and ninth level landings.[38]

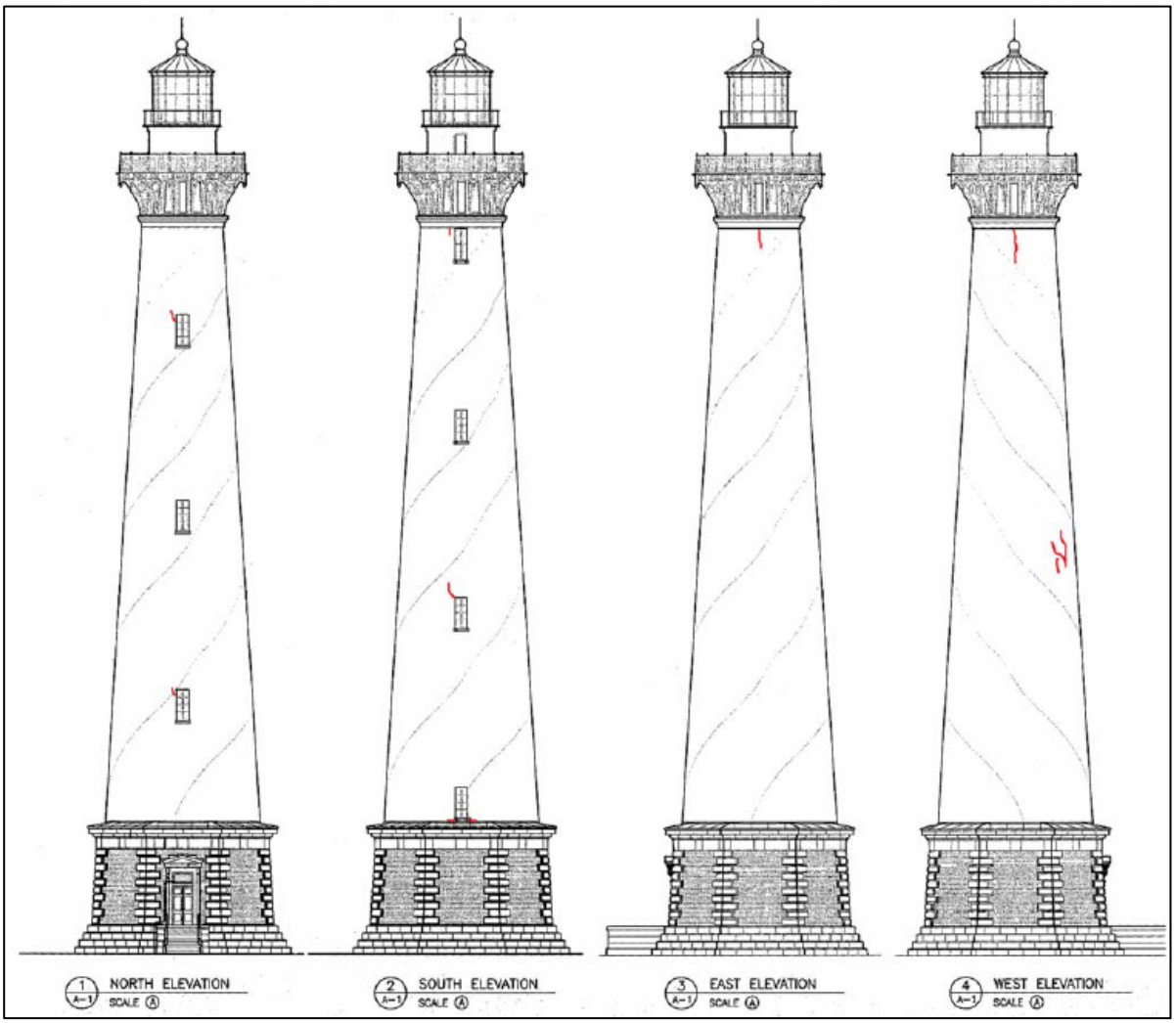


Figure 358. Exterior elevations showing the condition assessment of the tower walls in 2014 by JKO/BPE. The red lines denote new cracks documented in 2014. Cropped by author.

[38] JKO/BPE, *Condition Assessment Report,* p. 23.

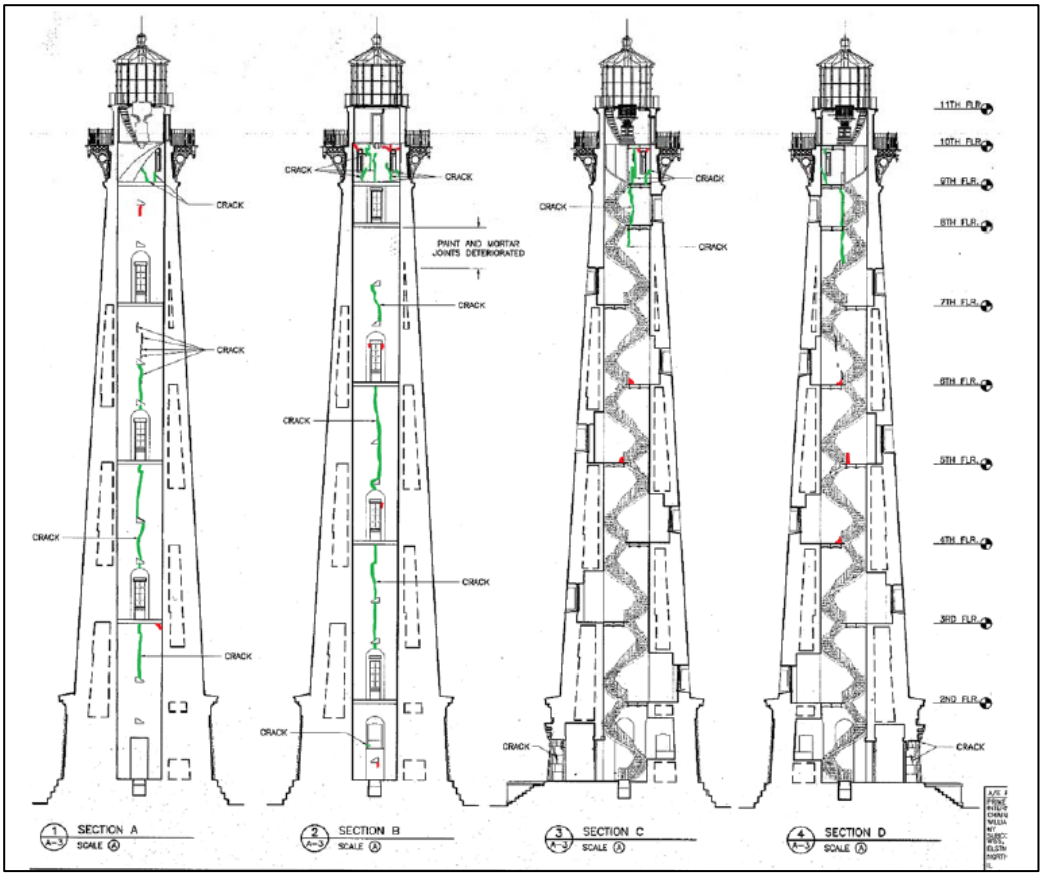


Figure 359. Sections through the tower showing the condition assessment of the interior faces of the tower walls in 2014 by JKO/BPE. The green lines denote cracks documented in 1999 prior to the move. The red lines denote new cracks documented in 2014. Cropped by author.

Since JKO/BPE's assessment, the exterior of the tower was painted. Unfortunately, this covered any evidence of cracking and deteriorated bricks and mortar on the exterior surfaces; therefore HPTC cannot provide an assessment of the exterior. It should be noted that the exterior surfaces were painted with an acrylic-based paint which is inappropriate for the historic brick structure. This type of paint does not allow brick to breathe or allow moisture to pass through it.

On the interior, HPTC noted the same cracks documented by JKO/BPE, and agrees with the hypothesis of HHA/WJE that the large vertical cracks, present since 1879, are likely associated with thermal expansion (fig. 42). Areas of cracking related to the floor decks are more of a concern, especially on the structural capacity of the decks themselves (fig. 43). See B101003-2 Second-Eighth Level Floor Decks for more information. Lastly, areas surrounding the windows and interior wall areas adjacent to the exterior brackets show brick and mortar deterioration due to water infiltration (figs. 44-45). In some instances, Portland-cement-based mortar (unsympathetic to the historic structure) had been installed in the mortar joints.

Regarding the color of the interior of the exterior walls, the 1902 *Instructions to Light-Keepers and Masters of Light-House Vessels,* published by the U.S. Lighthouse Board, states the required color for the interior of the walls is whitewash.[39]

[39] Great Lakes Lighthouse Keepers Association. "Instructions to Light-Keepers," p. 53.

Condition Rating: FAIR
Deficiency Rating: SERIOUS



Figure 360. An interior wall crack located under the stair bracket between the Third Level and Fourth Level. These thermal expansion cracks are of little concern and have been documented since 1879. Photo: HPTC, 06/17/15.



Figure 361, right. The area under the Ninth Level Floor Deck exhibits a crack under the central beam. This is an area of concern because it directly affects the structural integrity of the floor deck. Photo: HPTC, 06/17/15.



Figure 362. The area under one of the windows in the tower shows deteriorated brick, mortar, and paint covering due to water infiltration from the open window above. Note the use of Portland cement-based mortar. Photo: HPTC, 06/17/15.



Figure 363. A portion of the interior wall on the Eighth Level adjacent to an exterior bracket shows deteriorated brick, mortar, and paint covering due to water infiltration. Note the use of Portland cement-based mortar. Photo: HPTC, 06/17/15.

B2010-3	Ninth (Service Room) Level Exterior Walls

HHA/WJE extensively assessed the exterior walls of the Ninth (Service Room) Level of the tower in their 1986 report. At that time water was leaking down the wall from the Lantern level above and significant deterioration had occurred to the interior iron wall plates, the brickwork behind the plates, and the floor deck below. The infiltration had also caused severe deterioration to the exterior lintel grids between the brackets, an interior tension bar related to the brackets, and the exterior wall plates between the brackets.[40] In addition, vertical cracks were noted on the interior surfaces of the wall at the Ninth Level. The cracks were directly related to corrosion of the exterior brackets.[41]

The 1989 preservation drawings of the lighthouse noted the following regarding the Ninth Level exterior walls:

> Install new lintel grids (after installation of new tension ring segments and new gallery deck floor plates).
>
> Grind out vertical crack, caulk.[42]

It is assumed that all of this work was completed by ICC in 1991-93.

Prior to the move in 1999, existing interior cracks and other deterioration throughout the lighthouse structure were documented in the design drawings for the move (see fig. 357). These drawings show cracks related to the brackets. The cracks may have been historic.

The JKO/BPE 2014 report on the lighthouse provided a reassessment of the tower exterior walls, including an update to the drawings completed in 1999. The interior section drawings show a few new cracks in the Service Room associated with the windows (see fig. 358). No additional written description was provided by JKO/BPE.

HPTC noticed that the interior surfaces of the exterior wall are deteriorated, including the brickwork, mortar, paint coverings, and the iron plates (figs. 364-65). Because of this, it is likely that water is still finding its way into this portion of the wall probably through the exterior gallery above and the joints between the brackets and exterior wall plates. In addition, portions of the wall have been repointed with Portland-cement-based mortar (unsympathetic to the historic structure).

Regarding the color of the interior of the exterior walls, the 1902 *Instructions to Light-Keepers and Masters of Light-House Vessels,* published by the U.S. Lighthouse Board, states the required color for the interior of the walls is whitewash.[43]

Condition Rating: FAIR
Deficiency Rating: SERIOUS

[40] HHA/WJE, *Comprehensive Structural Analysis Report*, pp. 116-120.
[41] HHA/WJE, *Comprehensive Structural Analysis Report*, pp. 44-65.
[42] HPA/WJE. "Preservation of Cape Hatteras Lighthouse."
[43] Great Lakes Lighthouse Keepers Association. "Instructions to Light-Keepers," p. 53.



Figure 364. Deterioration of the interior metal wall plates was noted as early as 1986. Photo: HPTC, 06/17/15.



Figure 365. Brick, mortar, and paint deterioration due to water infiltration on the Ninth Level. Portland cement-based mortar was seen. Photo: HPTC, 06/17/15.

B2010-4	Tenth (Watch Room) Level Exterior Walls

The 1986 assessment report by HHA/WJE found the exterior cast iron wall plates of the Tenth Level to be in overall good condition, but noted numerous small, deep pits in the plates. In addition, the base plates were extensively cracked, likely due to expansion of the gallery floor deck.[44]

The 1989 preservation drawings of the lighthouse noted the following regarding the Tenth Level exterior walls:

> Existing Cast Iron Wall Plates – Clean to near white metal…. Clean out corrosion pits. Prime. Fill w/plastic metal filler and repaint (typ. all around).
>
> Existing Masonry Wall – Remove water damaged paint and allow wall to dry out before tuckpointing eroded joints (typical).[45]

It is assumed that all of this work was completed by ICC in 1991-93.

[44] HHA/WJE, *Comprehensive Structural Analysis Report*, p. 106-116.
[45] HPA/WJE. "Preservation of Cape Hatteras Lighthouse."

Neither the 1999 design drawings nor the updated 2014 documentation drawings noted any cracks at this level (see figs. 357-59). A written assessment was not provided by JKO/BPE.

HPTC found the interior surfaces to be in good condition, albeit slightly dirty from visitor use (fig. 366). On the exterior, the metal wall plates have some deteriorated paint. This has caused some rust (figs. 367-68).

Regarding the color of the interior of the exterior walls, the 1902 *Instructions to Light-Keepers and Masters of Light-House Vessels*, published by the U.S. Lighthouse Board, states the required color for the interior of the walls is whitewash. The metal components on the exterior were to be painted black (primed with red lead).[46]

Condition Rating: FAIR
Deficiency Rating: MINOR

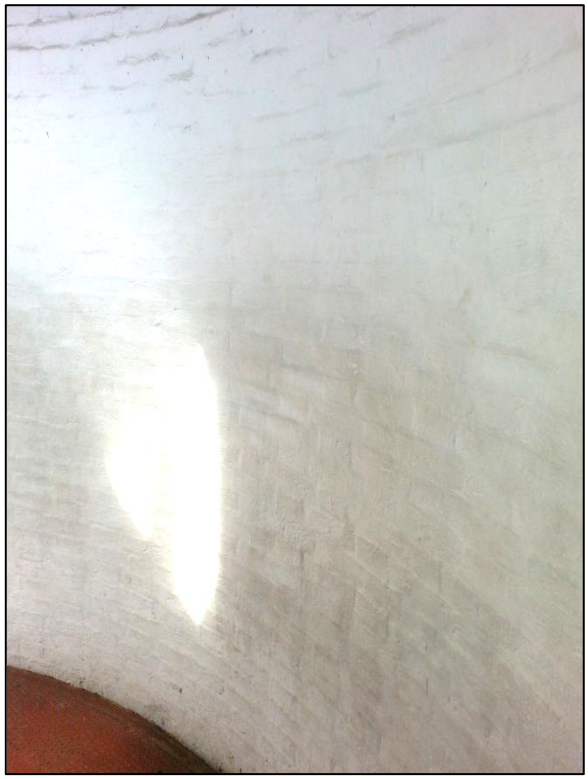


Figure 366. The interior surfaces of the Tenth Level exterior wall are in good condition. Photo: HPTC, 06/17/15.

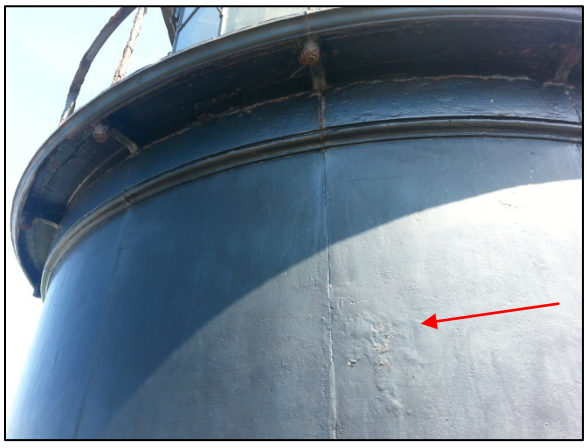


Figure 367. The exterior wall plates show old deterioration. Photo: HPTC, 06/17/15.



Figure 368. Paint peeling from the exterior wall plates has caused rust to form. Photo: HPTC, 06/17/15.

[46] Great Lakes Lighthouse Keepers Association. "Instructions to Light-Keepers," p. 53.

B2010-5	Lantern Level Exterior Walls

The 1986 assessment report by HHA/WJE detailed the poor condition of the Lantern Level exterior walls. Problems included:

- Missing screws from approximately 10% of the glazing stops.
- Some glazing strips replaced with metal.
- Small amount of corrosion at base of exterior face of the window walls.
- Caulking around perimeter of windows is in poor condition allowing water to penetrate into interior of lighthouse, including the Watch Room and Service Room below.
- Corrosion to horizontal mullions due to water infiltration.
- Corrosion to interior sills due to water infiltration.
- Cracked glass and replacement Plexiglas present.
- Metal components coated in thick, epoxy-like paint.[47]

The 1989 preservation drawings of the lighthouse noted the following regarding the Tenth Level exterior walls:

> Existing Lantern Curtain Wall – Remove all exterior metal glass stops and replace with new of bronze. Reglaze using new 5/16" laminated glass and silicone glazing system.
>
> Existing vertical iron mullion to remain.
>
> Existing bronze handles – Remove; clean off paint and dirt, prime and paint all surfaces; reinstall upon completion of curtain-wall restoration process. Replace [four] missing lower handles…with new bronze handles to match existing.
>
> Existing Horizontal Iron Mullion… [and] Existing Iron Sill/Ventilator – These elements are to be removed, refurbished, and replaced using new fasteners throughout. Work must be done sequentially and temporary enclosure provided during restoration.
>
> Existing Sliding Ventilator Panel – Remove existing set screws, then remove vent panel from sill. Clean rust & loose paint from surfaces, prime & paint. Reinstall using new set screws as shown and positioning ventilators in their open position (eight of these).
>
> Abrasively clean existing iron cornice. Prime and repaint.
>
> Replace ladder support rods and sockets.
>
> New ¼" x $1^1/_8$" bronze glass stop painted prior to installation. Attach with bronze screws and washers.
>
> Existing Cast Iron Mullion – Remove from curtain wall after removing glazing and glass stops. Clean all surfaces of mullion and rebuild mating surfaces of flanges w/plastic metal filler as necessary. Prime & paint all surfaces, the reattach to vert. mullions using new fasteners.
>
> Typical Glazing System [includes] silicone cap bead, double-sided foam glazing tape, continuous silicone wet seal between setting blocks, continuous silicone wet seal-inject between glass & glass stop, neoprene glazing wedge.
>
> Note: All iron surfaces to be covered by other construction are to have all rust & loose paint removed, primed and painted after existing glazing and stops have been removed and prior to installation of any new elements.[48]

[47] HHA/WJE, *Comprehensive Structural Analysis Report*, pp. 139-142.

It is assumed that all of this work was completed by ICC in 1991-93.

In their 2014 report, JKO/BPE noted that a glass panel was broken in the lantern.[49]

HPTC found the exterior curtain wall of the Lantern to be in fair condition (figs. 369-70). Some minor rust is exhibited on the interior metal pieces (figs. 371-72).

Regarding the color of the exterior of the Lantern walls, the 1902 *Instructions to Light-Keepers and Masters of Light-House Vessels,* published by the U.S. Lighthouse Board, states the required color was to be black (primed with red lead). The interior portions of the lantern were to be painted white.[50]

Condition Rating: FAIR
Deficiency Rating: MINOR



Figure 369. The exterior of the Lantern curtain wall system. Photo: HPTC, 06/16/15.

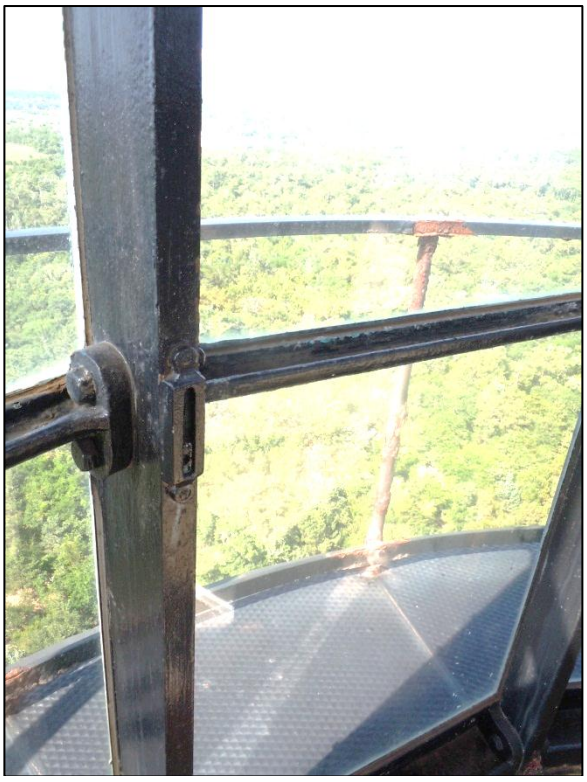


Figure 370, right. The interior of the Lantern curtain wall system. Photo: HPTC, 06/16/15.

[48] HPA/WJE. "Preservation of Cape Hatteras Lighthouse."
[49] JKO/BPE, *Condition Assessment Report,* p. 35.
[50] Great Lakes Lighthouse Keepers Association. "Instructions to Light-Keepers," p. 53.



Figure 371. One of the eight curtain wall vents located at the base of every other wall panel. Photo: HPTC, 06/16/15.

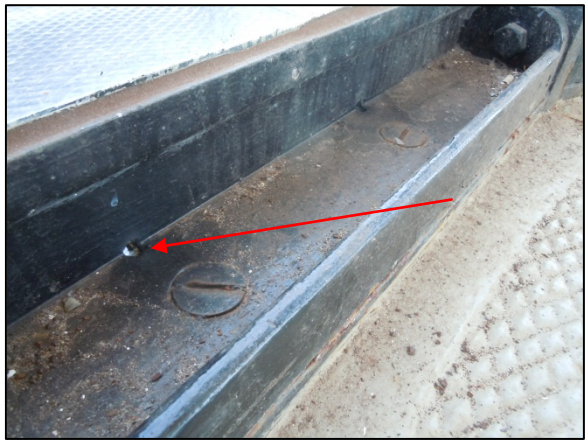


Figure 372. *B*ase of one segment of the curtain wall with weep hole dating to 1991-93 work. Photo: HPTC, 06/16/15.

B2020	Exterior Windows
B2020-1	**Tower Windows (Second Level through Eighth Level)**

Between July 1963 and August 1, 1965, the exterior pedimented window hoods and brackets were removed from the window openings on the Second through Eighth Levels.

HHA/WJE extensively assessed the condition of the tower exterior windows in their 1986 report. It was noted then that the casement window sash (two per opening) located in the seven windows of the tower (Second Level through Eighth Level) had been previously replaced. At that time, the window frames, sash, sills, and lintels were in overall fair condition. There was some pitting and rust located on the underside of the lintels and exposed edges where the pediments and lintels were once located. The hardware was noted missing altogether or in poor condition, particularly the hinges, which left the casements permanently open, allowing water to penetrate into the interior of the lighthouse. Some of the window panes were missing or cracked and a majority of the glazing was loose due to deteriorated or missing putty. The sash and frames were deformed by rust and pitted, and in some areas were split, cracked, and broken.[51]

The 1989 preservation drawings of the lighthouse noted the following regarding the exterior windows located in the tower (Second Level through Eighth Level):

> Existing Cast Iron Lintel – Abrasively clean, prime & paint all exposed surfaces and all surfaces.
>
> Existing Cast Iron Sill – Abrasively clean, prime & paint all exposed surfaces.
>
> Remove existing wood frames & metal screens. Fill & paint mtg. holes in masonry.
>
> Remove rust scale sufficiently to secure existing landing windows in closed position by mechanical means approved by contracting officer. After securing, seal all joints in and around windows – inside and outside – except for weeps.[52]

It appears that repair work was completed to the windows during 1991-93 by ICC. It is not known if the windows were ever permanently closed.

[51] HHA/WJE, *Comprehensive Structural Analysis Report,* pp. 78-83.
[52] HPA/WJE. "Preservation of Cape Hatteras Lighthouse."

The following assessment of the exterior tower windows was provided in the 2014 JKO/BPE *Condition Assessment Report:*

> The casement windows of the tower have frames, sash, and hardware made of cast iron; corrosion is pervasive in all seven windows. The window at the second-level landing has a split sill. The window at the fifth-level landing has an apron that is splitting. The lintel of the eighth-level landing is severely corroded. On the exterior, the original pedimented window heads of the casement windows are missing.[53]

HPTC concurs with assessment of JKO/BPE. In addition, severe deterioration is occurring to the materials and structural components surrounding the windows due to water infiltration because the windows are permanently open (figs. 373-77). This could cause irreparable damage to the historic masonry walls, the window openings, the historic floor coverings on the floor decks, and the floor deck structures below. Furthermore, the missing pediments over the exterior of each window opening also once helped with the protection of the interior components from water infiltration (fig. 378).

Regarding the color of the windows, the 1902 *Instructions to Light-Keepers and Masters of Light-House Vessels,* published by the U.S. Lighthouse Board, states the required exterior color for shutters (windows) was to be red, green, or brown. The interior color is not prescribed.[54] However, it is assumed the extant colors are what they were historically.

Condition Rating: POOR
Deficiency Rating: CRITICAL



Figure 373, left. The Second Level opening is typical of all of the tower windows and shows typical conditions, including non-historic plastic fencing used as screening. Photo: HPTC, 06/17/15.



Figure 374, above. Water infiltration is affecting the wall below the window on the Second Level. Photo: HPTC, 06/17/15.

[53] JKO/BPE, *Condition Assessment Report,* p. 25.
[54] Great Lakes Lighthouse Keepers Association. "Instructions to Light-Keepers," p. 53.



Figure 375. The sill of the Second Level window is split. Note the deteriorated paint and glimpses of rust at the edges. Photo: HPTC, 06/17/15.



Figure 376, right. The sash of the Second-Level window are permanently open due to inoperable hinges. Note also the rust. Photo: HPTC, 06/17/15.



Figure 377. The lintel above the Second Level window. Deterioration to the metal is caused by water running over the lintel because the window hood has been removed from the exterior of the opening. Photo: HPTC, 06/17/15.



Figure 378, right. The exterior of the Second Level window. A ghost mark of the original hood and brackets can be seen. The removal of these features is detrimental to the opening. Photo: HPTC, 06/17/15.

B2020-2	Ninth (Service Room) Level Windows

HHA/WJE extensively assessed the condition of the Service Room exterior windows in their 1986 report. At that time, they were in poor condition. They had cracked and warped iron frames due to water infiltration from the lantern Level above. The once-operable transoms located above each of the openings were permanently closed which had eliminated the ventilation they once provided for the space. This allowed extra humidity and moisture to accumulate in the space. The glazing was missing for two of the windows. The other window exhibited cracked and painted glazing.[55]

The 1989 preservation drawings noted the following regarding the exterior windows located on the Ninth (Service Room) Level:

> Abrasively clean all corrosion from glass stop receiver. Rebuild profile with plastic metal filler. Grind filler smooth to provide straight, true surface for glass stop attachment. Bed for glazing to be 1¼" wide.
>
> New 1" laminated glass (Typ. For all windows).
>
> Remove existing glazing, glass stops and wood closure panels from iron frame. Abrasively clean all remaining iron surfaces, prime and paint.... New 3/8" x 2¼" bronze glass stop attached with bronze screws thru plastic metal into iron (typical).
>
> New rod and caulk between masonry and iron frame at head and jambs (typical for all windows). Remove all existing sealant from this gap.
>
> Existing iron frame for ventilator – remove temporary plywood panels and existing iron vent panels. Abrasively clean all exposed surfaces, prime and paint. Typical for all windows.
>
> New cast iron ventilator panel in each opening to match original.
>
> New ½" Ø stainless steel pivot pin threaded into iron panel and clamped to iron frame (typical).
>
> Grind out diagonal crack in iron soffit, fill with plastic metal filler, grind smooth and paint. This work at [two windows].
>
> New cast iron casing element welded to existing iron cheek wall.
>
> Grind smooth existing edge of iron sill where apron has broken away. Cast new replacement apron to match those on adjacent windows. Weld to sill and grind weld flush with surface of sill. This work at [one] window...only.
>
> Remove existing iron casing which has separated from cheek wall and grind edge of cheek wall smooth. Cast new iron casing element as shows, matching the profile of the original casing. Weld new element to edge of cheek wall. Grind weld flush with surface of panel, prime and paint. Typical for the right hand jambs on [two windows].
>
> Remove existing broken cheek wall and cast new of iron. Weld new panel to sill, soffit and jamb with continues weld. [56]

It is assumed that very little of the above repair work was completed in 1991-93 by ICC based on the condition of the openings currently. At the very least, new glass was installed in each of the openings.

[55] HHA/WJE, *Comprehensive Structural Analysis Report,* pp. 78-83.
[56] HPA/WJE. "Preservation of Cape Hatteras Lighthouse."

The following assessment of the Service Room windows was provided in the JKO/BPE 2014 report:

> The ninth-level landing has three fixed sash windows with operable louvered vents above, all made of cast iron. There is significant corrosion on all window frames and vents. The northeast window is missing its operable louver.[57]

HPTC concurs with assessment of JKO/BPE. It is likely that a majority of the corrosion occurred prior to the 1991-93 repair work. However, many components still remain in a seriously deteriorated state, including the transom elements and interior trim pieces (figs. 61-66).

Regarding the color of the windows, the 1902 *Instructions to Light-Keepers and Masters of Light-House Vessels,* published by the U.S. Lighthouse Board, states the required exterior color for shutters (windows) was to be red, green, or brown. The interior color is not prescribed.[58] It is assumed the extant exterior color (black) was extant historically. It is likely that the interior of the windows were painted black to match the rest of the ironwork inside the lighthouse.

Condition Rating: POOR
Deficiency Rating: SERIOUS

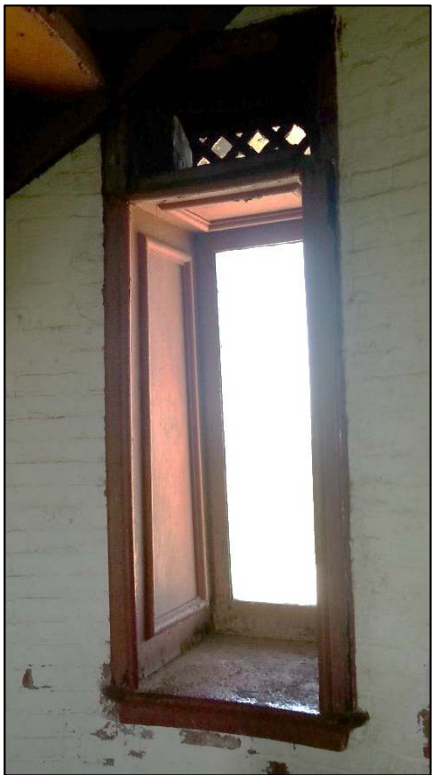




Figure 380, above. The transom above the northeast Service Room window shows a lot of deterioration and missing pieces. Photo: HPTC, 06/17/15.

Figure 379, left. The interior of the northeast Service Room window. Some of the corrosion is likely leftover from damage which occurred prior to 1991-93. Photo: HPTC, 06/17/15.

[57] JKO/BPE, *Condition Assessment Report,* p. 25.
[58] Great Lakes Lighthouse Keepers Association. "Instructions to Light-Keepers," p. 53.





Figure 382, above. The transom over the southeast window is deteriorated, likely beyond repair. Photo: HPTC, 06/17/15.

Figure 381, left. The interior of the southeast Service Room window. Photo: HPTC, 06/17/15.



Figure 383. The southwest window shows cracks in its lintel and trim componenets. Photo: HPTC, 06/17/15.



Figure 384. The transom over the southwest window is deteriorated, likely beyond repair. Photo: HPTC, 06/17/15.

B2030	Exterior Doors
B2030-1	**First Level Exterior Doors**

The 1986 HHA/WJE report provided the following assessment of the First Level exterior door opening:

> The bronze doors are in good condition, although the screws holding the exterior slide bolt are split and broken and all of the replacement washers on the inside face of the doors are corroded. The slide bolt at the top of the east door is missing from its holder. The hinges are bronze and the center one on the east door is rusting. Holes have been cut through the iron transom for electrical conduit. The conduit now runs through the wood louver transom. . . .[59]

The 1989 preservation drawings of the lighthouse noted the following regarding the First Level exterior door opening:

> Existing Cast Iron Lintel – Clean exposed portions. Prime & paint.
>
> Existing Cast Iron Transom bar and Frame – Clean, prime and paint. Fill misc. small holes and pits with plastic metal filler. Existing Bronze Hinges with Frame MTD leaf embedded behind granite. Replace pins with new bronze to match existing.
>
> [One] hinge is severed at granite and is to remain as is.
>
> Replace all ferrous washers with new of bronze.
>
> Note: Remove Doors from frame, leaving embedded hinge leaves in place. Clean entire iron frame and sill. Fill miscellaneous holes and fits. Then prime and paint. Reinstall doors with new hinge pins.[60]

It is assumed that the repair work was completed in 1991-93 by ICC.

The following assessment of the first-level exterior door opening was provided in the 2014 report by JKO/BPE:

> The doors have some corrosion, and the iron door frame has a great deal. In addition to the corrosion, there are two holes in the transom bar over the doors, probably drilled to install electrical conduit and now abandoned. The openings are allowing moisture to enter the cast elements, causing the metal to further deteriorate.[61]

The bronze doors are unpainted. The door surround is painted. In 2014, the paint was noted to be "blistering and chipping."[62]

HPTC concurs with the findings of JKO/BPE. See Figures 385-86 for photos from HPTC's assessment visit.

Condition Rating: FAIR
Deficiency Rating: MINOR

[59] HHA/WJE, *Comprehensive Structural Analysis Report*, p. 84.
[60] HPA/WJE. "Preservation of Cape Hatteras Lighthouse."
[61] JKO/BPE, *Condition Assessment Report,* p. 26.
[62] JKO/BPE, *Condition Assessment Report,* p. 26.





Figure 386, above. The transom has been infilled with a wood louver. Holes in the original metal portion of the frame detract from the historic structure. Photo: HPTC, 06/17/15.

Figure 385, left. The exterior of the First Level exterior door. Light corrosion and rust can be seen on the exterior of the bronze doors. Otherwise the doors are in good condition. Photo: HPTC, 06/17/15.

B2030-2	Tenth (Watch Room) Level Exterior Door

The 1986 HHA/WJE report stated that the cast iron frame of the Tenth Level exterior door was extremely corroded. At that time it did not affect the function of the door and was only aesthetic.[63]

The 1989 preservation drawings provided the following regarding the Tenth Level exterior door:

> Existing iron Frame – Clean away rust & loose paint. Prime all miscellaneous abandoned screw holes with plastic metal filler and repaint.
>
> Remove three existing hinges prior to abrasively cleaning the iron frame. Reinstall hinges after cleaning, priming, and painting the frame. Paint all surfaces of hinges prior to reinstalling.
>
> Existing Iron Door – Clean away rust and loose paint. Prime and paint all surfaces…. Rehang door, after machining edges as required so that it fits the opening and closes properly.
>
> Install new bronze bolt w/lock bars on interior. Bolt shall be similar to that on bronze doors at ground floor.
>
> Existing Iron Sill – Clean, prime and repaint.
>
> Caulk iron frame into masonry all around.[64]

It is assumed that the repair work was completed in 1991-93 by ICC.

[63] HHA/WJE, Comprehensive Structural Analysis Report, pp. 106-107.
[64] HPA/WJE. "Preservation of Cape Hatteras Lighthouse."

The 2014 JKO/BPE report stated the Tenth Level exterior door "has extensive corrosion. The surround has some corrosion but is in sound condition."[65]

HPTC concurs with the findings of JKO/BPE. See Figures 387-88 for photos from HPTC's assessment visit. It is likely that the door color (black) is its historic color.

Condition Rating: POOR
Deficiency Rating: SERIOUS





Figure 388, above. The frame shows some corrosion and degraded paint. Photo: HPTC, 06/17/15.

Figure 387, left. The exterior face of the Tenth Level exterior door is severely corroded its entire height. Photo: HPTC, 06/17/15.

B30	ROOFING
B3010	**Roof Coverings**

Repairs to the lighthouse roof were completed in early 1994 (scope unknown).

The roof coverings were not assessed by JKO/BPE in 2014.

The roof coverings were inaccessible during the June assessment. There was no evidence of any current leaks or issues.

Condition Rating: FAIR
Deficiency Rating: MINOR

[65] JKO/BPE, *Condition Assessment Report,* p. 26.

C	INTERIORS
C10	INTERIOR CONSTRUCTION
C1020	Interior Doors
C1020-1	**First Level Interior Doors**

The 1986 HHA/WJE report noted the following about the First Level interior doorway:

> The wood doors in storage are in good condition. They are painted white and the glazing is intact. The door handles have been painted over and the knobs are not extant. The hinges are missing and only a lock/bolt receiver remains. The cast iron frame is also in good condition, although holes have been cut through the transom bar for the conduit that now runs through the empty transom space above.[66]

The First Level interior doorway was not assessed by JKO/BPE in 2014.

The door frame retains the same condition as found in 1986 (fig. 389).

Regarding the color of interior door, the 1902 *Instructions to Light-Keepers and Masters of Light-House Vessels*, published by the U.S. Lighthouse Board, states the required color for interior ironwork (surround) was to be black (primed with red lead) and interior woodwork (non-extant doors) was to be white.[67]

Condition Rating: GOOD
Deficiency Rating: MINOR



Figure 389. The First Level interior doorway no longer retains its doors or transom. Holes can be seen in the historic metal frame. Photo: HPTC, 06/17/15.

[66] HHA/WJE, *Comprehensive Structural Analysis Report*, p. 84.
[67] Great Lakes Lighthouse Keepers Association. "Instructions to Light-Keepers," p. 53.

C1020-2	Ninth (Service Room) Level Interior Door

The 1986 HHA/WJE report found the Ninth Level Service Room door to be in good condition. At that time it was displaced from its hinges and needed to be rehung. The iron frame was cracked.[68] It was likely placed back on its hinges during the 1991-93 repair work completed by ICC.

The 2014 JKO/BP report noted that the Ninth Level door, frame, and hardware are corroded.[69] HPTC found this corrosion to be light and minor (figs. 390-91).

Regarding the color of interior door, the 1902 *Instructions to Light-Keepers and Masters of Light-House Vessels*, published by the U.S. Lighthouse Board, states the required color for interior ironwork (surround) was to be black (primed with red lead).[70]

Condition Rating: FAIR
Deficiency Rating: MINOR



Figure 390. The Ninth Level doorway with door open. Photo: HPTC, 06/17/15.



Figure 391. The Ninth Level doorway with door closed. Minor corrosion can be seen. Photo: HPTC, 06/17/15.

[68] HHA/WJE, *Comprehensive Structural Analysis Report,* p. 88.
[69] JKO/BPE, *Condition Assessment Report,* p. 26.
[70] Great Lakes Lighthouse Keepers Association. "Instructions to Light-Keepers," p. 53.

C1020-3	Tenth (Watch Room) Level Interior Door

The 1986 HHA/WJE report did not assess the Tenth Level interior doorway.

The 1989 preservation drawings noted that the door was to be removed. It is assumed it was removed by ICC in 1991-93.

The interior metal door on the tenth (Watch Room) level is no longer extant. Its location is unknown.

Condition Rating: N/A
Deficiency Rating: N/A

C20	STAIRS	
C2010	Stair Construction	
C201001	Interior Stair Construction	
C201001-1	**Main Stair (Second Level to Ninth Level)**	

HHA/WJE extensively assessed the main interior stair in their 1986 report. A summary statement from the report:

> The results of the survey indicate that the stairs are generally in good structural condition. Only a few elements require replacement or substantial repairs. However, a pattern of deterioration that is directly related to the construction is evident. Wherever metal rests against metal moisture gathers and rust develops. As the elements rust pressures between the elements increase and the brittle cast-iron cracks.[71]

The 1989 preservation drawings noted the following regarding typical treatment to the main interior stair:

> GENERAL STAIR REPAIR NOTES
>
> 1. The damage indicated on the schedule is a listing of all damage found during field surveys of the stair system. Special repair treatment is required only in the highlighted rows & columns on the schedule.
> 2. Typical treatment for the entire stair system is to be as follows:
>   - Clean all rust & loose paint from treads, brackets, and stringer, including exposed bolts. Clean rust away from all cracks but do not grind out any of the cracks.
>   - Prime and paint the areas exposed during cleaning as described in the specifications, flooding all cracks with paint. Completely bridge cracks with paint where possible.
>   - Grind out all joints between tread & riser elements to a uniform width of 1/8", removing all corrosion from these joints. Prime & paint exposed metal after grinding. . . .
> 3. Tread elements to be completely replaced are indicated by the highlighted horizontal rows on the schedule. . . .
> 4. Repair treatment for the category entitled 'nut/bolt missing' is to be as follows:
>   - Refill & tap existing bolt holes.
>   - Insert new bolt with head matching adjacent original fasteners. . . .

[71] HHA/WJE. *Comprehensive Structural Analysis Report.*

5. Replacement and repairs called for tin the 'remarks' column are explained in specific notes A thru D below.

SPECIFIC NOTES

A. Replace footplate (tread #00) and upper tread (#31) elements at landings.
B. Replace these typical tread elements.
C. Inspect all bolted connectors and tighten where loose. If bolt is frozen and cannot be tightened, drill out and treat as described in Note "D" below.
D. Remove rust from deteriorated back face of stringer at lower half of flight #2. Drill out corroded bolts in this area. Redrill bolt holes large enough to expose sound metal within hole. Tap the holes and install new bolts. Paint all exposed metal on stringer and all new bolts. . . .[72]

It is assumed that this repair work was completed by ICC in 1991-93.

JKO/BPE noted the following general conditions of the metal stair components in the lighthouse in their 2014 report:

> Throughout the structure, corrosion of the [original] iron [components] and [replacement] steel [components] is pervasive. Pieces of iron that are easy to maintain have been maintained but those that are difficult to maintain have not been. The common problems throughout the ferrous metals in the lighthouse include:
>
> - Corrosion of the nuts on the bottom of the stair balustrade.
> - Corrosion of the iron up against the masonry, where it is not repainted regularly.
> - Corrosion of the stair treads on the face and nosing.[73]

In addition, they noted that in areas where the metal is corroding, the paint is also deteriorated. Additionally, high-use components like the handrails, have thin paint cover.

JKO/BPE also gave comments on specific components of the main stair. On the Fourth Level: "Where the bolts that secure the stringer to the tread support were easy to replace, they have been replaced, but where they are difficult to replace they have not been replaced and are corroded." On the Fifth Level: "Bottom of [lowest tread] shows significant surface corrosion." On the Seventh Level: "The stringer going up from landing seven is showing delamination and corrosion. The stair treads above landing seven start to slope downward away from the wall. There is a gap between [the uppermost] stair tread. . .the riser [above it]."[74]

HPTC was unable to complete a component-by-component assessment of the main interior stair. Overall, HPTC does agree with the general comments made by JKO/BPE, as quoted above. See Figures 392-93 for photographs from HPTC's visit.

Due to the absence of early color photographs of the lighthouse interior, it is hard to determine the original interior color of the main stair. Historic black-and-white photographs show the stairs were painted a dark color in 1955, and repainted a lighter color, likely the extant red, in 1960 (figs. 394-95). Additionally, the 1902 *Instructions to Light-Keepers and Masters of Light-House Vessels,* published by the U.S. Lighthouse Board, notes the required color for interior iron staircases and

[72] HPA/WJE. "Preservation of Cape Hatteras Lighthouse."
[73] JKO/BPE, *Condition Assessment Report,* pp. 23-24.
[74] JKO/BPE, *Condition Assessment Report,* pp. 27-30.

railings was black. The underside of the stairways was to be black or white. Red was not a permissible color on the interior.[75]

Condition Rating: FAIR
Deficiency Rating: SERIOUS



Figure 392. Corroding bolts on the bottom of the stair tread-riser assembly, here seen between the First and Second Levels. Photo: HPTC, 06/17/15.



Figure 393. Degrading paint on the bottom of the treads between the Eighth and Ninth Levels. Photo: HPTC, 06/17/15.



Figure 394. A view of the main insteior stair on October 6, 1955. At this time the dark paint is deteriorated. Photo: Cape Hatteras National Seashore Archives. Cropped by author.



Figure 395. A view of the main inteiror stair in February 1960 likely after it was painted. Photo: Cape Hatteras National Seashore Archives.

[75] Great Lakes Lighthouse Keepers Association. "Instructions to Light-Keepers," p. 53.

C201001-2	Ninth Level Enclosed Stair

HHA/WJE extensively assessed the interior stair in their 1986 report. A summary statement from the report:

> The results of the survey indicate that the stairs are generally in good structural condition. Only a few elements require replacement or substantial repairs. However, a pattern of deterioration that is directly related to the construction is evident. Wherever metal rests against metal moisture gathers and rust develops. As the elements rust pressures between the elements increase and the brittle cast-iron cracks.[76]

The 1989 preservation drawings noted the following regarding repair work to the Ninth Level enclosed stair: "Clean rust and loose paint from all surfaces. Prime and repaint."[77] It is assumed this work was completed in 1991-93 by ICC.

JKO/BPE noted the following general conditions of the metal stair components in the lighthouse in their 2014 report:

> Throughout the structure, corrosion of the [original] iron [components] and [replacement] steel [components] is pervasive. Pieces of iron that are easy to maintain have been maintained but those that are difficult to maintain have not been. The common problems throughout the ferrous metals in the lighthouse include:
>
> - Corrosion of the nuts on the bottom of the stair balustrade.
> - Corrosion of the iron up against the masonry, where it is not repainted regularly.
> - Corrosion of the stair treads on the face and nosing.[78]

On the Ninth Level, they specifically noted: "The stringer going up from level nine is likewise corroded enough to demand additional evaluation. The stairs above this level are enclosed in iron or steel panels. This paneling along the stairs in corroding. The top riser leading to level ten is fractured."[79]

HPTC was unable to complete a component-by-component assessment of the main interior stair. Overall, HPTC does agree with the general comments made by JKO/BPE, as quoted above. See Figures 396-99 for photographs from HPTC's visit.

See C201001-2 Main Stair above for comments regarding the original color of the interior stair components.

Condition Rating: POOR
Deficiency Rating: SERIOUS

[76] HHA/WJE. *Comprehensive Structural Analysis Report.*
[77] HPA/WJE. "Preservation of Cape Hatteras Lighthouse."
[78] JKO/BPE, *Condition Assessment Report,* pp. 23-24.
[79] JKO/BPE, *Condition Assessment Report,* pp. 30-32.



Figure 396. The stair from the Ninth Level to the Tenth Level is enclosed with metal panels which have degraded paint. Photo: HPTC, 06/17/15.



Figure 397. The underside of the Ninth Level stair shows corrosion. Photo: HPTC, 06/17/15.



Figure 398. Major corrosion located where the Ninth Level stair meets the metal plates covering the interior face of the exterior brick wall. Photo: HPTC, 06/17/15.



Figure 399. The top riser of the Ninth Level stair is cracked. Photo: HPTC, 06/17/15.

C201001-3	Lantern Ladder

HHA/WJE extensively assessed the interior stair in their 1986 report. A summary statement from the report:

> The results of the survey indicate that the stairs are generally in good structural condition. Only a few elements require replacement or substantial repairs. However, a pattern of deterioration that is directly related to the construction is evident. Wherever metal rests against metal moisture gathers and rust develops. As the elements rust pressures between the elements increase and the brittle cast-iron cracks.[80]

The 1989 preservation drawings noted the following regarding repair work to the Lantern ladder: "Clean rust & loose paint from all surfaces. Prime & repaint."[81] It is assumed this work was completed in 1991-93 by ICC.

JKO/BPE noted in their 2014 assessment report that the Lantern ladder has surface corrosion.[82] HPTC agrees with this assessment (fig. 400).

Condition Rating: FAIR
Deficiency Rating: MINOR



Figure 400. The Lantern ladder shows corrosion. Photo: HPTC, 06/16/15.

C201002	Exterior Stair Construction

The 1989 preservation drawings noted that all caulk was to be removed from the exterior stone stairs, and it was to be repointed.[83] It is assumed this work was completed in 1991-93 by ICC.

Prior to the move in 1999, existing cracks throughout the lighthouse structure were documented in the design drawings for the move. The documentation drawings note a few cracks, spalling, stone failure, etc. on the exterior stair (see fig. 319).

The exterior stairs were completely disassembled prior to the move (fig. 401). It was reassembled with the same components on a new brick masonry foundation after the move (fig. 402).

JKO/BPE reassessed the existing conditions of the exterior stair and found no significant changes to the condition (figs. 403, 405, 407).[84]

[80] HHA/WJE. *Comprehensive Structural Analysis Report.*
[81] HPA/WJE. "Preservation of Cape Hatteras Lighthouse."
[82] JKO/BPE, *Condition Assessment Report,* pp. 32-33.
[83] HPA/WJE, "Preservation of Cape Hatteras Lighthouse."

HPTC also assessed the exterior stair (figs. 404, 406, 408). The assessment team noticed a few instances of calcification in joints and biological growth on most of the mortar joints (figs. 409-10). The modern handrail is in good condition.

Condition Rating: FAIR
Deficiency Rating: MINOR



Figure 401. The exterior stair was disaessembled prior to the move. Photo: Cape Hatteras National Seashore Archives, 01/19/99.



Figure 402. The exterior stair was reassembled on a new brick masonry foundation after the move. Photo: Cape Hatteras National Seashore Archives, 10/12/99.

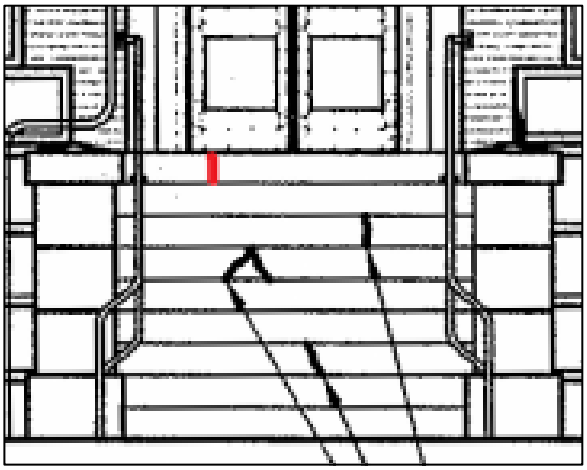


Figure 403. The front (north) elevation of the stair from the JKO/BPE report shows no change to the conditions documented in 1999. Cropped by author.

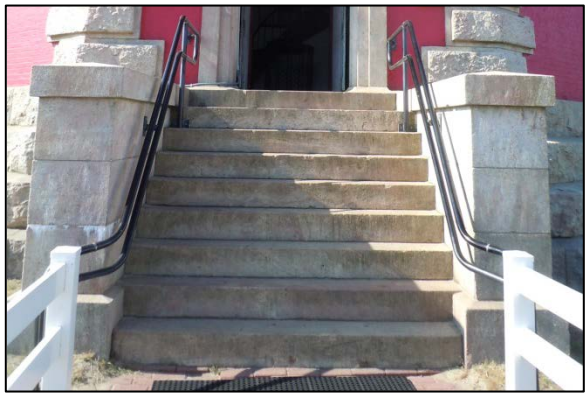


Figure 404. The front north elevation as seen by HPTC. Photo: 06/17/15.

[84] JKO/BPE, *Condition Assessment Report,* Appendix pp. 4-14.

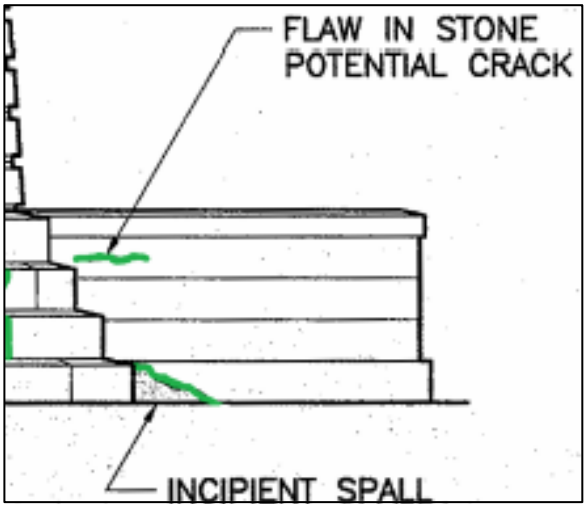


Figure 405. The east elevation from the 2014 JKO/BPE report shows no change to the conditions documented in 1999. Cropped by author.



Figure 406. The east elevation as seen by HPTC. Photo: 06/17/15.

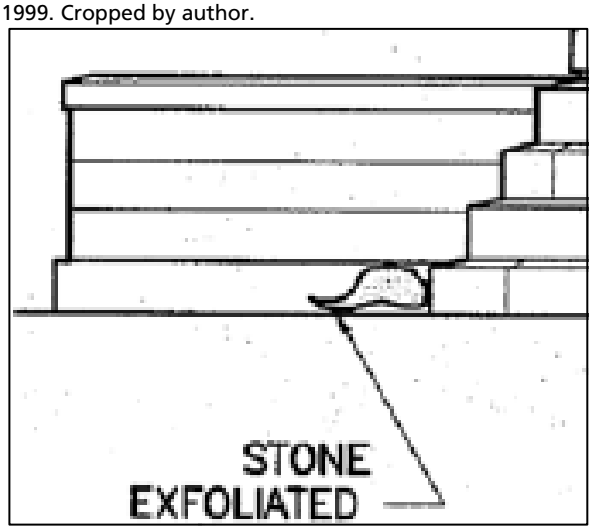


Figure 407. The west elevation from the 2014 JKO/BPE report shows no change to the conditions documented in 1999. Cropped by author.



Figure 408. The west elevation as seen by HPTC. Photo: 06/17/15.



Figure 409. Calcification can be seen in a few locations on the exterior stair. Photo: HPTC, 06/17/15.



Figure 410. Biologicial growth covers most of the mortar joints. Photo: HPTC, 06/17/15.

C30	INTERIOR FINISHES
C3020	**Floor Finishes**

The 2014 JKO/BPE report stated: "The marble pavers appear to have suffered damages from both impact and abrasion. The particular causes are unknown. In many instances, the deterioration is significant enough that even continued foot traffic will cause additional damage."[85]

HPTC found a majority of the original black and white marble tiles to be in good condition. Several show cracks from general use and discoloration likely from waterproofing sealants applied over time (figs. 411-12). This original feature should be retained rather than replaced.

Condition Rating: FAIR
Deficiency Rating: MINOR



Figure 411. Cracked and discolored original tiles on the First Level. Photo: HPTC, 06/17/15.



Figure 412. Worn and discolored original tiles on the Second Level. Photo: HPTC, 06/17/15.

D	SERVICES
D20	**PLUMBING**

There is no plumbing system extant in the lighthouse.

Condition Rating: N/A
Deficiency Rating: N/A

D40	**FIRE PROTECTION SYSTEMS**

There is no fire protection system extant in the lighthouse.

Condition Rating: N/A
Deficiency Rating: N/A

[85] JKO/BPE, *Condition Assessment Report*, p. 38.

D50 ELECTRICAL

The electrical system for the lighthouse is carried through the lighthouse via standard plastic conduit. The modern conduit detracts from the historic structure, particularly at the front entrance (fig. 413). The conduit runs up the center of the lighthouse via the guardrails for the weight well. This is a good use of space, however ideally the conduit should be made a color to match the color of the paint. In addition, the panel at the top of the lighthouse is large and detracts from the Watch Room space (fig. 414).

Condition Rating: GOOD
Deficiency Rating: MINOR



Figure 413. The modern conduit at the front entrance detracts from the historic features. Photo: HPTC, 06/17/15.



Figure 414. The electrical components at the top of the lighthouse are mounted to a panel which is imposing in the historic space. Photo: HPTC, 06/17/15.

D5030 Communications & Security Systems

There are no communications or security systems extant in the lighthouse.

Condition Rating: N/A
Deficiency Rating: N/A

D5090	Other Electrical Systems
D509004	**Lightning Protection System**

A new lightning protection system was installed on the lighthouse after its move in 1999. One large contact point is located on the top of the lighthouse roof (fig. 415). The downlead cables then run through the roof into the interior to conduit located in the Lantern (fig. 416). The conduit runs down the center of the lighthouse via the guardrails for the weight well. At the base of the lighthouse, the downlead cables run through the First Level floor and are grounded in the granite and brick foundation (fig. 417).

Condition Rating: GOOD
Deficiency Rating: MINOR



Figure 415. A large lightning rod is located on top of the lighthouse roof. Photo: HPTC, 06/18/15.



Figure 416. The downlead cables penetrate the roof to meet conduit on the interior of the lighthouse. Photo: HPTC, 06/16/15.



Figure 417, right. The downlead cables are run to the base of the lighthouse and are grounded in the foundation. Photo: HPTC, 06/17/15.

G	BUILDING SITEWORK
G20	SITE IMPROVEMENTS
G2040	**Site Development**

The brick walk is in good condition.

The modern vinyl fence is in good condition; however it is unsympathetic to the historic lighthouse site.

Condition Rating: GOOD
Deficiency Rating: MINOR

G90	OTHER SITE WORK
G9087	**Overall Building Site Drainage**

The lighthouse site retains its re-graded condition since the move and is in good condition..

Condition Rating: GOOD
Deficiency Rating: MINOR

Part 2 | Treatment and Use

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Requirements for Treatment and Use

The treatment and use of the Cape Hatteras Lighthouse must be considered within a framework of applicable laws, agreements, and policies. These mandates govern a wide range of management issues beyond the preservation, protection, and interpretation of the Cape Hatteras National Seashore's cultural resources. They extend to issues of visitor and staff use, agricultural lease, safety, and universal accessibility, among others. Additionally, the Cape Hatteras National Seashore Foundation Statement is discussed below.

Cape Hatteras National Seashore Foundation Statement

A foundation statement is "a formal statement of [a park's] core mission to provide basic guidance for all planning and management decisions: a foundation for planning and management." The document includes the definition of the park purpose, the park significance statements, primary interpretive themes, fundamental resources and values, and special mandates.[1]

Park Purpose:

> The purpose of Cape Hatteras National Seashore is to permanently preserve the wild and primitive character of the ever-changing barrier islands, protect the diverse plant and animal communities sustained by the coastal island process, and provide for recreational use and enjoyment that is compatible with preserving the distinctive natural and cultural resources of the nation's first national seashore.[2]

Park Significance: This section identifies seven reasons why the park's resources are significant enough to warrant national park designation. Two directly relate to the lighthouse:

> Significance Statement 6: Its artifacts, historic sites, and geographic setting provide tangible links to understanding humankind's ability to adapt in a harsh and changing coastal environment in isolation from the mainland. These links, which are of deep symbolic significance to local villagers, include lighthouses, shipwrecks, Native American sites, and more.
>
> Significance Statement 7: Numerous historical events of national significance have occurred on or near its shores including four centuries of shipwrecks, the United States government's response to protect maritime commerce during the Civil War and World War II, and the experimental development and use of new technology.[3]

Primary Interpretive Themes: This section is based on the stated park purpose and significance. Two themes directly relate to the lighthouse:

> Topic: History and Heritage – Within this dynamic and once isolated barrier island system, unique cultures have evolved which serve as a testament to humankind's relationship with the boundary of land and sea.

[1] National Park Service. "Foundation Statement: Cape Hatteras National Seashore, North Carolina." September 2011, pp. 6-7.
[2] Ibid, p. 9.
[3] Ibid, pp. 10-10-11.

> Topic: Stewardship and Preservation – Stewardship of the national seashore and preservation of its history provides future opportunities for people to access, experience, and learn about coastal dynamics/cultural change.[4]

Fundamental Resources and Values: This section identifies attributes "which warrant primary consideration during park planning and management because they are critical to achieving the park's purpose and maintaining its significance." The lighthouse is identified as a fundamental resource under "Historic structures, archeological sites, and cultural landscapes."[5] Another identified important value is the story of "the movement and preservation of the Cape Hatteras Light Station."[6]

Outer Banks Group Climate Action Plan

On September 29, 2015 the *Climate Action Plan* for Cape Hatteras National Seashore and the other entities of the Outer Banks Group was finalized.[7] The plan acknowledges that climate change threatens the cultural and natural resources which the NPS strives to preserve. Directives and guidelines provide information on how to take action through adaptation and mitigation to climate changes. These directives and guidelines include the following, among others:

- Executive Order No. 13693: "Planning for Federal Sustainability in the Next Decade"
- Green Parks Plan (NPS)
- 2012-2014 Climate Change Action Plan (NPS)
- Climate Change Response Strategy (NPS)

The plan further defines strategies that CAHA enact to meet required mitigation and adaptation goals. These include:

1. Reduce Greenhouse Gas emissions resulting from activation by operations
2. Increase climate change education and outreach
3. Actions for adapting cultural and natural resources to a changing climate

Strategy 3 most directly affects the Cape Hatteras Lighthouse. It further states:

> Climate change threatens the cultural and natural resources that the Outer Banks Group is known for and so the Outer Banks Group has considered actions to take to adapt to climate change. In the context of climate change, adaptation is an adjustment in natural or human systems that moderates harm or seeks out beneficial opportunities in response to change. Adaptation may include a variety of social, economic, or ecological responses such as adapting the location, structure, or function of Outer Banks Group facilities in anticipation of climate change. Given the potential impact from climate change, it is important to closely monitor

[4] Ibid, pp. 12-13.
[5] Ibid, pp. 14-15.
[6] Ibid, p. 16.
[7] National Park Service, U.S. Department of the Interior. "Cape Hatteras National Seashore, Wright Brothers National Memorial, & Fort Raleigh National Historic Site." *Climate Action Plan.* Signed September 29, 2015. Accessed at http://www.nps.gov/subjects/climatechange/upload/CAHA_Action-Plan-final-9-29-15.pdf on December 15, 2015.
Additional information on how the National Park Service is planning for and addressing climate change, can be found through the following sources:
Rockman, Marcy. "An NPS Framework for Addressing Climate Change with Cultural Resources." *The George Wright Forum, vol. 32, no. 31 (2015)*. pp. 37-50. Accessed at http://www.georgewright.org/321rockman.pdf on December 15, 2015.
National Park Service, U.S. Department of the Interior. "Preserving Coastal Heritage." *Summary Report, April 3-4, 2014, Federal Hall National Monument, New York City.* Accessed at http://www.achp.gov/docs/preserve-coastal-heritage.pdf on December 15, 2015.

cultural and natural resources and identify those that are most at risk. From this identification, the Outer Banks Group can work towards reducing the risk or documenting the resources to try and keep a record of them. Presented below are the actions that are currently under way and which comprise the Outer Banks Group's progress to date, and those actions that the Outer banks Group will pursue.

Progress to Date

- Relocated Cape Hatteras Lighthouse and other buildings away from eroding seashore.

Adaptation

1. Incorporate climate adaptation into all levels of NPS planning
   - Monitor resources for climate impacts
   - Develop management strategies to increase the adaptive capability of park resources and facilities
   - Identify species and resources most at risk
     - Conduct climate science within parks

Evaluate Progress and Identify Areas for Improvement

By taking the actions established in the goals above, the Outer Banks Group plans to reduce its emissions to the specified goals. Achieving these goals will require an ongoing commitment by the Outer banks Group, which may include subsequent emission inventories, additional mitigation and adaptation actions, and reevaluation of goals. Presented below are the actions that the Outer Banks Group will pursue.

Monitoring – Planned Actions

1. Monitor progress with respect to reducing emissions and use this to drive continual performance
   - Track progress on climate friendly actions through the environmental management system.

National Historic Preservation Act

Section 106 of the National Historic Preservation Act (NHPA) mandates that federal agencies, like the National Park Service, take into account the effects of their actions on properties listed or eligible for listing on the National Register of Historic Places and gives the Advisory Council on Historic Preservation (ACHP) a reasonable opportunity to comment.[8] The Cape Hatteras Lighthouse is listed as a contributing structure in the Cape Hatteras Light Station National Historic Landmark District and any undertakings (typically expenditure of federal funds) will be reviewed in accordance to NPS policy and federal historic preservation laws including the *Programmatic Agreement Among the National Park Service (U.S. Department of the Interior), the Advisory Council on Historic Preservation and the National Conference of State Historic Preservation Officers for Compliance with Section 106 of the National Historic Preservation Act* (2008).[9]

Section 110 of the NHPA clarifies the broad historic preservation responsibilities of Federal agencies with the intention of ensuring that historic preservation is fully integrated into the ongoing programs of all Federal agencies by identifying, protecting, and avoiding unnecessary damage to historic properties. Additionally, each agency is required to use historic properties available to it

[8] The NHPA of 1966 was last amended in 2006. A downloadable copy is located at (http://www.achp.gov/nhpa.html).
[9] A copy of this agreement can be found on the NPS's website at (http://www.nps.gov/policy/106agreement.pdf).

and when managing these properties, must consider preservation of their historic, archaeological, architectural, and cultural values.[10]

Executive Order No. 11593

Executive Order No. 11593: Protection and Enhancement of the Cultural Environment (1971) mandates that "the Federal Government shall provide leadership in preserving, restoring, and maintaining the historic and cultural environment of the Nation."[11] Responsibilities of federal agencies include:

- Nominating "...to the Secretary of the Interior all sites, buildings, districts, and objects under their jurisdiction of the control that appear to qualify for listing on the National Register of Historic Places."
- Exert caution "...during the interim period until inventories and evaluation...are completed to assure that any federally owned property that might qualify for nomination is not inadvertently transferred, sold, demolished, or substantially altered."
- "Initiate measures to assure that where as a result of Federal action or assistance a property listed on the National register of Historic Places is to be substantially altered or demolished, timely steps be taken to make or have made records, including measured drawings, photographs, and maps, of the property, and that copy of such records then be deposited in the Library of Congress as part of the Historic American Buildings Survey or Historic American Engineering Record for future use and reference."
- "Initiate measures and procedures to provide for the maintenance, through preservation, rehabilitation, or restoration, of federally owned and registered sites professional standards prescribed by the Secretary of the Interior."

Executive Order No. 13006

Executive Order No. 13006: Locating Federal Facilities on Historic Properties (1996) mandates that "the Federal Government shall utilize and maintain, wherever operationally appropriate and economically prudent, historic properties and districts…." Furthermore, "any rehabilitation or construction that is undertaken pursuant to this order must be architecturally compatible with the character of the surrounding historic district or properties."[12]

Secretary of the Interior's Standards

Treatment to the Cape Hatteras Lighthouse is to be guided by *The Secretary of the Interior's Standards for Historic Preservation Projects.*[13] Descriptions of the four standards are as follows:

> Preservation: "the act or process of applying measures necessary to sustain the existing form, integrity, and materials of an historic property. Work, including preliminary measures to protect and stabilize the property, generally focuses upon the ongoing maintenance and repair of historic materials and features rather than extensive replacement and new construction.

[10] More information on Section 110 can be found on the NPS's website at (http://www.nps.gov/hps/fapa_110.htm).
[11] A copy of this E.O. can be found on the NPS's website at (http://www.nps.gov/history/history/online_books/anps/anps_7b.htm).
[12] A copy of this agreement is located on the ACHP's website at (http://www.achp.gov/EO13006.html).
[13] Weeks, Kay D. and Anne E. Grimmer. "The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings." United States Department of the Interior, National Park Service, Cultural Resource Stewardship and Partnerships, Heritage Preservation Services, Washington, DC, 1995.

> New exterior additions are not within the scope of this treatment; however, the limited and sensitive upgrading of mechanical, electrical, and plumbing systems and other code-required work to make properties functional is appropriate within a preservation project."
>
> Rehabilitation: "the act or process of making possible a compatible use for a property through repair, alterations, and additions while preserving those portions or features which convey its historical, cultural, or architectural values."
>
> Restoration: "the act or process of accurately depicting the form, features, and character of a property as it appeared at a particular period of time by means of the removal of features from other periods in its history and reconstruction of missing features from the restoration period. The limited and sensitive upgrading of mechanical, electrical, and plumbing systems and other code-required work to make properties functional is appropriate within a restoration project."
>
> Reconstruction: "the act or process of depicting, by means of new construction, the form, features, and detailing of a non-surviving site, landscape, building, structure, or object for the purpose of replicating its appearance at a specific period of time and in its historic location."

Because the Cape Hatteras Lighthouse stands intact, reconstruction is not a treatment consideration.

Director's Order 28

DO-28 Cultural Resource Management Guideline is intended to guide the National Park Service through successful cultural resource management through three steps[14]:

- Research: "identify, evaluate, document, register, and establish other basic information about cultural resources;"
- Planning: "ensure that this information is well integrated into management processes for making decisions and setting priorities;" and
- Stewardship: "planning decisions are carried out and resources are preserved, protected, and interpreted to the public."[15]

Through the development of this HSR, the research and planning (for treatment and use) of the Cape Hatteras Lighthouse is addressed. The general preservation philosophy integrated into this HSR is best represented by the following:

> Better to preserve than to repair, better repair than restore, better restore than [re]construct. It is ordinarily better to retain genuine old work of several periods, rather than arbitrarily to 'restore' the whole, by new work, to its aspect at a single period.[16]

Decisions for the future stewardship of the Cape Hatteras Lighthouse are under the purview of Cape Hatteras National Seashore. As part of NPS-28 "stewardship focuses on five major activities:

- Control of treatment and use,

[14] A copy of NPS-28 can be found at http://www.nps.gov/history/history/online_books/nps28/28contents.htm.
[15] NPS-28, p. 1.
[16] The Advisory Board on National Parks, Historic Sites, Buildings, and Monuments policy statement (1936). NPS-28, p. 2 .

- Monitoring conditions of deterioration and structural failure,
- Protecting from human and environmental threats,
- Retaining or delegating responsibility for structures, and
- Developing the skills, knowledge, and attitudes needed to support the program."[17]

A Call to Action

In 2011, National Park Service Director John Jarvis put forth his vision for NPS employees and partners "to commit to actions that advance the service toward a shared vision for 2016 and our second century."[18]

Action Item #25, "What's Old is New," addresses preservation actions: "Modernize historic preservation methods and technologies, show how historic structures can be made sustainable, and support efforts to rebuild the economic vitality of rural and urban communities by updating the *Secretary of the Interior's Standards and Guidelines for the Treatment of Historic Properties* in consultation with historic preservation partners."

Additionally, creativity and flexibility are encouraged when applying these Actions and should not hinder the day-to-day operations of the NPS.

International Building Code

According to the 1988 Amendment to the Public Buildings Act, any building constructed or altered by a Federal agency must, "to the maximum extent feasible, be in compliance with one of the nationally recognized model building codes and with other applicable nationally recognized codes." The International Building Code (IBC) is one of the allowable recognized model building codes.[19]

Treatments of the structure and its site are to be guided by the International Building Code (IBC).[20] Threats to public life, safety, and welfare are to be addressed; however, because the Cape Hatteras Lighthouse is historic, alternatives to full legislative and code compliance are recommended where compliance would needlessly compromise the integrity of the historic building with the removal of character-defining features or infringement upon the National Historic Landmark characteristics of the site and/or structures.

Accessibility

With no construction activity to initiate changes, it is premature to recommend accessibility design modifications to the Cape Hatteras Lighthouse. Additionally, an accessibility assessment was not included in the scope of work for this project and therefore recommended accessibility treatments

[17] NPS-28, p. 127.
[18] More information on A Call to Action is located on the NPS website at (http://www.nps.gov/calltoaction/).
[19] The General Services Administration had more information on this amendment and other accepted building codes at (http://www.gsa.gov/portal/content/101288).
[20] IBC is overseen by the International Code Council. More information is located at http://www.iccsafe.org/CS/Pages/default.aspx.

will not be provided. However, it should be noted that modifications may be likely as property use evolves and rehabilitation work commences. The most appropriate response will take into account scoping and technical design requirements of the Architectural Barrier Act Accessibility Standards and skillful application of preservation principles to preserve the historic character and historical integrity of this property.[21] Refer to NPS Preservation Brief #32: "Making Historic Properties Accessible" for more information.[22]

[21] The Architectural Barrier Act Accessibility Standards are under the authorization of the United States Access Board. More information can be found through Access Board's website (http://www.access-board.gov/aba/).
[22] Jester, Thomas C. and Sharon C. Park. "Making Historic Properties Accessible." Preservation Brief 32. Washington, DC, September 1993. Accessible at (http://www.nps.gov/hps/tps/briefs/brief32.htm).

Preferred Ultimate Treatment and Use

The Cape Hatteras Lighthouse has predominantly retained its use as such since it was constructed in 1870 through the present.

Because there are no funded and/or active projects occurring at the Cape Hatteras Lighthouse presently, the ultimate treatment and use recommendations provided are meant to guide the ultimate treatment and do not provide a construction or architectural program. The identification of resource impacts should be fully assessed once a construction or architectural program is finalized.

Considering the applicable laws, agreements, and policies discussed above, the Preferred Ultimate Treatment for the Cape Hatteras Lighthouse is as follows:

- *Exterior Restoration* with the removal of non-sympathetic modern accretions and retention, preservation, and restoration of character-defining features important to the historic design and construction of the lighthouse by the United States government in 1870.
- *Interior Rehabilitation* and preservation of character-defining features with removal of non-sympathetic modern accretions to reflect its original function. This treatment will preserve character-defining features and allow for the reversal of non-sympathetic treatments, materials, and finishes.

Also, considering the applicable laws, agreements, and policies discussed above, the Preferred Ultimate Use of the Cape Hatteras Lighthouse is to continue its use as an exhibit accessible by the visiting public, as well its lease to the United States Coast Guard as an active lighthouse beacon in the Lantern.

Alternatives for Treatment and Use

There are no identified alternatives for treatment and use at this time for the Cape Hatteras Lighthouse.

Recommended Treatments by Feature

Treatment Timeframes

As part of the planning process required by NPS-28, the recommended treatments for each feature have been divided into different timeframes. The "Immediate" timeframe is for features that must be repaired or replaced in the next one to three years, and are often the items which are in the worst condition (poor and critical). The "Short-Term" timeframe is for features which should be addressed in the next three to five years and are likely the items which are in moderate condition (fair and serious). Features found to be in good condition with a maintenance deficiency of minor have been categorized in the "Long-Term" timeframe. Typically these features currently require routine maintenance to maintain their current condition employing preventative maintenance methodologies but there is a reduced life expectancy within the five- to ten-year period and beyond.

Recommended treatments for items with an urgent need (Timeframe: *Immediate (1-3 years*), less urgent need (Timeframe: *Short-Term (3-5 years*), and minor need (Timeframe: *Long-Term (5-10 years)*, as described above are included under the Uniformat II layout by condition and deficiency rating in the Recommended Treatments for the Cape Hatteras Lighthouse section below.

Table 4. **Cape Hatteras Lighthouse Prioritized Treatment List**

Major Group Element	Group Element	Individual Element	Specific Element	Sub-Element	Condition Rating	Deficiency Rating
POOR						
B Shell	B10 Super-structure	B1010 Floor Construction	B101003 Floor Decks and Slabs	B101003-3 Ninth (Service Room) Level Floor Deck	POOR	CRITICAL
B Shell	B10 Super-structure	B1010 Floor Construction	B101003 Floor Decks and Slabs	B101003-4 Tenth (Watch Room) Level Floor Deck	POOR	CRITICAL
B Shell	B20 Exterior Enclosure	B2020 Exterior Windows	B2020-1 Tower (2nd thru 8th Level) Exterior Windows		POOR	CRITICAL
B Shell	B20 Exterior Enclosure	B2020 Exterior Windows	B2020-2 Ninth (Service Room) Level Exterior Windows		POOR	CRITICAL
B Shell	B10 Super-structure	B1010 Floor Construction	B101003 Floor Decks and Slabs	B101003-2 Second thru Eighth Level Floor Decks	POOR	SERIOUS
C Interiors	C20 Stairs	C2010 Stair Construction	C201001 Interior Stair Construction	C201001-2 Ninth Level Enclosed Stair	POOR	SERIOUS
B Shell	B20 Exterior Enclosure	B2030 Exterior Doors	B2030-2 Tenth (Watch Room) Level Exterior Doors		POOR	SERIOUS

(Table4 continued)

FAIR						
A Sub-structure	A10 Foundations	A1010 Standard Foundations			FAIR	SERIOUS
B Shell	B10 Super-structure	B1010 Floor Construction	B101004 Balcony Construction	B101004-1 Ninth (Watch Room) Level Exterior Gallery	FAIR	SERIOUS
B Shell	B10 Super-structure	B1010 Floor Construction	B101004 Balcony Construction	B101004-2 Lantern Room Interior & Exterior Balconies	FAIR	SERIOUS
B Shell	B10 Super-structure	B1020 Roof Construction			FAIR	SERIOUS
B Shell	B20 Exterior Enclosure	B2010 Exterior Walls	B2010-1 Base Exterior Walls		FAIR	SERIOUS
B Shell	B20 Exterior Enclosure	B2010 Exterior Walls	B2010-2 Tower Exterior Walls (2nd thru 8th Level)		FAIR	SERIOUS
B Shell	B20 Exterior Enclosure	B2010 Exterior Walls	B2010-3 Ninth (Service Room) Level Exterior Walls		FAIR	SERIOUS
C Interiors	C20 Stairs	C2010 Stair Construction	C201001 Interior Stair Construction	C201001-1 Main Stair (2nd thru 9th Levels)	FAIR	SERIOUS
B Shell	B20 Exterior Enclosure	B2010 Exterior Walls	B2010-4 Tenth (Watch Room) Level Exterior Walls		FAIR	MINOR
B Shell	B20 Exterior Enclosure	B2010 Exterior Walls	B2010-5 Lantern Level Exterior Walls		FAIR	MINOR
B Shell	B20 Exterior Enclosure	B2030 Exterior Doors	B2030-1 First Level Exterior Doors		FAIR	MINOR
B Shell	B20 Exterior Enclosure	B30 Roofing	B3010 Roof Coverings		FAIR	MINOR
C Interiors	C10 Interior Construction	C1020 Interior Doors	C1020-2 Ninth (Service Room) Level Interior Door		FAIR	MINOR
C Interiors	C20 Stairs	C2010 Stair Construction	C201001 Interior Stair Construction	C201001-3 Lantern Ladder	FAIR	MINOR
C Interiors	C20 Stairs	C2010 Stair Construction	C201002 Exterior Stair Construction		FAIR	MINOR
C Interiors	C30 Interior Finishes	C3020 Floor Finishes			FAIR	MINOR
GOOD						
B Shell	B10 Super-structure	B1010 Floor Construction	B101003 Floor Decks and Slabs	B101003-1 First Level Floor Slab	GOOD	MINOR
C Interiors	C10 Interior Construction	C1020 Interior Doors	C1020-1 First Level Interior Door		GOOD	MINOR
D Services	D50 Electrical				GOOD	MINOR
D Services	D50 Electrical	D5090 Other Electrical Systems	D509004 Lightning Protection		GOOD	MINOR
G Building Sitework	G20 Site Im-provements	G2040 Site Development			GOOD	MINOR
G Building Sitework	G90 Other Site Work	G9087 Overall Building Site Drainage			GOOD	MINOR
NOT RATED, NOT APPLICABLE or UNKNOWN						
C Interiors	C10 Interior Construction	C1020 Interior Doors	C1020-2 Tenth (Watch Room) Level Interior Door		N/A	N/A
D Services	D20 Plumbing				N/A	N/A
D Services	D30 Fire Protection Systems				N/A	N/A
D Services	D50 Electrical	D5030 Communications & Security Systems			N/A	N/A
End of Table.						

Cape Hatteras Recommended Treatments

General Comments

It is recommended that a historic paint survey be undertaken to determine if any remnants of historic coatings are extant. The study should include developing the most historic paint scheme. Historic paint colors should then be used when recoating all painted surfaces on the interior and exterior of the lighthouse.

A long-term solution for protecting all of the metal (primarily iron) components of the lighthouse is the installation of an Impressed Current Cathodic Protection System. The system is based on the principle that anodes corrode and cathodes do not corrode. If a building element is made a cathode through an applied direct current, no corrosion would occur on that element. Therefore an applied anode (of a sacrificial metal) would corrode instead of the cathodic element.[1] The system has been applied to the Middle Bay Lighthouse in Mobile Bay of Alabama, and Point Arena Lighthouse, California. It is planned for the Thomas Point Shoal Lighthouse in the Chesapeake Bay of Maryland.[2]

When developing a construction or architectural program, the original specifications and drawings and archival photographs should be consulted to provide the closest replication of original design intent for the lighthouse.

Visitation data has been accumulated for those climbing the lighthouse between the 2007 season and the 2015 season. During the 2015 season, 107,780 people climbed the lighthouse (equaling approximately 602 people per day). A study may be warranted to determine the maximum number of climbers per day. Extras stresses on the structure are likely being caused by the numbers of daily visitors, especially on a structure which historically accommodated only three men at one time.

Ventilation

The following information regarding ventilation and minimizing condensation buildup within a lighthouse is located in the *Historic Lighthouse Preservation Handbook* (1997).[3] It has been edited and reduced to only include information relevant to the Cape Hatteras Lighthouse. Refer to the handbook.

> As humidity levels increase in a lighthouse, the plaster, wood, iron components, and masonry are affected. Increased moisture content in the porous materials—wood, plaster, and mortar joints—causes significant damage. . . . Increased moisture content in the mortar joints will cause the leaching of the lime from the mortar, which results in the failure of the joint. Increased

[1] For more information on the Impressed Current Cathodic Protection System, refer to Appalachian Underground Corrosion Short Course, *Fundamentals Course*, West Virginia University, 2015. Accessed at http://www.aucsc.com/bia/AUCSCFundamentalsText041715.pdf on October 15, 2015.
[2] For more information on these projects, refer to the following websites accessed on October 15, 2015: http://preserveala.org/pdfs/sites/MIDDLE%20BAY%202%20PAGE%20FACTS.pdf, http://usa.sika.com/dms/getdocument.get/3b4f9d7d-a9d2-3066-9c6c-f678077d6b21/cs-cpd-Point-Arena-Lighthouse-us.pdf, and http://keasthood.com/projects/thomas-point-shoal-lighthouse/ .
[3] NPS, USLS. *Historic Lighthouse Preservation Handbook.* 1997. Accessed at http://www.nps.gov/maritime/nhlpa/handbook.htm. Part IV. H, pp. 3-4.

moisture will cause any exposed iron to corrode or rust. These conditions are easily avoided if the lighthouse is adequately ventilated.

Once the exterior has been made weathertight, adequate air exchange is essential throughout the lighthouse. The needs of each historic lighthouse must be individually evaluated because there are so many variables that affect the performance of each interior space once the lighthouse has been made weathertight. A mechanical engineer or a specialist in interior climates should be consulted, particularly for lighthouses with significant interiors.

When looking at the type and amount of interior ventilation needed for a…lighthouse, there are four critical climate zones: cold and damp (Pacific northwest and northeastern states); temperate and humid (mid-Atlantic states, coastal areas); hot and humid (southern states), and the extremely cold (freezing) and seasonably damp (Great Lakes). Each climate zone has special ventilation considerations.

The absolute minimum air exchange for most…lighthouses consists of one to four air exchanges every hour; one or two air exchanges per hour in winter and often twice that amount in summer. Even this minimal exchange may permit mold and mildew in damp climates. Monitoring the lighthouse for approximately six months during the initial ventilation period will provide useful information on the effectiveness of the ventilation solution.

There is no exact science for how much ventilation should be provided for each lighthouse. There are, however, some general rules of thumb:

- During months of high humidity, it is important to keep the air within the tower moving at all times.
- The most difficult lighthouses to adequately ventilate without resorting to extensive louvering and/or mechanical exhaust fan systems are masonry lighthouses in humid climates. For this lighthouse type nearly every window will need to be fitted with a louver that occupies at least 50 percent of the window opening [or having operable windows which can be mechanically opened during the day and closed during inclement weather and at night].
- Take advantage of prevailing winds during the installation of louvers. This will provide the maximum amount of natural passive (non-mechanical) ventilation.
- The natural chimney effect in most lighthouses is best utilized by installation of vents at the top and bottom of the lighthouse only. Consider vandalism when locating the lower vent. •
- Be sure the built-in lantern vents are open and screened. This will also capitalize on the chimney effect that will naturally draw the air up and out of the lighthouse as the hot air in the tower rises.
- In lighthouses with AC power, fans controlled by thermostats and timers provide effective ventilation that can be tuned to operate in reaction to day-to-day climatic change. One fan in a small- to medium-sized lighthouse can reduce the amount of louvering substantially.
- If electric fans are used, study the environmental conditions of the lighthouse to determine whether the fans should be controlled by thermostats or automatic timers. Humidistats, designed for enclosed climate-control systems, generally are difficult to adapt for open… conditions. How the system will draw in or exhaust air is also important. It may be best to bring dry air in from the lantern or upper levels and force it out through lower tower windows. Additionally, less humid dry air is preferred to damper night air; this can be controlled with a timer switch mounted to the fan.
  In some extreme circumstances, heat will be needed during the winter, even at a minimal 45° Fahrenheit…, and using forced-fan ventilation in summer and will require retaining electrical service. For masonry lighthouses the interior temperature should be kept above the spring dew point to avoid damaging condensation. In most lighthouses the need for summer ventilation outweighs the winter requirements.

Note: The following is based on the Uniformat II BFML (refer to p. 155, Table 1) and is listed in prioritized order based and condition and deficiency ratings (refer to pp. 279-80, Table 4).

B101003-3 Ninth (Service Room) Level Floor Deck	**POOR**	**CRITICAL**
B101003-4 Tenth (Watch Room) Level Floor Deck	**POOR**	**CRITICAL**

JKO/BPE provided the following recommendations in their 2014 assessment report regarding the Ninth and Tenth Level Floor Decks:

> Examination of all ferrous metals buried in the brick masonry. We have limited knowledge of what is occurring inside the masonry, but we see enough serious corrosion to cause concern. The corrosion has advanced enough to split the masonry in many places throughout the interior of the lighthouse but there is no way of knowing what the extent of the damage is without further investigation through disassembly.[4]

Timeframe: *Emergency (within 1 year)*

Destructive investigation of embedded metal components of the Ninth and Tenth Level Floor Decks in the masonry should be completed immediately to determine the condition of those portions. The condition of the embedded metal will determine the final treatment.

Timeframe: *Immediate (1-3 years)*

All metal components should be painted to match the results of the historic paint study, or in the absence of early paint layers, painted black to match the specifications of the 1902 *Instructions to Light-Keepers* discussed in the Condition Assessment section of this HSR.

After study of the extant paint, the paint should be removed using a non-abrasive method. Refer to the PROSOCO catalog for examples of non-abrasive, environmentally responsible paint removal products (https://www.prosoco.com/).

NOTE: The following information regarding treatment recommendations to metal is located in the *Historic Lighthouse Preservation Handbook* (1997). Refer to this document for additional information.

Following paint removal, the newly cleaned iron should be painted immediately with a corrosion-inhibiting primer to prevent 'flash rust.' Any buildup of salt or chloride residue on the bare metal will affect paint/coating adherence. If priming is delayed, rust should be removed with a clean wire brush just before priming.

Traditionally, red lead was used as an anti-corrosive coating for priming iron. It was then coated with at least two coats of linseed-oil-based finish coats. This system is no longer regularly used due to toxicity. Instead, alkyd paints can and should be used, particularly with two coasts of a rust-prohibitive alkyd primer. Latex and other water-based paints should not be used because their water content causes immediate metal oxidation (rust) upon contact of the paint. Epoxy coatings have also been successful in application to clean iron surfaces.

[4] JKO/BPE, *Condition Assessment Report,* p. 43.

For further information, consult NPS Preservation Brief 27: The Maintenance and Repair of Architectural Cast Iron.

The best and most effective way to preserve metal in a marine environment is to maintain a protective paint or coating on the metal (preservation maintenance). The effective protective life span of an existing paint system can be greatly extended by routine touchups of deteriorating areas. Any damaged areas should be repaired before repainting, including paint and rust removal.[5]

B2020-1 Tower (2nd thru 8th Level) Exterior Windows	**POOR**	**CRITICAL**
B2020-2 Ninth (Service Room) Level Exterior Windows	**POOR**	**CRITICAL**

HHA/WJE provided the following recommendations in their 1986 assessment report regarding the exterior windows:

> The windows should be completely closed during wet or humid weather. The window should be open, however, during the day to ventilate the tower and consequently reduce the condensation on metal elements within the tower.[6]

JKO/BPE provided the following recommendations in their 2014 assessment report regarding the same windows:

> Repair and reinstall original pedimented window heads currently in storage. Recast replacements for any missing or beyond repair. Remove paint coatings based on test methods, clean, and repair all damaged sash, frames, and hardware. Retain early glass in windows were possible. Design and install interior barrier for public at operable casement windows. Repair or recast damaged elements of the casement windows of levels two, five, and eight. Repair and recast missing metal louvered vents above fixed windows at ninth-level landing (Service Room). Prep and apply new finish coatings to metal frames, sash, and hardware to protect and prevent corrosion.[7]

In addition, it is HPTC's recommendation that the windows be restored immediately. The windows cannot be closed and are directly and negatively affecting interior elements of the lighthouse, including floor decks, walls, and floor and wall treatments. Well-maintained, operable windows are important in protecting the lighthouse and creating efficient passive ventilation. The missing window hoods is also a detriment, as their design and inclusion originally helped deter water infiltration into the window openings.

Timeframe: *Immediate (1-3 years)*

An extensive opening-by-opening assessment of the windows should be completed before any restoration work is completed so that repair methods and possible replacement options can be fully explored. All components which can be retained, including glass, sash, hardware, frames, and sills, should be retained. The exterior window hoods and brackets should be reinstalled.

[5] NPS, USLS. *Historic Lighthouse Preservation Handbook*.Part IV. B, pp. 18-25.
[6] HHA/WJE, *Comprehensive Structural Analysis Report,* pp. 78-83.
[7] JKO/BPE, *Condition Assessment Report*, p. 40.

The paint and rust should be removed from the metal windows by hand scraping. Sandblasting, heat, and chemical-dipping paint removal processes should not be used. Rust should be removed using a clean wire brush. The material should be tested for lead-based paint before any work is completed. If lead-based paint is found, all precautions should be taken to protect workers from exposure. Refer to OSHA's *Lead in Construction* for more information.[8]

Once damage and deterioration is identified, the affected areas should be treated. Frames and sash should be repaired with patches, splices, consolidation, or reinforcement. When possible, remove earlier repairs that were done insensitively and repair appropriately.

Components which are extensively deteriorated or missing should be replaced using surviving prototypes or historic drawings and photographs, including the original pedimented window hoods and brackets of the tower windows and the degraded transom components of the Ninth Level. Original hardware should be repaired and oiled for proper use, particularly casement hinges. Missing hardware should be replicated to match historic and installed.

NOTE: The following information regarding treatment recommendations for metal windows is located in the *Historic Lighthouse Preservation Handbook* (1997). Refer to this document for additional information.

Following paint removal, the newly cleaned iron should be painted immediately with a corrosion-inhibiting primer to prevent 'flash rust.' Any buildup of salt or chloride residue on the bare metal will affect paint/coating adherence. If priming is delayed, rust should be removed with a clean wire brush just before priming.

Traditionally, red lead was used as an anti-corrosive coating for priming iron. It was then coated with at least two coats of linseed-oil-based finish coats. This system is no longer regularly used due to toxicity. Instead, alkyd paints can and should be used, particularly with two coasts of a rust-prohibitive alkyd primer. Latex and other water-based paints should not be used because their water content causes immediate metal oxidation (rust) upon contact of the paint. Epoxy coatings have also been successful in application to clean iron surfaces.

For further information, consult NPS Preservation Brief 13: The Repair and Thermal Upgrading of Historic Steel Windows.



Figure 418. Transparent polycarbonate bars affixed to the interior of a casement window does not inhibit the view and prohibits access by visitors. Photo: MultiSafe Security.[9]

[8] Accessible at https://www.osha.gov/Publications/osha3142.pdf.
[9] Accessed at http://www.multisafe.co.za/photo-gallery/page/2/ on October 15, 2015.

The best and most effective way to preserve metal in a marine environment is to maintain a protective paint or coating on the metal (preservation maintenance). The effective protective life span of an existing paint system can be greatly extended by routine touchups of deteriorating areas. Any damaged areas should be repaired before repainting, including paint and rust removal.[10]

In addition, HPTC recommends that the interior plastic fencing should be removed from each opening. A more sympathetic treatment should then be used. An example treatment is the installation of transparent polycarbonate bars on the extant wooden frames, painted to match the historic metal window frames. The transparent bars provide little visual obstruction and provide sufficient restrictions for visitors leaning out of the openings. See Lexan ClearBars (http://www.multisafe.co.za/) for example applications (fig. 418).

B101003-2 Second thru Eighth Level Floor Decks	POOR	SERIOUS

JKO/BPE provided the following recommendations in their 2014 assessment report regarding the Second through Eighth Level Floor Decks:

> Examination of all ferrous metals buried in the brick masonry. We have limited knowledge of what is occurring inside the masonry, but we see enough serious corrosion to cause concern. The corrosion has advanced enough to split the masonry in many places throughout the interior of the lighthouse but there is no way of knowing what the extent of the damage is without further investigation through disassembly.
>
> Disassembly of masonry vaults at landings; examination of metals; repair or replacement as needed; coating of all metals; and reconstruction of vaults and walking surfaces.[11]

Timeframe: *Emergency (within 1 year)*

Destructive investigation of embedded metal components of the Second through Eighth Level Floor Decks in the masonry should be completed immediately to determine the condition of those portions. The condition of these portions of embedded metal will determine the final treatment.

Timeframe: *Immediate (1-3 years)*

Historic paint colors should be used when recoating the floor decks. This would include whitewash, or similar breathable mineral paint (see http://www.keim.com/ for an example product), on the brick masonry components. All metal components should be painted to match the results of the historic paint study, or in the absence of early paint layers, painted black to match the specifications of the 1902 *Instructions to Light-Keepers* discussed in the Condition Assessment section of this HSR.

After a study of the extant paint, the paint should be removed using a non-abrasive method. Refer to the PROSOCO catalog for examples of non-abrasive, environmentally responsible paint removal products (https://www.prosoco.com/).

[10] NPS, USLS. *Historic Lighthouse Preservation Handbook.* Part IV. B, pp. 18-25.
[11] JKO/BPE, *Condition Assessment Report,* p. 43.

NOTE: The following information regarding treatment recommendations to metal is located in the *Historic Lighthouse Preservation Handbook* (1997). Refer to this document for additional information.

Following paint removal, the newly cleaned iron should be painted immediately with a corrosion-inhibiting primer to prevent 'flash rust.' Any buildup of salt or chloride residue on the bare metal will affect paint/coating adherence. If priming is delayed, rust should be removed with a clean wire brush just before priming.

Traditionally, red lead was used as an anti-corrosive coating for priming iron. It was then coated with at least two coats of linseed-oil-based finish coats. This system is no longer regularly used due to toxicity. Instead, alkyd paints can and should be used, particularly with two coasts of a rust-prohibitive alkyd primer. Latex and other water-based paints should not be used because their water content causes immediate metal oxidation (rust) upon contact of the paint. Epoxy coatings have also been successful in application to clean iron surfaces.

For further information, consult NPS Preservation Brief 27: The Maintenance and Repair of Architectural Cast Iron.

The best and most effective way to preserve metal in a marine environment is to maintain a protective paint or coating on the metal (preservation maintenance). The effective protective life span of an existing paint system can be greatly extended by routine touchups of deteriorating areas. Any damaged areas should be repaired before repainting, including paint and rust removal.[12]

C201001-2 Ninth Level Enclosed Stair	**POOR**	**SERIOUS**
C1020-2 Ninth (Service Room) Level Interior Door	**FAIR**	**MINOR**

Timeframe: *Emergency (within 1 year)*

Destructive investigation of embedded metal components and metal components which directly abut masonry of the Ninth Level Enclosed Stair should be completed immediately to determine the condition of those portions, particularly the outer stringer and top riser. The condition of these portions of metal will determine the final treatment.

Timeframe: *Immediate (1-3 years)*

All metal stair, wall, and door components should be painted to match the results of the historic paint study, or in the absence of early paint layers, painted black to match the specifications of the 1902 *Instructions to Light-Keepers* discussed in the Condition Assessment section of this HSR.

After study of the extant paint, the paint should be removed using a non-abrasive method. Refer to the PROSOCO catalog for examples of non-abrasive, environmentally responsible paint removal products (https://www.prosoco.com/).

[12] NPS, USLS. *Historic Lighthouse Preservation Handbook.* Part IV. B, pp. 18-25.

NOTE: The following information regarding treatment recommendations to metal is located in the *Historic Lighthouse Preservation Handbook* (1997). Refer to this document for additional information.

Following paint removal, the newly cleaned iron should be painted immediately with a corrosion-inhibiting primer to prevent 'flash rust.' Any buildup of salt or chloride residue on the bare metal will affect paint/coating adherence. If priming is delayed, rust should be removed with a clean wire brush just before priming.

Traditionally, red lead was used as an anti-corrosive coating for priming iron. It was then coated with at least two coats of linseed-oil-based finish coats. This system is no longer regularly used due to toxicity. Instead, alkyd paints can and should be used, particularly with two coasts of a rust-prohibitive alkyd primer. Latex and other water-based paints should not be used because their water content causes immediate metal oxidation (rust) upon contact of the paint. Epoxy coatings have also been successful in application to clean iron surfaces.

For further information, consult NPS Preservation Brief 27: The Maintenance and Repair of Architectural Cast Iron.

The best and most effective way to preserve metal in a marine environment is to maintain a protective paint or coating on the metal (preservation maintenance). The effective protective life span of an existing paint system can be greatly extended by routine touchups of deteriorating areas. Any damaged areas should be repaired before repainting, including paint and rust removal.[13]

B2030-2 Tenth (Watch Room) Level Exterior Door	**POOR**	**SERIOUS**

JKO/BPE provided the following recommendations in their 2014 assessment report regarding the Tenth Level exterior door: "Remove paint coatings based on tested methods, clean, and repair. Apply new finish coatings to protect and prevent corrosion."[14]

Timeframe: *Immediate (1-3 years)*

All metal door components should be painted to match the results of the historic paint study, or in the absence of early paint layers, painted black to match the specifications of the 1902 *Instructions to Light-Keepers* discussed in the Condition Assessment section of this HSR.

After study of the extant paint, the paint should be removed using a non-abrasive method. Refer to the PROSOCO catalog for examples of non-abrasive, environmentally responsible paint removal products (https://www.prosoco.com/).

NOTE: The following information regarding treatment recommendations to metal is located in the *Historic Lighthouse Preservation Handbook* (1997). Refer to this document for additional information.

[13] NPS, USLS. *Historic Lighthouse Preservation Handbook*. Part IV. B, pp. 18-25.
[14] JKO/BPE, *Condition Assessment Report,* p. 40.

Following paint removal, the newly cleaned iron should be painted immediately with a corrosion-inhibiting primer to prevent 'flash rust.' Any buildup of salt or chloride residue on the bare metal will affect paint/coating adherence. If priming is delayed, rust should be removed with a clean wire brush just before priming.

Traditionally, red lead was used as an anti-corrosive coating for priming iron. It was then coated with at least two coats of linseed-oil-based finish coats. This system is no longer regularly used due to toxicity. Instead, alkyd paints can and should be used, particularly with two coasts of a rust-prohibitive alkyd primer. Latex and other water-based paints should not be used because their water content causes immediate metal oxidation (rust) upon contact of the paint. Epoxy coatings have also been successful in application to clean iron surfaces.

For further information, consult NPS Preservation Brief 27: The Maintenance and Repair of Architectural Cast Iron.

The best and most effective way to preserve metal in a marine environment is to maintain a protective paint or coating on the metal (preservation maintenance). The effective protective life span of an existing paint system can be greatly extended by routine touchups of deteriorating areas. Any damaged areas should be repaired before repainting, including paint and rust removal.[15]

A1010 Standard Foundations	FAIR	SERIOUS

JKO/BPE provided the following recommendations in their 2014 assessment report regarding the lighthouse:

> Examination of the below-grade brick infill and concrete mat to determine whether or not the irreversible brick growth due to long term moisture absorption has damaged either the subsurface brick infill or the concrete mat supporting it.
>
> Brick testing of the brick infill of the foundation to determine the moisture-related growth characteristics.
>
> Grouting of the cracks in the exposed granite foundation stones and grouting of open joints between stones. This work will also require repointing of the granite and installation of granite crack repair material.[16]

Timeframe: *Emergency (within 1 year)*

Crack monitors should be installed on plinth cracks which are known to have increased in size/length between 1999 and 2014. See Condition Assessment section for diagrams of these areas. The crack monitors are inexpensive two-piece gauges which measure small changes along two-dimensional X and Y axes of a structure. Easily applied to a structure, the gauges should be protected from visitor interference. A monitoring program will also need to be developed in the park with use of a standardized log. See Appendix G for more information (including simple scope of work) on crack monitoring recommendations by Vertical Access.[17]

[15] NPS, USLS. *Historic Lighthouse Preservation Handbook*. Part IV. B, pp. 18-25.
[16] JKO/BPE, *Condition Assessment Report,* p. 43.
[17] Diebolt, Kent (Vertical Access) "Cape Hatteras Lighthouse." *Site Visit Report.* Completed for NPS HPTC. November 11, 2015.

Timeframe: *Immediate (1-3 years)*

Repairs are needed to the mortar joints of the foundation plinth. The following information regarding treatment recommendations to repointing masonry is located in the *Historic Lighthouse Preservation Handbook* (1997). Refer to this document for additional information.

- Remove deteriorated mortar by carefully hand raking the joints to avoid damaging the masonry.
- Duplicate the historic mortar in strength, composition, color, and texture. A mortar analysis can be performed by most preservation professionals.
- Duplicate old mortar joints in width and in joint profile.
- Do not remove non-deteriorated mortar form sound joints for purely cosmetic reasons.
- Do not use electric saws and hammers rather than hand tools to remove deteriorated mortar from joints prior to repointing.
- Do not repoint with mortar of high Portland-cement content (unless it is the same content of the historic mortar). This can often create a bond that is stronger than the historic material and cause damage resulting from the differing coefficient of expansion and the differing porosity of the material and the mortar.
- Do no repoint with a synthetic caulking compound.[18]

For further information, consult NPS Preservation Brief 2: Repointing Mortar Joints in Historic Masonry Buildings for more information.

B101004-1 Ninth (Watch Room) Level Exterior Gallery	FAIR	SERIOUS

JKO/BPE provided the following recommendations in their 2014 assessment report regarding the Ninth Level exterior balcony: "Clean and repair metal brackets, floor plates, handrail, and balustrade. Apply new finish coatings to prevent corrosion."[19]

Timeframe: *Immediate (1-3 years)*

All metal components should be painted to match the results of the historic paint study, or in the absence of early paint layers, painted black to match the specifications of the 1902 *Instructions to Light-Keepers* discussed in the Condition Assessment section of this HSR.

After study of the extant paint, the paint should be removed using a non-abrasive method. Refer to the PROSOCO catalog for examples of non-abrasive, environmentally responsible paint removal products (https://www.prosoco.com/).

NOTE: The following information regarding treatment recommendations to metal is located in the *Historic Lighthouse Preservation Handbook* (1997). Refer to this document for additional information.

Following paint removal, the newly cleaned iron should be painted immediately with a corrosion-inhibiting primer to prevent 'flash rust.' Any buildup of salt or chloride residue on the bare metal

[18] NPS, USLS. *Historic Lighthouse Preservation Handbook*. Part IV. A, p. 19.
[19] JKO/BPE, *Condition Assessment Report*, p. 40.

will affect paint/coating adherence. If priming is delayed, rust should be removed with a clean wire brush just before priming.

Traditionally, red lead was used as an anti-corrosive coating for priming iron. It was then coated with at least two coats of linseed-oil-based finish coats. This system is no longer regularly used due to toxicity. Instead, alkyd paints can and should be used, particularly with two coasts of a rust-prohibitive alkyd primer. Latex and other water-based paints should not be used because their water content causes immediate metal oxidation (rust) upon contact of the paint. Epoxy coatings have also been successful in application to clean iron surfaces.

For further information, consult NPS Preservation Brief 27: The Maintenance and Repair of Architectural Cast Iron.

The best and most effective way to preserve metal in a marine environment is to maintain a protective paint or coating on the metal (preservation maintenance). The effective protective life span of an existing paint system can be greatly extended by routine touchups of deteriorating areas. Any damaged areas should be repaired before repainting, including paint and rust removal.[20]

B101004-2 Lantern Room Interior & Exterior Balconies	FAIR	SERIOUS

JKO/BPE provided the following recommendations in their 2014 assessment report regarding the Lantern Room interior and exterior balconies: "Repair metal floor plates. Install new railing and balustrade. Apply new finish coatings to prevent corrosion.[21]

Timeframe: *Emergency (within 1 year)*

The handrail located on the exterior balcony of the Lantern should be completely replaced. The in-kind replacement of cast-iron components is often the only practical solution when the feature is severely corroded beyond feasible repair. Because the extant railings were slightly altered in 1991-93, the new components should be cast to match the original specification drawings (fig. 419). The new components should be painted (black) prior to installation, with any touchup painting occurring after installation. Upon installation, care should be taken to protect the surrounding historic components from damage.

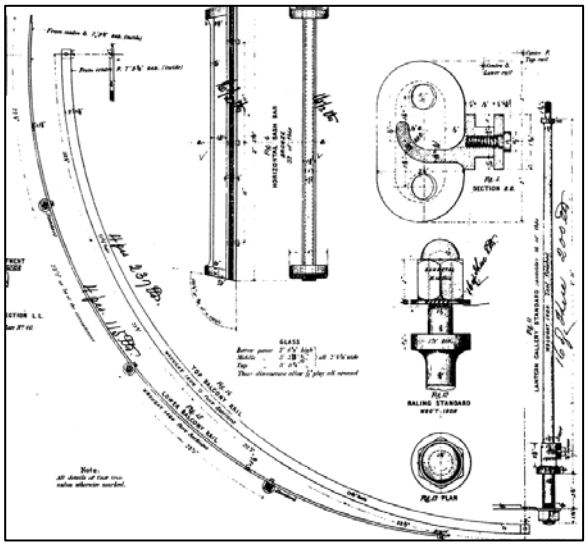


Figure 419. The original specification drawings show the original design intention of the Lantern exterior balcony railing. Source: Plate No. 17.

All eight vents which communicate from the interior of the lantern to the exterior (below the exterior lantern balcony) should be scoped for

[20] NPS, USLS. *Historic Lighthouse Preservation Handbook.* Part IV. B, pp. 18-25.
[21] JKO/BPE, *Condition Assessment Report,* p. 40.

possible blockages. Every effort should be made to re-open these vents to allow passive ventilation to the interior of the lantern.

Timeframe: *Immediate (1-3 years)*

All metal components should be painted to match the results of the historic paint study. In the absence of early paint layers, the exterior metal surfaces should be painted black and the interior metal surfaces painted white to match the specifications of the 1902 *Instructions to Light-Keepers* discussed in the Condition Assessment section of this HSR.

After study of the extant paint, the paint should be removed using a non-abrasive method. Refer to the PROSOCO catalog for examples of non-abrasive, environmentally responsible paint removal products (https://www.prosoco.com/).
NOTE: The following information regarding treatment recommendations to metal is located in the *Historic Lighthouse Preservation Handbook* (1997). Refer to this document for additional information.

Following paint removal, the newly cleaned iron should be painted immediately with a corrosion-inhibiting primer to prevent 'flash rust.' Any buildup of salt or chloride residue on the bare metal will affect paint/coating adherence. If priming is delayed, rust should be removed with a clean wire brush just before priming.

Traditionally, red lead was used as an anti-corrosive coating for priming iron. It was then coated with at least two coats of linseed-oil-based finish coats. This system is no longer regularly used due to toxicity. Instead, alkyd paints can and should be used, particularly with two coasts of a rust-prohibitive alkyd primer. Latex and other water-based paints should not be used because their water content causes immediate metal oxidation (rust) upon contact of the paint. Epoxy coatings have also been successful in application to clean iron surfaces.

For further information, consult NPS Preservation Brief 27: The Maintenance and Repair of Architectural Cast Iron.

The best and most effective way to preserve metal in a marine environment is to maintain a protective paint or coating on the metal (preservation maintenance). The effective protective life span of an existing paint system can be greatly extended by routine touchups of deteriorating areas. Any damaged areas should be repaired before repainting, including paint and rust removal.[22]

B1020 Roof Construction	**FAIR**	**SERIOUS**

Timeframe: *Immediate (1-3 years)*

All metal components should be painted to match the results of the historic paint study. In the absence of early paint layers, the roof framing should be painted white to match the specifications of the 1902 *Instructions to Light-Keepers* discussed in the Condition Assessment section of this HSR.

[22] NPS, USLS. *Historic Lighthouse Preservation Handbook*. Part IV. B, pp. 18-25.

After study of the extant paint, the paint should be removed using a non-abrasive method. Refer to the PROSOCO catalog for examples of non-abrasive, environmentally responsible paint removal products (https://www.prosoco.com/).

NOTE: The following information regarding treatment recommendations to metal is located in the *Historic Lighthouse Preservation Handbook* (1997). Refer to this document for additional information.

Following paint removal, the newly cleaned iron should be painted immediately with a corrosion-inhibiting primer to prevent 'flash rust.' Any buildup of salt or chloride residue on the bare metal will affect paint/coating adherence. If priming is delayed, rust should be removed with a clean wire brush just before priming.

Traditionally, red lead was used as an anti-corrosive coating for priming iron. It was then coated with at least two coats of linseed-oil-based finish coats. This system is no longer regularly used due to toxicity. Instead, alkyd paints can and should be used, particularly with two coats of a rust-prohibitive alkyd primer. Latex and other water-based paints should not be used because their water content causes immediate metal oxidation (rust) upon contact of the paint. Epoxy coatings have also been successful in application to clean iron surfaces.

The best and most effective way to preserve metal in a marine environment is to maintain a protective paint or coating on the metal (preservation maintenance). The effective protective life span of an existing paint system can be greatly extended by routine touchups of deteriorating areas. Any damaged areas should be repaired before repainting, including paint and rust removal.[23]

HPTC also recommends the use of a paint which has high resistance to UV-degradation. In addition, the installation of shades on the interior of the Lantern, to match historic shades, will cut down on UV levels. Refer to B2010-5 Lantern Level Exterior Walls for more information on these shades.

B2010-1 Base Exterior Walls	FAIR	SERIOUS

JKO/BPE provided the following recommendations in their 2014 assessment report regarding the Base exterior walls: "Remove exterior and interior coatings based on tested methods, repair cracks, and repoint brick with appropriate mortar. Apply new exterior and interior paint coatings to brick based on test analysis."[24]

Timeframe: *Immediate (1-3 years)*

Repairs are needed to the mortar joints of the base exterior walls, particularly at granite details. The following information regarding treatment recommendations to repointing masonry is located in the *Historic Lighthouse Preservation Handbook* (1997). Refer to this document for additional information.

[23] NPS, USLS. *Historic Lighthouse Preservation Handbook.* Part IV. B, pp. 18-25.
[24] JKO/BPE, *Condition Assessment Report,* p. 29.

- Remove deteriorated mortar by carefully hand raking the joints to avoid damaging the masonry.
- Duplicate the historic mortar in strength, composition, color, and texture. A mortar analysis can be performed by most preservation professionals.
- Duplicate old mortar joints in width and in joint profile.
- Do not remove non-deteriorated mortar form sound joints for purely cosmetic reasons.
- Do not use electric saws and hammers rather than hand tools to remove deteriorated mortar from joints prior to repointing.
- Do not repoint with mortar of high Portland-cement content (unless it is the same content of the historic mortar). This can often create a bond that is stronger than the historic material and cause damage resulting from the differing coefficient of expansion and the differing porosity of the material and the mortar.
- Do no repoint with a synthetic caulking compound.[25]

For further information, consult NPS Preservation Brief 2: Repointing Mortar Joints in Historic Masonry Buildings for more information.

Timeframe: *Short-Term (3-5 Years)*

Once repairs are made to the exterior of the base exterior walls, including repointing where necessary, the brick portions should be painted to match the results of the historic paint study. In the absence of early paint layers, the brick should be painted brick red to match the specifications of the 1902 *Instructions to Light-Keepers* discussed in the Condition Assessment section of this HSR.

The paint used to re-coat the brick should be a breathable, exterior masonry paint. Keim Mineral Coatings of America, Inc. (http://www.keim.com/) offers several options for vapor-permeable paints and coatings for historic masonry structure preservation projects. The paint has an extended life. A product representative will be able to provide technical assistance on appropriate treatments and products.

In addition, the 1997 *Historic Lighthouse Preservation Handbook* provides the following guidance regarding recoating historic masonry in lighthouses:

- Before recoating, inspect all masonry surfaces to determine whether repainting is necessary. If painting is the determined treatment, a schedule of colors, locations, and quantities should be developed.
- Remove damaged or deteriorated material only to the next sound layer, using the gentlest method possible (e.g., hand scraping) before recoating.
- Recoat surfaces with a system designed for the masonry substrate—brick, stone, or stucco. The system should be designed to 'breathe' so that moisture trapped within the masonry units can escape. This quality is referred to as the permeability of the coating system.
- Use colors that are historically appropriate to the lighthouse or that maintain the character-defining features of the daymark.
- Do not remove any coating that is firmly adhering to, and thus protecting, masonry surfaces.
- Do not use methods of removing coatings which are destructive to masonry, such as sandblasting, application of caustic solutions, or high-pressure water blasting.
- Do not apply coatings such as stucco to masonry that historically has been painted or uncoated.

[25] NPS, USLS. *Historic Lighthouse Preservation Handbook, P*art IV. A, p. 19.

- Do not remove historic masonry coatings and leave the underlying layer exposed to the elements.
- Do not apply a sealing type paint to the interior of a lighthouse. This will potentially trap moisture in the wall which will cause the wall to deteriorate.[26]

B2010-2 Tower Exterior Walls (2nd thru 8th Level)	FAIR	SERIOUS

Timeframe: *Short-Term (3-5 Years)*

After the new exterior paint covering has reached the end of its useful life, the tower should be re-coated using a breathable, exterior masonry paint to match the extant historic colors.

On the interior, once immediate repairs are made to the floor decks and embedded metal components, the interior faces of the exterior tower walls should also be re-coated using a breathable masonry paint to mimic whitewash.

For both applications, Keim Mineral Coatings of America, Inc. (http://www.keim.com/) offers several options for vapor-permeable paints and coatings for historic masonry structure preservation projects. The paint has an extended life. A product representative will be able to provide technical assistance on appropriate treatments and products.

In addition, the 1997 *Historic Lighthouse Preservation Handbook* provides the following guidance regarding recoating historic masonry in lighthouses:

- Before recoating, inspect all masonry surfaces to determine whether repainting is necessary. If painting is the determined treatment, a schedule of colors, locations, and quantities should be developed.
- Remove damaged or deteriorated material only to the next sound layer, using the gentlest method possible (e.g., hand scraping) before recoating.
- Recoat surfaces with a system designed for the masonry substrate—brick, stone, or stucco. The system should be designed to 'breathe' so that moisture trapped within the masonry units can escape. This quality is referred to as the permeability of the coating system.
- Use colors that are historically appropriate to the lighthouse or that maintain the character-defining features of the daymark.
- Do not remove any coating that is firmly adhering to, and thus protecting, masonry surfaces.
- Do not use methods of removing coatings which are destructive to masonry, such as sandblasting, application of caustic solutions, or high-pressure water blasting.
- Do not apply coatings such as stucco to masonry that historically has been painted or uncoated.
- Do not remove historic masonry coatings and leave the underlying layer exposed to the elements.
- Do not apply a sealing type paint to the interior of a lighthouse. This will potentially trap moisture in the wall which will cause the wall to deteriorate.[27]

Any repointing repairs needed on the exterior brick masonry walls, particularly on the interior near the windows, should be undertaken prior to repainting of the brick. The following information

[26] NPS, USLS. *Historic Lighthouse Preservation Handbook.* Part IV. A, pp. 16-17.
[27] NPS, USLS. *Historic Lighthouse Preservation Handbook.* pp. 16-17.

regarding treatment recommendations to repointing masonry is located in the *Historic Lighthouse Preservation Handbook* (1997). Refer to this document for additional information.

- Remove deteriorated mortar by carefully hand raking the joints to avoid damaging the masonry.
- Duplicate the historic mortar in strength, composition, color, and texture. A mortar analysis can be performed by most preservation professionals.
- Duplicate old mortar joints in width and in joint profile.
- Do not remove non-deteriorated mortar form sound joints for purely cosmetic reasons.
- Do not use electric saws and hammers rather than hand tools to remove deteriorated mortar from joints prior to repointing.
- Do not repoint with mortar of high Portland-cement content (unless it is the same content of the historic mortar). This can often create a bond that is stronger than the historic material and cause damage resulting from the differing coefficient of expansion and the differing porosity of the material and the mortar.
- Do no repoint with a synthetic caulking compound.[28]

For further information, consult NPS Preservation Brief 2: Repointing Mortar Joints in Historic Masonry Buildings for more information.

B2010-3 Ninth (Service Room) Level Exterior Walls	**FAIR**	**SERIOUS**
B2010-4 Tenth (Watch Room) Level Exterior Walls	**FAIR**	**MINOR**

Timeframe: *Immediate (1-3 years)*

All exterior and interior metal wall components of the Ninth Level exterior walls should be painted to match the results of the historic paint study. In the absence of early paint layers, the metal surfaces should be painted black to match the specifications of the 1902 *Instructions to Light-Keepers* discussed in the Condition Assessment section of this HSR.

After study of the extant paint, the paint should be removed using a non-abrasive method. Refer to the PROSOCO catalog for examples of non-abrasive, environmentally responsible paint removal products (https://www.prosoco.com/).

NOTE: The following information regarding treatment recommendations to metal is located in the *Historic Lighthouse Preservation Handbook* (1997). Refer to this document for additional information.

Following paint removal, the newly cleaned iron should be painted immediately with a corrosion-inhibiting primer to prevent 'flash rust.' Any buildup of salt or chloride residue on the bare metal will affect paint/coating adherence. If priming is delayed, rust should be removed with a clean wire brush just before priming.

Traditionally, red lead was used as an anti-corrosive coating for priming iron. It was then coated with at least two coats of linseed-oil-based finish coats. This system is no longer regularly used due to toxicity. Instead, alkyd paints can and should be used, particularly with two coasts of a rust-

[28] NPS, USLS. *Historic Lighthouse Preservation Handbook,* Part IV. A, p. 19.

prohibitive alkyd primer. Latex and other water-based paints should not be used because their water content causes immediate metal oxidation (rust) upon contact of the paint. Epoxy coatings have also been successful in application to clean iron surfaces.

The best and most effective way to preserve metal in a marine environment is to maintain a protective paint or coating on the metal (preservation maintenance). The effective protective life span of an existing paint system can be greatly extended by routine touchups of deteriorating areas. Any damaged areas should be repaired before repainting, including paint and rust removal.[29]

Timeframe: *Short-Term (3-5 Years)*

On the interior, once immediate repairs are made to the floor decks and embedded metal components, the interior faces of the exterior tower walls should also be re-coated using a breathable masonry paint to mimic whitewash.

Keim Mineral Coatings of America, Inc. (http://www.keim.com/) offers several options for vapor-permeable paints and coatings for historic masonry structure preservation projects. The paint has an extended life. A product representative will be able to provide technical assistance on appropriate treatments and products.

In addition, the 1997 *Historic Lighthouse Preservation Handbook* provides the following guidance regarding re-coating historic masonry in lighthouses:

- Before recoating, inspect all masonry surfaces to determine whether repainting is necessary. If painting is the determined treatment, a schedule of colors, locations, and quantities should be developed.
- Remove damaged or deteriorated material only to the next sound layer, using the gentlest method possible (e.g., hand scraping) before recoating.
- Recoat surfaces with a system designed for the masonry substrate—brick, stone, or stucco. The system should be designed to 'breathe' so that moisture trapped within the masonry units can escape. This quality is referred to as the permeability of the coating system.
- Use colors that are historically appropriate to the lighthouse or that maintain the character-defining features of the daymark.
- Do not remove any coating that is firmly adhering to, and thus protecting, masonry surfaces.
- Do not use methods of removing coatings which are destructive to masonry, such as sandblasting, application of caustic solutions, or high-pressure water blasting.
- Do not apply coatings such as stucco to masonry that historically has been painted or uncoated.
- Do not remove historic masonry coatings and leave the underlying layer exposed to the elements.
- Do not apply a sealing type paint to the interior of a lighthouse. This will potentially trap moisture in the wall which will cause the wall to deteriorate[30].

Any repointing repairs needed on the brick masonry walls, particularly on the interior near the windows, should be undertaken prior to repainting of the brick. The following information regarding treatment recommendations to repointing masonry is located in the *Historic Lighthouse Preservation Handbook* (1997). Refer to this document for additional information.

[29] NPS, USLS. *Historic Lighthouse Preservation Handbook.* Part IV. B, pp. 18-25.
[30] Ibid, Part IV. A, pp. 16-17.

- Remove deteriorated mortar by carefully hand raking the joints to avoid damaging the masonry.
- Duplicate the historic mortar in strength, composition, color, and texture. A mortar analysis can be performed by most preservation professionals.
- Duplicate old mortar joints in width and in joint profile.
- Do not remove non-deteriorated mortar form sound joints for purely cosmetic reasons.
- Do not use electric saws and hammers rather than hand tools to remove deteriorated mortar from joints prior to repointing.
- Do not repoint with mortar of high Portland-cement content (unless it is the same content of the historic mortar). This can often create a bond that is stronger than the historic material and cause damage resulting from the differing coefficient of expansion and the differing porosity of the material and the mortar.
- Do no repoint with a synthetic caulking compound.[31]

For further information, consult NPS Preservation Brief 2: Repointing Mortar Joints in Historic Masonry Buildings for more information.

C201001-1 Main Stair (2nd thru 9th Levels)	FAIR	SERIOUS

JKO/BPE provided the following recommendations in their 2014 assessment report regarding the Main Stair: "Remove paint coatings based on tested methods, clean, and repair. Apply new finish coatings to protect and prevent corrosion. The stairs that are sloping at level seven should be examined in particular detail."[32]

Timeframe: *Emergency (within 1 year)*

The portion of the stair located between the Seventh and Eighth Levels should be assessed by a structural engineer to determine the issues pertaining to the sloping condition. The engineer's recommendation will dictate the final recommended treatment for this portion of the stair.

Timeframe: *Short-Term (3-5 years)*

All metal stair components should be painted to match the results of the historic paint study, or in the absence of early paint layers, painted black to match the specifications of the 1902 *Instructions to Light-Keepers* discussed in the Condition Assessment section of this HSR.

After study of the extant paint, the paint should be removed using a non-abrasive method. Refer to the PROSOCO catalog for examples of non-abrasive, environmentally responsible paint removal products (https://www.prosoco.com/).

NOTE: The following information regarding treatment recommendations to metal is located in the *Historic Lighthouse Preservation Handbook* (1997). Refer to this document for additional information.

Following paint removal, the newly cleaned iron should be painted immediately with a corrosion-inhibiting primer to prevent 'flash rust.' Any buildup of salt or chloride residue on the bare metal

[31] NPS, USLS. *Historic Lighthouse Preservation Handbook.* Part IV. A, p. 19.
[32] JKO/BPE, *Condition Assessment Report,* pp. 40, 43.

will affect paint/coating adherence. If priming is delayed, rust should be removed with a clean wire brush just before priming.

Traditionally, red lead was used as an anti-corrosive coating for priming iron. It was then coated with at least two coats of linseed-oil-based finish coats. This system is no longer regularly used due to toxicity. Instead, alkyd paints can and should be used, particularly with two coasts of a rust-prohibitive alkyd primer. Latex and other water-based paints should not be used because their water content causes immediate metal oxidation (rust) upon contact of the paint. Epoxy coatings have also been successful in application to clean iron surfaces.

For further information, consult NPS Preservation Brief 27: The Maintenance and Repair of Architectural Cast Iron.

The best and most effective way to preserve metal in a marine environment is to maintain a protective paint or coating on the metal (preservation maintenance). The effective protective life span of an existing paint system can be greatly extended by routine touchups of deteriorating areas. Any damaged areas should be repaired before repainting, including paint and rust removal.[33]

B2010-5 Lantern Level Exterior Walls	FAIR	MINOR

Timeframe: *Immediate (1-3 years)*

All interior and exterior metal components should be painted to match the results of the historic paint study. In the absence of early paint layers, the exterior metal surfaces should be painted black and the interior metal surfaces painted white to match the specifications of the 1902 *Instructions to Light-Keepers* discussed in the Condition Assessment section of this HSR.

After study of the extant paint, the paint should be removed using a non-abrasive method. Refer to the PROSOCO catalog for examples of non-abrasive, environmentally responsible paint removal products (https://www.prosoco.com/).

NOTE: The following information regarding treatment recommendations to metal is located in the *Historic Lighthouse Preservation Handbook* (1997). Refer to this document for additional information.

Following paint removal, the newly cleaned iron should be painted immediately with a corrosion-inhibiting primer to prevent 'flash rust.' Any buildup of salt or chloride residue on the bare metal will affect paint/coating adherence. If priming is delayed, rust should be removed with a clean wire brush just before priming.

Traditionally, red lead was used as an anti-corrosive coating for priming iron. It was then coated with at least two coats of linseed-oil-based finish coats. This system is no longer regularly used due to toxicity. Instead, alkyd paints can and should be used, particularly with two coasts of a rust-prohibitive alkyd primer. Latex and other water-based paints should not be used because their

[33] NPS, USLS. *Historic Lighthouse Preservation Handbook.* Part IV. B, pp. 18-25.

water content causes immediate metal oxidation (rust) upon contact of the paint. Epoxy coatings have also been successful in application to clean iron surfaces.

For further information, consult NPS Preservation Brief 13: The Repair and Thermal Upgrading of Historic Steel Windows.

The best and most effective way to preserve metal in a marine environment is to maintain a protective paint or coating on the metal (preservation maintenance). The effective protective life span of an existing paint system can be greatly extended by routine touchups of deteriorating areas. Any damaged areas should be repaired before repainting, including paint and rust removal.[34]

B2030-1 First Level Exterior Doors	FAIR	MINOR

Timeframe: *Immediate (1-3 years)*

Treatment to the exterior bronze doors should always begin with the cleaning of the doors with a conservator's soap, such as Vulpex, to remove accumulations of dirt and salt from the surface. Once clean, the bronze should be sealed with the application of a coat of hot wax. Upon cooling, this wax may be buffed to a luster with a soft cloth. After buffing, a coat of cold wax may be applied and buffed as an additional protection measure.

Timeframe: *Short-Term (3-5 years)*

Restoration planning should include the restoration of the historic transom above the First Level exterior door. The replica transom should match the original specification drawings which include an iron frame around plate glass.

Concurrent with this work, the conduit which runs through the extant louvered transom will need to be rerouted through one of the extant holes in the door frame, or the new transom could be modified to sensitively include an opening for the conduit to pass through. The preferred option would be to run electricity underground, which would eliminate the need for conduit at this location.

B3010 Roof Coverings	FAIR	MINOR

Timeframe: *Ongoing*

The roof should be inspected periodically to ensure that it is in good structural condition.

[34] NPS, USLS. *Historic Lighthouse Preservation Handbook*. Part IV. B, pp. 18-25.

C201001-3 Lantern Ladder	FAIR	MINOR

Timeframe: *Immediate (1-3 years)*

All metal components should be painted to match the results of the historic paint study. In the absence of early paint layers, the Lantern ladder should be painted white to match the specifications of the 1902 *Instructions to Light-Keepers* discussed in the Condition Assessment section of this HSR.

After study of the extant paint, the paint should be removed using a non-abrasive method. Refer to the PROSOCO catalog for examples of non-abrasive, environmentally responsible paint removal products (https://www.prosoco.com/).

NOTE: The following information regarding treatment recommendations to metal is located in the *Historic Lighthouse Preservation Handbook* (1997). Refer to this document for additional information.

Following paint removal, the newly cleaned iron should be painted immediately with a corrosion-inhibiting primer to prevent 'flash rust.' Any buildup of salt or chloride residue on the bare metal will affect paint/coating adherence. If priming is delayed, rust should be removed with a clean wire brush just before priming.

Traditionally, red lead was used as an anti-corrosive coating for priming iron. It was then coated with at least two coats of linseed-oil-based finish coats. This system is no longer regularly used due to toxicity. Instead, alkyd paints can and should be used, particularly with two coasts of a rust-prohibitive alkyd primer. Latex and other water-based paints should not be used because their water content causes immediate metal oxidation (rust) upon contact of the paint. Epoxy coatings have also been successful in application to clean iron surfaces.

For further information, consult NPS Preservation Brief 27: The Maintenance and Repair of Architectural Cast Iron.

The best and most effective way to preserve metal in a marine environment is to maintain a protective paint or coating on the metal (preservation maintenance). The effective protective life span of an existing paint system can be greatly extended by routine touchups of deteriorating areas. Any damaged areas should be repaired before repainting, including paint and rust removal.[35]

C201002 Exterior Stair Construction	FAIR	MINOR

Timeframe: *Short-Term (3-5 years)*

The granite masonry exterior stair should be cleaned to remove calcification and biological growth from the mortar joints. Light cleaning is advisable periodically using the gentlest means possible (soap and light water, cleaned with a natural bristle brush). Abrasive or chemical cleaners should not be used. If needed, a light cleaning solution, such as D/2 Biological Solution can be used. D/2 is

[35] NPS, USLS. *Historic Lighthouse Preservation Handbook.* Part IV. B, pp. 18-25.

biodegradable, removes stains, and is effective on a variety of surfaces including monuments (http://www.d2bio.com/).

C3020 Floor Finishes	FAIR	MINOR

JKO/BPE provided the following recommendations in their 2014 assessment report regarding the floor finishes: "Repair or replace marble pavers as determined feasible during testing phase. Approximately 120 of the total pavers are damaged. Repair and retention is the preferred treatment option when possible.[36]

Timeframe: *Short-Term (3-5 years)*

The black-and-white marble tile floors seen throughout the lighthouse should be retained. Repair is warranted if the tiles are loose or are uneven and could cause a tripping hazard. Light cleaning is advisable periodically using the gentlest means possible (mild soap and limited quantities of water, using a natural bristle brush). Abrasive or chemical cleaners should not be used. Staining to the white marble particularly will likely never fade.

B101003-1 First Level Floor Slab	GOOD	MINOR

Timeframe: *Ongoing*

The First Level floor slab should be maintained in a good condition.

C1020-1 First Level Interior Door	GOOD	MINOR

Timeframe: *Long-Term (beyond 5 years)*

The original or, if the original cannot be found or repaired, new doors and transom to match the original First Level interior doors and transom should be reinstalled to replicate the historic appearance of this door opening. Use the original specification drawings and archival photographs to replicate the doors and transom, if needed.

D50 Electrical	GOOD	MINOR

Timeframe: *Long-Term (beyond 5 years)*

As part of the interior rehabilitation, the electrical conduit on the interior should be changed to match the new paint color of the weight wells (black). In addition, every effort should be used to mask the appearance of the modern conduit, to include rerouting the conduit underground to avoid its presence at the front entrance.

[36] JKO/BPE, *Condition Assessment Report,* pp. 38, 40.

At the top of the lighthouse, the electrical service components should be inspected to ensure each component is necessary. The wood panel used to hang these components should be made smaller, or perhaps moved behind the Lantern ladder, to replicate the historic appearance of the Watch Room. A large electrical panel and components, which are painted builder's grey, are not historically sensitive.

D509004 Lightning Protection	GOOD	MINOR

Timeframe: *Ongoing*

Periodically, the extant lightning protection system should be inspected to ensure safety, system continuity and proper maintenance.

G2040 Site Development	GOOD	MINOR

Timeframe: *Long-Term (beyond 5 years)*

The extant modern vinyl fence should be removed. A replica of the original granite and cast iron fence should be reconstructed around the base of the lighthouse to replicate the historic appearance of the lighthouse site. Use archival photographs and recovered archeological remains of the fence to replicate, if needed.
For further information, consult NPS Preservation Brief 36: Protecting Cultural Landscape: Planning, Treatment and Management of Historic Landscapes.

G9087 Overall Building Site Drainage	GOOD	MINOR

Timeframe: *Ongoing*

The overall building site drainage should be maintained in good condition, with water sloping away from the foundation of the lighthouse and the built-up swale mound maintained to deter high water events from damaging the base of the lighthouse.

C1020-2 Tenth (Watch Room) Level Interior Door	N/A	N/A

Timeframe: *Long-Term (beyond 5 years)*

The original or, if the original cannot be found or repaired, a new door to match the original Tenth Level interior door should be reinstalled to replicate the historic appearance of this door opening. Use the original specification drawings and archival photographs to replicate the door, if needed.

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Effects of Recommended Treatments

The potential effects of the recommended treatments for preservation are outlined in Table 5. The table is ordered by prescribed timeframe: emergency first, immediate second, short-term third, and long-term last. Effects to historic fabric, recommended mitigating measures, and beneficial outcomes are examined. Treatment recommendations which include periodic housekeeping and maintenance, reassessment, or are in good and minor conditions, are not discussed.

Table 5. **Cape Hatteras Recommended Treatment Effects**

Recommended Treatment	Potential Effect on Historic Fabric	Mitigating Measures	Beneficial Effects
Emergency (within 1 year)			
Destructive investigation of embedded metal components of all floor decks.	Minimal impact to extant historic fabric for investigative purposes.	Extant feature exhibits critical maintenance deficiencies.	Critical maintenance deficiencies will be investigated.
Destructive investigation of embedded metal components of all stairs.	Minimal impact to extant historic fabric for investigative purposes.	Extant feature exhibits serious maintenance deficiencies.	Serious maintenance deficiencies will be investigated.
Install crack monitors to cracks in plinth which have moved between 1999 and 2014.	No adverse effect.	Extant feature exhibits maintenance deficiencies.	Maintenance deficiencies will be investigated.
Install new exterior lantern handrail.	No adverse effect. (Extant handrail does match historic handrail.)	Extant feature exhibits serious maintenance deficiencies.	Maintenance deficiencies will be corrected; returns structure to historic appearance.
Conserve first-level exterior door.	No adverse effect.	Will prevent further UV-degradation to surrounding historic materials.	Returns structure to historic appearance.
Immediate (1-3 years)			
Repaint all interior metal components to match most historic color.	No adverse effect.	Will return features to good condition.	Returns structure to historic appearance.
Restore all nine window openings to operable condition, including reinstallation of new hoods and brackets.	No adverse effect.	Will return features to good, operable condition.	Returns structure to historic appearance.
Install sympathetic interior window visitor protection system.	May be minimal impact to extant historic fabric.	Will replace non-sympathetic fence material at each opening.	Returns structure to a more accurate appearance.
Repoint granite plinth and granite base features with historically accurate mortar.	Repairs historic fabric; returns to good condition.	Repairs will not be visibly intrusive.	Maintenance deficiencies will be corrected.
Repaint all exterior metal components to match most historic color.	No adverse effect.	Will return features to good condition.	Maintenance deficiencies will be corrected.

(Table 4 continued)

Repaint all interior structural roof components to match most historic color.	No adverse effect.	Will return features to good condition.	Returns structure to historic appearance.
Repaint all interior and exterior components of the Lantern.	No adverse effect.	Will return features to good condition.	Returns structure to historic appearance.
Install historically accurate roller shades to interior of lantern.	No adverse effect.	Will prevent further UV-degradation to surrounding historic materials.	Returns structure to historic appearance.
Short-Term (3-5 years)			
Repaint painted exterior brick of base with historically sensitive masonry paint to match most historic color.	No adverse effect.	Will return features to good condition.	Returns structure to historic appearance.
Repaint painted exterior brick of tower with historically sensitive masonry paint to match historic color.	No adverse effect.	Will return features to good condition.	Returns structure to historic appearance.
Repaint painted interior brick walls of base and tower with historically sensitive masonry paint to match most historic color.	No adverse effect.	Will return features to good condition.	Returns structure to historic appearance.
Restore first-level exterior door transom.	No adverse effect.	Will return features to good condition.	Returns structure to historic appearance.
Long-Term (beyond 5 years)			
Restore first-level interior doors and transom.	No adverse effect.	Will return features to good condition.	Returns structure to historic appearance.
Restore tenth-level interior door.	No adverse effect.	Will return features to good condition.	Returns structure to historic appearance.
Removal of vinyl perimeter fence. Restoration of historic iron and granite perimeter fence.	No adverse effect.	Removal of a non-sympathetic, non-historic feature.	Returns site to historic appearance.
Restore original Fresnel lens to lighthouse.	No adverse effect.	Will return features to good condition.	Returns structure to historic appearance.
End of Table 4.			





As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. Administration.

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